

BINDURA UNIVERSITY OF SCIENCE EDUCATION

**THE ROLE OF PREDICTIVE ANALYTICS IN IMPROVING ROAD SAFETY IN
ZIMBABWE**

BY

MUFARO ZHOU

226843A

**A DISSERTATION SUBMITTED TO THE BINDURA UNIVERSITY OF SCIENCE
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APPROVAL FORM

The undersigned certify that they have read and recommended to Bindura University of Science Education (BUSE) for acceptance a Dissertation entitled “**The role of predictive analytics in improving road safety in Zimbabwe**” by **Mufaro Zhou** in partial fulfillment of the requirements for the degree of Master of Science Degree in Entrepreneurship and Innovation

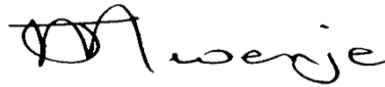
Student Name: Mufaro Zhou

Signature: 

Date: 9/01/2026

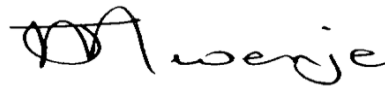
Student

Supervisor: Dr J. Mwenje Signature:



Date: 9/01/2026

GSB Director : Dr J. Mwenje Signature:



Date: 9/01/2026

..... Signature: Date:

Faculty Chairperson

..... Signature: Date:

External Examiner

RELEASE FORM

NAME OF AUTHOR: MUFARO ZHOU

STUDENT NUMBER: 226843A

TITLE OF DISSERTATION: THE ROLE OF PREDICTIVE ANALYTICS TO
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Signature: 

Date: 10 December 2025

Permanent Address: 6695 Maranatha; Tynwald; Harare

E-mail: mufarozhou@gmail.com

Cell Number: 0772806414

DECLARATION

I, Mufaro Zhou Student Reg Number 226843A, do hereby declare that this dissertation is a result of my own investigation and research, except to the extent indicated in the acknowledgments, bibliography, references, and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.

STUDENT SIGNATURE



DATE: 10 December 2025

DEDICATION

This work is dedicated to all passionate entrepreneurs and tech innovators committed to bringing change to our country in line with road safety guidelines. Its further dedicated to all road safety stakeholders who wholeheartedly desire to save lives on Zimbabwe's roads through upholding policy, implementing best practices, transparency, integrity and justice for all road users.

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To my family I do acknowledge and am grateful for your love and support to pull through my studies.

Finally, Glory be to the God Almighty who rendered me ability and sufficient grace to conquer this seemingly impossible task during a difficult season.

ABSTRACT

This research was driven by the significance of road traffic accidents in Zimbabwe, leading to injuries, fatalities, and economic losses. The aim is to prevent unnecessary injuries and loss of life caused by road accidents in Zimbabwe through the need to leverage predictive analytics to identify high-risk areas and behaviors. The objective of the study is to assess the role of predictive analytics in improving road safety in Zimbabwe. The target population was all road users and stakeholders. The researcher used the number of registered vehicles in Zimbabwe (1,583,700, ZINARA 2023) to calculate a representative minimum sample size of 385 respondents using the Rao soft calculator (Cochran 1977 formula). The parameters used were a 95% confidence level ($Z = 1.96$), a 5% margin of error ($d = 0.05$), and a 50% response distribution ($p = 0.5$). In order to answer the research questions, the researcher employed a mixed-method approach through closed questionnaires (for quantitative data, easy to group and analyze) and key informant interviews (for qualitative, in-depth data and exploring context). The researcher focused on ensuring that the questionnaire is in line with the research's objectives through matching every question to any one of the research's objectives. The closed questionnaire used in the study was advantageous in gathering focused, quantitative data from respondents, which is easy to group, compare and analyze whilst key informant interviews in 15 conveniently sampled strategic organisations were used as a method of collecting more information that was not included in the closed questionnaires. Descriptive statistics were used to analyse the demographic profile of the survey's respondents. A total of 391 participants responded to this survey with 118 (30.18%) being female, which is a fair representation of females considering the general gender bias in tech-related subjects. The participants also represented a broad age spectrum. In terms of educational attainment, the majority (77.50%) of respondents held a tertiary qualification whilst an overwhelming majority (96.42%) reported having a valid driver's licence. The distribution also suggests that most respondents were seasoned drivers, likely with substantial exposure to road traffic conditions and safety issues. Further analysis of the results indicated that predictive analytics was indeed effective in improving road safety with a significant majority of respondents (65.98%) believing that predictive analytics can reduce road accidents, and 97% agreed it can identify high-risk areas. However, challenges were noted, including resource constraints, a lack of stakeholder collaboration, and limited staff technical abilities. The major causes of accidents categorized into five domains which were human-related factors, vehicle condition, environmental factors, governance/enforcement as well as socio-economic factors. Historical accident data was identified as the most crucial data source, followed by driver behavior, traffic flow data, and vehicle data. There is also evidence that predictive analytics will help with resource allocation and enhance decision-making and policy formulation for transport authorities. Several positive outcomes have already been influenced by data, such as targeted awareness campaigns, warning sign installations, and major infrastructure projects. While the general understanding of predictive analytics is high (88.49%), awareness of its application specifically in road safety is lower. There was a statistically significant association between educational attainment and understanding of predictive analytics ($\chi^2(8) = 53.01$, $p < 0.001$). The research conclusion is that predictive analytics has significant potential to transform road safety in Zimbabwe by shifting from a traditional reactive approach to data-driven prevention strategies. For successful adoption, the study recommends a multi-pronged approach which includes strengthening data infrastructure, building institutional and technical capacity, support multi-sector collaboration, deploy technology-driven Interventions, implement public awareness strategies as well as allocate sustainable funding.

Key words: Predictive Analytics, Road Safety, Stakeholders, Effectiveness, Awareness, transformation potential

LIST OF ACRONYMS

BUSE – Bindura University of Science Education
FGDs – Focus Group Discussions
GSB – Graduate School of Business
IoT – Internet of Things
MEI – Master of Science in Entrepreneurship and Innovation
NRZ – National Railways of Zimbabwe
OECD – Organisation for Economic Co-operation and Development
PARS – Predictive Analytics for Road Safety
SADC – Southern African Development Community
SPSS – Statistical Package for the Social Sciences
SSATP – Africa Transport Policy Programme
TSCZ – Traffic Safety Council of Zimbabwe
UNECA – United Nations Economic Commission for Africa
VID – Vehicle Inspection Department
WHO – World Health Organization
ZINARA – Zimbabwe National Road Administration
ZRP – Zimbabwe Republic Police

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1.0 CHAPTER ONE - INTRODUCTION

1.0 INTRODUCTION

This research aims to explore how predictive analytics can be used to reduce the number of road traffic accidents in Zimbabwe. Predictive analytics has become a powerful tool in various fields, including transportation and road safety. Road traffic accidents (RTAs) are a major global public health and development challenge in many countries, resulting in significant loss of life, injuries, disabilities, and huge economic costs whilst also putting so much pressure on health systems. According to the World Health Organization (WHO), road traffic crashes are among the leading causes of death worldwide. Rapid urbanization, increasing motorization, inadequate road infrastructure, human error, and weak enforcement of traffic regulations have contributed to the growing burden of road traffic accidents, especially in low- and middle-income countries.

Advances in various Information and Communication Technologies (ICTs) such as big data and Artificial Intelligence (AI) have transformed how authorities address complex public safety challenges. On the other hand advancement in predictive analytics uses historical and real-time data, statistical algorithms, and machine learning techniques to identify patterns, forecast future events to support evidence-based decision-making. Across the world, predictive analytics has been successfully applied in various sectors to improve efficiency, reduce risks, and optimize resource allocation. In road safety management, predictive analytics enables authorities to identify accident-prone locations, predict periods of high accident risk, understand the factors contributing to accidents so as to be proactive before accidents occur.

In many developed countries, predictive analytics has become an integral component of Intelligent Transport Systems (ITS). Such data-driven approaches have enhanced road safety planning, informed infrastructure improvements, strengthened law enforcement strategies, and supported public awareness campaigns aimed at reducing road traffic accidents. In Africa, however, the adoption of predictive analytics for road safety remains relatively limited due to the low rate of technology adoption. Many African countries continue to rely on traditional methods of accident reporting and reactive interventions, which often focus on responding to accidents after they occur rather than preventing them. Challenges such as limited access to quality data, inadequate

technological infrastructure, fragmented information systems, and resource constraints have slowed the adoption of advanced data analytics technologies. Nevertheless, increasing digitalization and investments in ICT infrastructure provide opportunities for African countries to leverage predictive analytics in improving road safety management.

In Zimbabwe, road traffic accidents are a significant concern, leading to injuries, fatalities, and economic losses. By utilizing predictive analytics the aim is to analyze historical data, identify patterns and trends, and develop solutions to predict and prevent road traffic accidents. This research sought to leverage data-driven insights to enhance road safety measures, reduce accident rates, and ultimately save lives on Zimbabwean roads. Zimbabwe faces several challenges related to road safety, including inadequate infrastructure, lack of enforcement of traffic laws, driver behavior issues such as speeding and drunk driving, and limited emergency response capabilities. These factors contribute to the high number of road traffic accidents in the country, posing a threat to public health and safety. Predictive analytics in the context of road safety can be applied to various datasets, including historical accident data, weather conditions, road infrastructure details, vehicle information, and driver behavior patterns. By analyzing these datasets, one can identify risk factors associated with road traffic accidents and develop solutions for potential accident hotspots or times.

1.1 BACKGROUND OF THE STUDY

The use of predictive analytics dates back a number of years when data was analysed to determine the outcome of future events. The concept of predictive analytics involves using data, statistical algorithms and various techniques to identify the likelihood of future outcomes based on historical data. A clear example of predictive analytics which has been in use over years is the weather forecast which seems so simple yet involves so much data analysis of past events. In terms of road safety, predictive analytics has evolved over the years as technology and data science capabilities have advanced. The application of predictive analytics in road safety aims to forecast potential accidents, identify high-risk areas, and develop strategies to prevent road incidents.

The early adoption of predictive analytics in road safety can be traced back to the late 20th century when researchers and transportation agencies started exploring ways to leverage data to predict

and prevent accidents. Initial efforts focused on analyzing historical accident data to identify patterns and trends that could help in predicting future incidents. With the advancement of technology, particularly in data collection and processing, the capabilities of predictive analytics in road safety expanded. The introduction of Geographic Information Systems (GIS) to map locations enabled more accurate predictions of accident hotspots and risk factors.

In recent years, the integration of machine learning algorithms has revolutionized predictive analytics in road safety. Machine learning models can analyze vast amounts of data, including real-time traffic information, weather conditions, and driver behavior, to predict potential accidents with higher accuracy. Transportation agencies and industry partners have collaborated to develop sophisticated predictive analytics tools tailored for road safety. These partnerships have led to the creation of predictive models that can not only forecast accidents but also recommend targeted interventions to mitigate risks.

The latest trend in predictive analytics for road safety is the implementation of real-time predictive models. By leveraging real-time data streams from sensors, cameras, and connected vehicles, authorities can proactively respond to potential hazards on the road. With advancements in artificial intelligence and IoT technologies, predictive models are expected to become more accurate and adaptive, leading to a significant reduction in road accidents and fatalities. The history of using predictive analytics in road safety showcases a journey from basic data analysis to sophisticated machine learning models that have transformed how authorities predict and prevent accidents on the roads.

1.2 STATEMENT OF THE RESEARCH PROBLEM

The research problem addressed by this study is to prevent unnecessary injuries and loss of life for drivers, passengers and pedestrians caused by road accidents in Zimbabwe. Road accidents are a major cause of death and injury in Zimbabwe with The Sunday Mail reporting an increase in road accidents over the years. In 2022 a total of 2 067 people were killed in 51 107 incidents of road accidents that also left 10 401 people injured.

The prevention of accidents will ensure the reduction of unnecessary loss of lives, reduce emotional trauma on communities, avoid property loss, safeguard the lives of economically viable citizens as well as reduce unnecessary pressure on the country's disaster management and health systems. By analyzing data from various sources, the research aims to provide insights that can be used to improve road safety for all users.

As much as so much accident data has been collected by the Zimbabwe Republic Police and Zimbabwe Traffic Safety Council there is very little evidence that this data has been systematically analyzed to support real time decision making. This is clearly seen by delayed decisions to implement road safety mechanisms in areas with frequently recurring traffic accidents. There is need for predictive analytics be leveraged to prevent road accidents through identifying high-risk driving behaviors and accident prone areas on Zimbabwean roads. This thereby safeguards lives and injury by improving road safety for all drivers, passengers, and pedestrians. Predictive analytics has not been incorporated into existing road safety management systems in Zimbabwe to determine the extent to which road accidents can be reduced.

1.3 RESEARCH OBJECTIVES

1.3.1 MAIN RESEARCH OBJECTIVE

To assess the role of predictive analytics in improving road safety in Zimbabwe.

1.3.2 SECONDARY RESEARCH OBJECTIVES

- Assessing the effectiveness of predictive analytics to forecast road accidents in Zimbabwe.
- Identify contributing factors around road traffic accidents.
- Inform policy and decision making to enhance overall road safety.
- Promote awareness and education about the potential of predictive analytics in reducing accidents.

1.4 RESEARCH QUESTIONS

1.4.1 MAIN RESEARCH QUESTION

Can predictive analytics be leveraged to improve road safety in Zimbabwe through analyzing factors around road accidents?

1.4.2 SECONDARY RESEARCH QUESTIONS

- How effective is predictive analytics in forecasting road accidents in Zimbabwe?
- What factors contribute to road traffic accidents?
- What are lessons that policy makers can learn from using predictive analytics in road safety?
- To what extent is the public, drivers and other road users aware of how predictive analytics work? What are the potential benefits of applying predictive analytics in road safety?

1.5 HYPOTHESIS

HO: Use of predictive analytics on existing traffic accident data can result in reduction of accidents on Zimbabwe's roads.

H1: Use of predictive analytics does not result in reduction of road accidents in Zimbabwe.

1.6 RESEARCH ASSUMPTIONS

- That the stakeholders involved in the study would be willing and able to participate in the research and provide accurate and reliable information.
- That the data collected will be representative of the broader spectrum of road accidents in Zimbabwe.
- That the data analysis, interpretation and presentation will be done in an informative and unbiased manner.
- That the research findings can be applied to any potential road accident incidents that are likely to happen in Zimbabwe.
- That the findings of the research will be relevant for Zimbabwean drivers.
- That the findings of the research will be used to improve road safety on Zimbabwean roads.

1.7 JUSTIFICATION OF THE STUDY

Predictive analytics is a powerful tool that leverages historical data techniques to identify the likelihood of future outcomes based on historical data. When applied to road safety, predictive analytics can play a crucial role in preventing accidents, reducing injuries, and saving lives. The justification for using predictive analytics to improve road safety lies in several key factors that include accident prevention, resource optimisation, real time decision making and proactive maintenance. By analyzing past accident data, traffic patterns, weather conditions, and other relevant variables, predictive analytics can help identify high-risk areas and times where accidents are more likely to occur. This information can be used to implement targeted interventions such as increased law enforcement presence, road signage improvements, or speed limit adjustments to prevent accidents before they happen. Predictive analytics can also help transport authorities allocate their resources more effectively by predicting where and when road safety interventions will have the most significant impact. This can lead to better deployment of police patrols, emergency services, road maintenance crews, and other resources to areas with the highest predicted risk of accidents. By harnessing the power of data and advanced analytics techniques, transportation authorities can create safer roads for all users. Finally, the justification for using predictive analytics to improve road safety is rooted in its ability to prevent accidents, optimize resource allocation and enable improved decision-making for drivers, passengers and pedestrians.

1.8 ASSUMPTIONS OF THE STUDY

The following assumptions guided the study:

- i. Participants would be willing and able to participate in the study
- ii. The collected data would represent a broader accident situation in Zimbabwe
- iii. The analysis of data would be objective and unbiased
- iv. The findings would have practical relevance to drivers and other road users in Zimbabwe
- v. The findings can be useful in contributing towards road safety

1.9 LIMITATIONS OF THE STUDY

The study had several limitations that should be considered when interpreting its findings. First, although the study achieved 391 questionnaire responses, stakeholder participants for the focus

group discussions were selected through convenience sampling, which may limit the representativeness of the findings across all road users and road-safety stakeholders in Zimbabwe. Second, the relatively limited understanding of predictive analytics among the general population may have affected respondents' ability to assess the technology comprehensively. Third, the study was conducted within a road-safety data environment characterised by fragmented, historical and incomplete datasets, limiting the availability of comprehensive information required for robust predictive analysis. The study also identified inadequate ICT infrastructure, implementation costs, data privacy concerns and limited institutional coordination as constraints to the wider adoption of predictive analytics.

Furthermore, the study relied substantially on respondents' perceptions and self-reported information; therefore, the findings demonstrate the perceived potential and usefulness of predictive analytics rather than establishing a direct causal relationship between the deployment of predictive analytics and reductions in road traffic accidents. The findings should consequently be interpreted within the context of the study design, available data and technological environment in Zimbabwe. Finally, the findings may not be directly generalizable to other countries with substantially different road infrastructure, data systems, institutional arrangements and levels of technological maturity.

1.10 DEFINITION OF TERMS

1.10.1 Predictive analytics:

Predictive analytics is the use of data to predict future trends and events. It uses historical data to forecast potential scenarios that can help drive strategic decisions (Cote, 2021).

1.10.2 Traffic accident:

According to Insee (2020) a traffic accident 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.

1.10.3 Accident prediction:

Accident prediction refers to the use of historical and current data to estimate the likelihood, frequency, location or severity of future road traffic accidents.

1.10.4 Road users:

Road users are individuals who use or interact with the road transportation system, including drivers, passengers, pedestrians and cyclists.

1.10.5 Road Safety

Road safety refers to the measures, policies, practices and interventions aimed at preventing road traffic crashes and reducing deaths, injuries and other consequences among road users.

1.8 CHAPTER SUMMARY

Chapter One establishes the rationale for investigating predictive analytics as a tool for improving road safety in Zimbabwe. It highlights the persistent problem of road traffic accidents and identifies human behavior, vehicle conditions, road infrastructure, enforcement and other factors as contributors to accidents. The chapter proposes that predictive analytics can use historical and relevant real-time data to identify patterns, forecast accident risks and support proactive interventions. It therefore focuses on assessing the effectiveness of predictive analytics in forecasting accidents, identifying contributing factors, informing policy and decision-making, and improving public awareness. The next chapter examines a survey of related literature to the subject that was researched on.

2.0 CHAPTER 2- LITERATURE REVIEW

2.1 CHAPTER INTRODUCTION

This literature review aims to explore the role of predictive analytics in improving road safety in Zimbabwe.

Predictive analytics is the use of data to predict future trends and events. It uses historical data to forecast potential scenarios that can help drive strategic decisions (Cote, 2021). Cote further explains that predictive analysis can be conducted manually or using machine-learning algorithms. Either way, historical data is used to make assumptions about the future. The science of predictive analytics can generate future insights with a significant degree of precision. Predictive analytics is a category of data analytics aimed at making predictions about future outcomes based on historical data and analytics techniques such as statistical modeling and machine learning (Olavrud & Edwards, 2024). Predictive analytics, as its name implies, is focused on predicting and understanding what could happen in the future (UNSW Sidney, 2020). Analysing past data patterns and trends by looking at historical data can predict what might happen going forward and, in doing so, inform many aspects of a business. Olavrud and Edwards (2024) postulate that the science of predictive analytics can generate future insights with a significant degree of precision. Predictive analytics is the use of historic data to predict new instances or cases (LGA UK, 2020). As confirmed by the LGA UK research in 2020, predictive analytics can usefully be employed in situations where there is a large data set of historical observations and where decision-making is difficult, time-consuming, or outcome-critical.

Hinshaw (2023) cites that **predictive analysis** helps identify roadway sites with the greatest potential for improvement and quantify the expected safety performance of different project alternatives. They go on to state that predictive approaches combine crash, roadway inventory, and traffic volume data to provide more reliable estimates of an existing or proposed roadway's expected safety performance. A proactive data-driven approach works to prevent severe and fatal crashes before they happen (Burkley, 2024).

2.1 EFFECTIVENESS OF PREDICTIVE ANALYTICS TO FORECAST ACCIDENTS

Road traffic accidents remain a major public safety concern, causing loss of life, injuries and significant economic costs. Predictive analytics offers an opportunity to analyse historical accident data and identify patterns and risk factors that can be used to forecast the likelihood of future road accidents. This study therefore examines the effectiveness of predictive analytics in forecasting road accidents, with the aim of assessing its potential to support proactive road-safety planning, targeted interventions and evidence-based decision-making.

2.1.1 EFFECTIVENESS OF PREDICTIVE ANALYTICS IN ROAD SAFETY

Predictive analytics has been identified as a potential tool for improving road safety in Zimbabwe. By analyzing historical data on road crashes, predictive analytics can help identify patterns and trends that can inform targeted interventions to reduce the risk of future crashes (Chong & Kumaraguru, 2017). Predictive analytics can also be used to predict the likelihood of future crashes based on real-time data from vehicles and infrastructure (Karlaftis & Vlahogianni, 2011). In the context of road safety, predictive analytics can analyze various factors such as weather conditions, traffic patterns, driver behavior, and road infrastructure to identify potential risks and take preventive actions. According to Latent View (2022) with the use of data analytics, traffic management becomes organized and effective as the authorities use data analytics and AI to plan the duration of halt at signals and ensure seamless movement of traffic, regulate the speed at certain areas by installing speedbumps & speed detection cameras, especially in the motorways, identify spots to place speed limit signboards and divert the vehicles to roads with less traffic to avoid congestion. Data can also be generated from the vehicles themselves with Fleutiaux (2018) noting that an average modern vehicle generates around 25 gigabytes of data every hour whilst autonomous cars generate even more data up to 3600 gigabytes per hour. This data includes the information captured by the drivetrain sensors that propel the vehicle and data of the driver's driving pattern, position, and movements of objects and people in the vehicle's surroundings, condition of the road. All this available information makes it possible to reduce accidents. Oyetunji et al (2017) developed a road traffic accident predictive model using the naive Bayes' model to forecast road traffic accidents in Nigeria, aiming to prevent or reduce their occurrence. The system

demonstrated reliability with 89.83% accuracy, using selected dependent variables such as road condition, road dimension, human factors, and vehicular factors.

2.1.2 PREDICTIVE ANALYTICS FOR HIGH RISK AREA IDENTIFICATION

Predictive analytics can be used to identify high-risk areas for road crashes based on historical data. By analyzing data on past crashes, predictive models can be developed to identify locations where the likelihood of future crashes is highest (Elvestad et al., 2018). These models can take into account various factors such as road type, lighting conditions, weather conditions, and traffic volume. Once high-risk areas have been identified, targeted interventions such as increased police patrols, traffic calming measures, and infrastructure improvements can be implemented to reduce the risk of future crashes. Although road accidents can happen at any place and at any time owing to multiple factors, a thorough look into road accident data reveals that certain areas witness more road accidents than others. These are called ‘accident-prone zones’. Using data analytics makes identifying these hotspots and taking necessary actions to mitigate accidents in these areas more efficient. (Latent View, 2022). Saxena et al (2023) also highlighted that predictive analytics can help in identifying potential road hazards and taking proactive measures to prevent accidents. Yannis Et Al (2020) propose that reliable and accurate data are a fundamental prerequisite to understand the magnitude of road safety problems in Africa and convince stakeholders to take proper actions. Reliable and accurate data are also needed to identify problems, priority areas and mostly risk factors in order to formulate strategies, set targets and monitor performance. Therefore, future systems should focus on the development and implementation of predictive analytics to enhance the effectiveness of road safety systems.

2.1.3 EFFECTIVENESS OF PREDICTIVE ANALYTICS FOR ACCIDENT PREDICTION

Predictive analytics can also be used to predict the likelihood of future accidents based on real-time data from vehicles and infrastructure. For example, predictive models can be developed to analyze data from vehicle sensors and GPS systems to identify patterns of risky behavior such as speeding or hard braking (Kumaraguru et al., 2013). These models can then predict the likelihood of an accident occurring based on the current driving behavior. Similarly, predictive models can be developed to analyze real-time data from traffic cameras and other infrastructure sensors to

identify potential hazards such as congestion or blocked lanes (Kiani et al., 2018). These models can then predict the likelihood of an accident occurring based on the current traffic conditions. Consequently, a predictive model is needed to assist road officials and transport managers in understanding the road conditions and the distribution of road traffic accidents, allowing them to predict and prevent future road traffic accidents and congestion (Yetay Berhanu, 2023). Experts within the transport sectors and road officials should definitely use data to know when and where accidents are likely to occur on various road networks so as to ensure safety improvement measures. If drivers and pedestrians are aware of the locations and timing of collision hotspots on the roads, they are more likely to avoid them or adopt more defensive strategies when approaching (Fan Y, 2018).

Predictive analytics can also be used to determine the factors contributing to road crashes. By analyzing data on past crashes, predictive models can be developed to identify patterns and trends in the contributing factors such as driver behavior, vehicle type, and road conditions (Wang et al., 2018). These models can then inform targeted interventions to address the specific factors contributing to crashes in Zimbabwe. For example, if predictive analytics identifies drunk driving as a significant contributor to road crashes in Zimbabwe, targeted interventions such as increased enforcement and public awareness campaigns could be implemented to reduce drink driving. Effective predictive modeling depends on diverse and high-quality data. Niture and Abdellatif (2024) emphasized the importance of integrating traffic collision data with real-time sensor inputs and historical crash records. They noted that the lack of standardized datasets and feature selection techniques hinders model accuracy and generalizability.

2.2.1 IDENTIFYING CONTRIBUTING FACTORS TO ROAD SAFETY

Road traffic data can be used to identify hazardous locations, diagnose safety problems, understand the types of crashes that are prevalent, assess the effectiveness of interventions, monitor countrylevel trends, tailor and prioritize prevention efforts, assess progress, and compare the scale of road traffic deaths and injuries relative to deaths and injuries from other causes (SSATP, 2021). Having data to back up the need for action is vital, not only to gain support, but also to advocate for resources and capacity building. The lack of accurate and reliable data hampers progress towards safer road and transportation systems in any country. The availability of data is key to

accurately identifying patterns of crashes and targeting those that are likely to yield the most effective results with the most important aspect of collecting data relating to its validity (WHO, 2018). Getnet (2019) demonstrated data mining models for accident severity analysis in support of reducing road traffic accidents by identifying and predicting the major vehicles and drivers' determinant risk factors (attributes) that cause road traffic accidents. The Africa Transport Policy Programme (2020) observed that in order to effectively analyze, compare, and draw informed conclusions from the road safety data, it is necessary to fulfil accuracy, complexity, availability and uniformity. Accuracy is about describing the individual parameters exactly, whilst complexity is all about including all features within the given system with availability being accessibility to all users and uniformity being application of standard definitions.

2.2.2 CURRENT ROAD SAFETY SITUATION IN ZIMBABWE

A road accident is defined as an accident which took place on the road between two or more objects, one of which must be any kind of a moving vehicle. Normally an accident occurs when a motor vehicle collision with another vehicle, pedestrian, animal or any other stationary object like a tree, building and the like, as a result that collision lead to morbidity, mortality and damage of properties. According to Insee (2020) a traffic accident 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. Road fatality means any person killed immediately or dying within 30 days as a result of a road injury accident (OECD, 2016). Suicides involving the use of a road motor vehicle are excluded. Wikipedia defines road traffic safety as the methods and measures used to prevent road users from being killed or seriously injured. Typical road users include pedestrians, cyclists, motorists, vehicle passengers, and passengers of on-road public transport (mainly buses and trams). It further states that contributing factors to highway crashes may be related to the driver (such as driver error, illness, or fatigue), the vehicle (brake, steering, or throttle failures), or the road itself (lack of sight distance, poor roadside clear- zones, etc.).

Road safety is a significant concern in Zimbabwe, with the country recording high numbers of road traffic fatalities each year. According to the World Health Organization (WHO), Zimbabwe has a road traffic fatality rate of 27.4 deaths per 100,000 population, which is significantly higher than the global average of 18.2 deaths per 100,000 population [(World Health Organization,

2018)]. The majority of road traffic fatalities in Zimbabwe occur on rural roads and are attributed to human error, including speeding, drink driving, and failure to wear seat belts (Traffic Safety Council of Zimbabwe, 2020). In addition, TSCZ and Zimbabwe Republic Police (ZRP) report that a road traffic accident occurs every day in Zimbabwe killing an average of 5 people daily and approximately 153 people every month. The number of road fatalities continue to increase from 2011 where 1291 accidents were recorded increasing to 1838 in 2016, 2000 deaths recorded in 2019 whilst 2067 deaths were recorded in 2022. Harare City has the highest number of traffic crashes with most of the victims being mainly passengers and pedestrians.

2.3 CHALLENGES IN INFORMATION FOR POLICY AND DECISION MAKING

While predictive analytics has the potential to improve road safety in Zimbabwe, there are also challenges and limitations that need to be considered to effectively inform policy and decision making. These include:

2.3.1 Data quality: The accuracy and reliability of predictive analytics depends on the quality of the data used. Effective predictive analytics requires high-quality, large-scale, and diverse datasets. Many systems face limitations from small-scale datasets, fragmented data sources, and lack of real-time information on road conditions. Inaccurate or incomplete data can lead to unreliable predictions and ineffective interventions. Ensuring that accurate and reliable data is collected and maintained is essential for effective predictive analytics. The Safer Africa Report (December 2018) report that reliable and accurate data are a fundamental prerequisite to understand the magnitude of road safety problems in Africa and convince stakeholders to take proper actions. Furthermore, reliable and accurate data are also needed to identify problems, priority areas and mostly risk factors in order to formulate strategies, set targets and monitor performance. Quality data sets provide predictive data technologies to deploy enforcement and emergency services during high-risk periods. Data collection inconsistencies and lack of centralized monitoring reduce prediction reliability. Ammah Sohail et al. (2023) indicated that high-quality data is crucial for any data-driven approach as the quality of the data directly affects its accuracy and utility. The existing data-driven approaches for road safety face several challenges regarding poor data quality due to the type of equipment/sensors used, observation strategies, undersampling etc.

2.3.2 Data privacy and safety: According to Saxena et al (2023) there are privacy and ethical concerns associated with data collection for road safety. The use of personal data, such as location and driving behavior, raises concerns about privacy and data protection. Zimbabwe's Cyber and Data Protection Act (2021) and SI 155 of 2024 regulate how personal data is collected, processed, and stored. These laws have several implications for predictive analytics which include licensing and compliance requirements, issues of consent and transparency, data minimisation and purpose limitation, security and breach notification as well as ethical concerns. This lack of transparency can hinder adoption by traffic management systems and policymakers who need to understand decision rationales. Therefore, technology solutions must comply with legal and ethical standards to ensure that data collection and use are appropriate and do not violate privacy or ethical concerns. Mutisi (2024) proposes that to harness predictive analytics effectively while respecting safety and privacy data governance frameworks must be strengthened, stakeholder education (drivers, operators, authorities) must be continuous, privacy-by-design principles should be embedded in all analytics systems and public-private partnerships must help fund ethical and compliant technology adoption.

2.3.3 Technical expertise: Developing and implementing predictive analytics requires specialized technical expertise. Bianco (2021) reported that one of the major barriers to the adoption of this modern technology—AI in Africa is skill. AI skills are very difficult to master and there is undoubtedly a demand–supply imbalance in the market worse off in Africa. Government departments and transport authorities often lack in-house analytics teams. This leads to outsourcing or reliance on donor-funded projects, which may not be sustainable long-term (Kamoyo & Chikazhe, 2025). Over and above a skills deficit, there is general under utilization of the available data. Unece (2022) identified that Zimbabwe collects road crash data through agencies like the Traffic Safety Council, but limited data science skills mean this data is often not analyzed effectively for predictive insights. Without skilled analysts, valuable patterns (e.g., accident hotspots, driver behavior trends) remain hidden. Gowthami & Kavitha (2025) further state that lack of expertise means Zimbabwe remains dependent on reactive approaches, such as post-crash investigations. Building capacity in this area within Zimbabwe's transport sector will be essential for effective implementation of predictive analytics.

2.3.4 Stakeholder Collaboration: Saxena et al (2023) noted that collaboration among stakeholders, including government agencies, private organizations, and the public, can help in the

development and implementation of effective road safety systems. Therefore, future efforts should focus on promoting collaborative efforts among stakeholders to enhance the effectiveness of road safety systems. The Road Safety Performance Review Report of 2021 indicated that there was no sharing of data and case file coordination amongst road management stakeholders. TSCZ (2022) emphasized that stakeholder collaboration ensures that policy decisions are informed by real-world data and local context, not just theoretical models. Public-private partnerships have promoted the use of AI-powered traffic systems, driver assistance technologies, and smart infrastructure. Collaboration helps secure funding, technical expertise, and regulatory support for these innovations (Mutisi, 2024)

2.3.5 Infrastructure: Infrastructure is a key enabler of predictive analytics in road safety, especially in Zimbabwe where efforts are underway to modernize traffic systems and reduce accident rates. Limited technological infrastructure and data collection capabilities may hinder the implementation of advanced analytics solutions. Data recording and retrieval is still being done manually due to the slow uptake of advanced technology and equipment (UNECA, 2021). Implementing predictive analytics requires robust technological infrastructure, including data collection systems, analytics tools, and communication networks. A study by Rumutsa (2025) shows that road design significantly influences accident rates. Poorly designed intersections, lack of pedestrian crossings, and inadequate signage contribute to crashes. Infrastructure improvements based on predictive insights can reduce these risks. Zimbabwe may need to invest in upgrading its technological capabilities to support the implementation of predictive analytics for road safety. UNECA (2022) further recommends strengthening road safety management, establishing a central crash database and coordinating post-crash care. These institutional frameworks support the use of predictive analytics by ensuring data availability, policy alignment, and stakeholder coordination

2.3.6 Cost: As much as developing and implementing predictive analytics can be costly, cost plays a dual role in the use of predictive analytics to improve road safety as it can be both a barrier and a driver of innovation. Successful implementation of predictive analytics requires strong executive support and sponsorship (Faster Capital, 2024). All AI technologies require large investments into new technologies and infrastructure which does not come cheap especially with the magnitude of data collection system required for road safety predictions. National Safety Council (2023) indicates that building predictive models from scratch and integrating them with

national systems requires technical expertise and financial resources, which are often limited. Ensuring that resources are available to support the development and implementation of predictive analytics will be essential for effective implementation.

2.4 THEORETICAL FRAMEWORK

Research on the use of predictive analytics to improve road safety in Zimbabwe can be approached through various theoretical frameworks. Predictive analytics involves the use of statistical algorithms and machine learning techniques to identify patterns and predict future outcomes based on historical data. In the context of road safety in Zimbabwe, predictive analytics can be utilized to forecast potential road accidents, identify high-risk areas, and develop targeted interventions to reduce accidents and fatalities.

2.4.1 The Systems Theory – It is one of the theoretical frameworks that can be applied to research on the use of predictive analytics for road safety in Zimbabwe. This framework views road safety as a complex system with interconnected components such as road infrastructure, vehicle design, human behavior, and environmental factors. By analyzing data from these different components using predictive analytics, researchers can gain insights into the underlying causes of road accidents and develop holistic strategies to improve safety.

2.4.2 Theory of Planned Behavior – It focuses on understanding individual attitudes, subjective norms, and perceived behavioral control towards road safety practices. By incorporating predictive analytics into this framework, researchers can analyze historical data on driver behavior and attitudes to predict future trends and tailor interventions to promote safer driving practices.

2.4.3 The Social Ecological Model – It can provide a comprehensive framework for studying road safety in Zimbabwe. This model considers how individual behavior is influenced by interpersonal relationships, community factors, societal norms, and public policies. Predictive analytics can help researchers identify key factors at each level of the social ecological model that contribute to road accidents and develop targeted interventions to address them.

2.4.4 The Health Belief Model - It can be applied to research on road safety in Zimbabwe by focusing on individual perceptions of risk, severity of consequences, benefits of preventive actions, and barriers to adopting safe behaviors. Predictive analytics can assist in identifying patterns in these beliefs and predicting future trends in road safety attitudes among drivers.

Overall, by integrating these theoretical frameworks with predictive analytics techniques, researchers can gain a deeper understanding of road safety issues in Zimbabwe and develop evidence-based strategies to prevent accidents and save lives. In line with the intended objectives this research will adopt the Theory of Planned Behaviour framework as the study is not only concerned with the technical ability of predictive analytics to forecast road accidents, but also with the behaviour and awareness of road users. Predictive analytics can identify risks, but the benefits will only be realised if drivers and other stakeholders understand the information, develop positive attitudes towards safer behaviour, perceive social support for that behaviour and believe that they are capable of acting on the information. The Theory of Planned Behavior therefore provides a useful framework for understanding how predictive analytics and road-safety information can translate into behavioural intentions and, ultimately, safer road-use practices.

2.5 CONCEPTUAL FRAMEWORKS

Conceptual frameworks in research on the use of predictive analytics to improve road safety typically provide a structured approach to understanding and implementing predictive analytics techniques in the context of road safety. These frameworks outline the key components, processes, and factors involved in leveraging predictive analytics for road safety interventions.

Here are two conceptual frameworks commonly referenced in this area:

2.5.1 THE "DATA-MODEL-INTERVENTION-EVALUATION" FRAMEWORK:

This framework, proposed by Chen Et Al (2011), outlines a systematic approach to utilizing predictive analytics for road safety improvement. It consists of four main stages:

- i. **Data Collection and Management:** Gather relevant data on road accidents, traffic flow, driver behavior, weather conditions, and other variables. Ensure data quality, standardization, and compatibility across different sources.
- ii. **Model Development and Validation:** Apply predictive analytics techniques, such as statistical models or machine learning algorithms, to analyze historical data and develop models that can predict accident likelihood, identify risk factors, or detect patterns. Validate the models using appropriate evaluation methods.
- iii. **Intervention Planning and Implementation:** Based on the insights gained from the predictive models, design and implement targeted interventions to mitigate identified risks

and improve road safety. These interventions may include infrastructure improvements, traffic control measures, educational campaigns, or law enforcement strategies.

- iv. **Evaluation and Continuous Improvement:** Evaluate the effectiveness of the implemented interventions using appropriate metrics and evaluation techniques. Monitor the impact of interventions on road safety and iteratively refine the predictive models and intervention strategies based on evaluation results.

2.5.2 THE "PREDICTIVE ANALYTICS FOR ROAD SAFETY" (PARS) FRAMEWORK

This framework was proposed by Quddus et al. (2019) and provides a holistic view of the various stages involved in utilizing predictive analytics for road safety. It consists of the following stages:

- i. **Data Preparation and Integration:** Collect and integrate relevant data from multiple sources, including accident records, traffic data, and contextual information. Conduct data preprocessing, cleaning, and harmonization to ensure data quality.
- ii. **Predictive Modeling:** Apply statistical techniques, machine learning algorithms, or other predictive analytics methods to develop models that can quantify the risk of accidents, identify contributing factors, or predict accident-prone locations. Validate and fine-tune the models using appropriate validation techniques.
- iii. **Risk Mapping and Visualization:** Use the predictive models to generate risk maps or spatial visualizations that highlight areas of high accident risk or identify hotspots. These maps help prioritize interventions and allocate resources effectively.
- iv. **Intervention Selection and Implementation:** Based on the risk maps and predictive models, select and implement targeted interventions such as road engineering improvements, traffic control measures, or education campaigns. Consider the cost-effectiveness and feasibility of interventions in the decision-making process.
- v. **Evaluation and Monitoring:** Assess the effectiveness of interventions through rigorous evaluation methods, considering quantitative and qualitative indicators. Monitor the long-term impact of interventions on road safety and iterate the process by incorporating feedback and new data.

These conceptual frameworks provide a structured approach to utilizing predictive analytics for road safety improvement. They guide researchers and practitioners in understanding the key

stages, considerations, and processes involved in the role of predictive analytics techniques to enhance road safety interventions. For the purposes of this research the first framework, the Data-Model-Intervention-Evaluation Framework, will be used to provide a theoretical foundation and structure for conducting this study. It will serve as a roadmap that guides the research process and helps the researcher conceptualize the study and its objectives.

2.6 CHAPTER SUMMARY

Predictive analytics has the potential to improve road safety in Zimbabwe by identifying high-risk areas, predicting accidents, and determining contributing factors. It presents a transformative opportunity to reduce traffic accidents, save lives, and optimize transportation systems. However, challenges and limitations such as data quality, privacy concerns, technical expertise, and cost need to be addressed for effective implementation. Building capacity in these areas will be essential for leveraging the potential benefits of predictive analytics for road safety in Zimbabwe. However, predictive safety analysis suggests that prioritizing safety treatments solely based on crash history may overlook other areas with significant crash risks (Burkley, 2024). Societies can transition from reactive road safety measures to proactive, data-driven interventions. This shift not only enhances public safety but also contributes to broader goals such as sustainable urban development, economic efficiency, and digital transformation.

3.0 CHAPTER THREE - METHODOLOGY

3.1 CHAPTER INTRODUCTION

This chapter focuses on outlining the approach for conducting research on the use of predictive analytics to improve road safety. According to Dawson (2019), a research methodology is the primary principle that will guide your research. It becomes the general approach in conducting research on your topic and determines what research method you will use. A research methodology is different from a research method because research methods are the tools you use to gather your data (Dawson, 2019). The research design, sampling, population, sources of data, research instruments and data reliability amongst other aspects of methodology will be discussed in this chapter.

3.2 RESEARCH DESIGN

A research design also called a research strategy, is a plan to answer a set of questions (McCombes, 2019). Jenkins-Smith, et al. (2017) further elaborates the definition of research design as the set of steps you take to collect and analyze your research data.

In order to effectively collect data to fully understand the subject at hand the researcher used questionnaires and focus group discussions to collect data. Ranganathan and Caduff (2023) define a research questionnaire as a data collection tool consisting of a series of questions or items that are used to collect information from respondents and thus learn about their knowledge, opinions, attitudes, beliefs, and behavior and informed by a positivist philosophy of the natural sciences that consider methods mainly as a set of rules for the production of knowledge; questionnaires are frequently used instrumentally as a standardized and standardizing tool to ask a set of questions to participants. They further state that the quality and accuracy of data collected using a questionnaire depend on how it is designed, used, and validated. The researcher focused on ensuring that the questionnaire is in line with the research's objectives through matching every question to any one of the research's objectives. The closed questionnaire used in the study were advantageous in gathering focused, quantitative data from respondents which is easy to group, compare and analyze. This type of questionnaire also has results that are statistically significant and help to show trends and percentages over time. However the chosen method of closed questionnaires does

not cover all possible answers and options by the interviewee, for example, where the respondent prefers a neutral option as their answer. It also might have answers that create confusion or are suggestive therefore leading to bias. The questionnaire included dichotomous questions and multiple-choice questions with either single select, multi select options or rating scale.

The research used key informant interviews as a method of collecting more information which was not included in the closed questionnaires. Key informants are a good way to gather information from people with known experiences to discuss a specific topic of interest through guided discussions. With appropriate facilitation the key informant interviews also contributed tremendously to the research findings through qualitative information. As discussions progressed in a key informant interview participants with an in-depth understanding of the subject at hand where providing provide much more information to aid the researcher to possibly explore the context behind road users behaviors.

3.3 POPULATION

For the purpose of sampling, “population” does not refer to the population of a country but to objects, subjects, phenomena or activities which the researcher wishes to research in order to establish new knowledge (Brynard & Hanekom, 2017). Welman and Kruger (2019) stated that a population encompasses the entire collection of cases or units about which the researcher wishes to make a conclusion. The target population of this study includes all road users and stakeholder from drivers, pedestrians, passengers, cyclists, road design authorities, law enforcement authorities and various road management organisations. In order to zero in on actual known and quantifiable road users the researcher focused on the number of registered vehicles in Zimbabwe which currently stands at 1583700 according to ZINARA (2023).

3.4 SAMPLING AND SAMPLING TECHNIQUES

Road traffic accidents are indiscriminate and affect people from various locations and settings each year through loss of lives, loss of property and injuries. In that regard it was near impossible to interview all road users and stakeholders hence the need to come up with a representative sample for the study. Sampling is the statistical process of selecting a subset (called a “sample”) of a population of interest for purposes of making observations and statistical inferences about that

population (Bhattacharjee, 2011). The sample size for this study was determined using the Raosoft sample size calculator (Raosoft Inc., 2004), which applies the Cochran (1977) formula for estimating sample size in large or unknown populations. The parameters used were a 95% confidence level ($Z = 1.96$), a 5% margin of error ($d = 0.05$), and a 50% response distribution ($p = 0.5$). The 50% response distribution was selected because the true proportion of road users who are aware of or utilise predictive analytics in road safety is unknown, and using 0.5 yields the maximum possible sample size, providing a conservative and statistically reliable estimate. Based on these parameters, the calculator produced a recommended minimum sample size of 385 respondents. This sample size ensures that the results are representative of the target population within the specified confidence limits.

The researcher also conducted Focus Group Discussions (FGDs) for participants within 15 conveniently sampled strategic organisations involved in road safety will participate in FGDs. The convenient sampling of road safety stakeholders was based information extracted from various media reports on workshops, trainings and consultations conducted by the government amongst stakeholders to improve road safety.

3.5 SOURCES OF DATA

The sources of data for research can come from many sources including documentation, interviews, observation, audiovisual record, and physical artifacts (Creswell, 2012). The major sources of data for this survey were the general public who are generally road users. The research also focused on gathering data from key stakeholders within the road sector in Zimbabwe. The following organisations were approached for FGDs: as ZRP traffic section, Zimbabwe Traffic Safety Council, ZINARA, InstaToll, Harare Municipality Traffic Police, VID, CVR, Ministry of Transport and Infrastructure Development, The Department of Roads, Transport operators and associations of Zimbabwe, Automobile association of Zimbabwe, Zimbabwe Cross Border Association, Commuters Association of Zimbabwe and Zimbabwe Road and Motor Transport Association, Zimbabwe Rural Transport Operators Association participated in Focus Group Discussions.

3.6 RESEARCH INSTRUMENTS

A mixed method research approach was therefore be used to conduct this study. Mixed-methods research (MMR) is a research methodology that incorporates multiple methods to address research questions in an appropriate and principled manner (Creswell, 2015), which involves collecting, analysing, interpreting and reporting both qualitative and quantitative data. The study was done in 2 phases which include the use of closed-ended quantitative questionnaires as well as focus group discussions. S Roopa & M S Rani (2012) recommend a questionnaire as the main means of collecting quantitative primary data. They further indicate that a questionnaire enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis

The questionnaire used in the research had 6 sections as follows:

Section 1: Demographic Information (7 questions)

This section collected background information on the respondents to understand their profile in relation to road usage and professional engagement in the transport sector. Questions covered age, gender, occupation (e.g., driver, commuter, traffic officer, or road authority employee), years of experience, education level, and location within Zimbabwe. This information helped identify how demographic and occupational factors influence knowledge, attitudes, and experiences related to road safety technologies.

Section 2: Knowledge and Awareness of Predictive Analytics (4 questions)

This section assessed the respondents' familiarity with predictive analytics concepts and applications within Zimbabwe's road safety system. The questions explored whether participants have heard of predictive analytics, understand its purpose, or know of any institutions (e.g., Zimbabwe Republic Police, Traffic Safety Council of Zimbabwe, or ZINARA) that use data-driven methods to predict or prevent road accidents. It established baseline awareness levels of data analytics tools among road users and stakeholders.

Section 3: Perception of Predictive Analytics in Road Safety (5 questions)

This section intended to capture participants' opinions on the usefulness and practicality of predictive analytics in improving road safety outcomes in Zimbabwe. The questions explored

perceived benefits, challenges, and trust in using data-driven systems to identify high-risk roads, forecast accidents, or allocate enforcement resources. Responses helped determine whether road users and authorities view predictive analytics as a viable solution to reduce traffic accidents and fatalities.

Section 4: Data Collection and Analysis (3 questions)

This section examined the respondents' understanding of existing data sources used for road safety planning in Zimbabwe, such as police accident reports, ZINARA road maintenance data, and VID vehicle inspection records. It explored how these data are currently collected, analysed, and shared, and identifies limitations such as incomplete records, lack of integration, or inconsistent reporting. The findings informed the readiness of Zimbabwe's data systems to support predictive analytics initiatives.

Section 5: Impact and Effectiveness (4 questions)

This section investigated whether respondents perceives any tangible impact or effectiveness of data-driven or predictive methods already applied in road safety management. Questions probed areas such as accident reduction, better enforcement, improved traffic flow, or enhanced decision-making due to data use by agencies like the ZRP Traffic Section or the Traffic Safety Council. This section indicated the current and potential effectiveness of predictive analytics in improving safety outcomes.

Section 6: Future Potential and Recommendations (4 questions)

This section invited respondents to share their views on how predictive analytics could be better integrated into Zimbabwe's road safety strategies. Questions focused on potential policy improvements, capacity building needs (training, infrastructure, data sharing), and recommendations for government and private-sector collaboration. The goal was to gather practical suggestions to guide the development of predictive analytics frameworks tailored to Zimbabwe's transport environment.

3.7 DATA COLLECTION PROCEDURES

After the pilot testing of the questionnaire and factoring of recommendations by the initial respondents, the questionnaire was self-administered through email to the selected sample for the study. Wright (2017) states that the advantages of administering online digital questionnaires include access to individuals in distant locations, ability to reach difficult to contact participants, and the convenience of having automated data collection, which reduces researcher time and effort. 391 questionnaires were distributed to the chosen respondents whilst 15 key informant interviews were conducted to collect qualitative data. Follow-up telephone calls were done to respondents to confirm their receiving the digital questionnaire as well as ensuring that they have responded within the stipulated time period.

3.8 DATA VALIDITY AND RELIABILITY

The questionnaire were pretested for validity and reliability. Roopa & Rani (2012) describe questionnaire validity as the degree to which a questionnaire measures what it was intended to measure. They further propose that a questionnaire could be checked for 4 types of validity, that is, content, face, criterion and construct. Expert judgment through the supervisor was used as the primary method to determine whether the data collection tools had content validity. Face, criterion and construct validity were tested through pilot testing the questionnaire to see if the interviewer was getting the response in the way the research aims to measure. The researcher also aimed to measure the extent to which the questionnaire conforms to existing ideas or hypothesis concerning the concepts that are being measured. The digital questionnaire was also configured to automatically validate responses and to ensure all questions are answered before accepting online submission.

Reliability is the degree to which the measure of a construct is consistent or dependable (Bhattacharjee, 2011). In quantitative research, reliability refers to the consistency, stability and repeatability of results, that is, the result of a researcher is considered reliable if consistent results have been obtained in identical situations but different circumstances. But, in qualitative research it is referred to as when a researcher's approach is consistent across different researchers and different projects (Twycross & Shields, 2004). The researcher used the self administered questionnaires in order to improve reliability through reducing subjectivity. The questionnaires

were also cleaned of ambiguous language and wording that may be misinterpreted by respondents as well as asking only questions that the respondents may know the answer to.

3.9 DATA PRESENTATION AND ANALYSIS

Data analysis is a process of inspecting, cleansing, transformation and data modelling with the main aim of discovering useful information, informed conclusions, and supporting empirical decision-making (Babajide, 2022). On the other hand, Marshall and Rossman (2021) describe data analysis as a messy, ambiguous, and time-consuming but creative and fascinating process through which a mass of collected data is brought to order, structure and meaning.

Data presentation involved presenting the data in a clear and concise way to communicate the research findings. The choice of data presentation technique depended on each of the research questions and objectives. Perform basic analysis like descriptive statistics through analyzing categorical variables to understand the distribution of variables with a limited number of categories like gender or education level. SPSS was also used to analyse continuous variables with many values like age to understand the mean, median, standard deviation, minimum and maximum of the respondents. Further exploration of relationships between variables was conducted through cross-tabulation which examined the relationships between two categorical variables evaluated in the research study. Finally SPSS was used to interpret results through reviewing outputs, using p-values to determine the significance of the results, check assumptions through histograms as well as draw conclusions and write up findings, acknowledging any limitations of the data or analysis.

Unlike quantitative analysis, which is statistics driven and largely independent of the researcher, qualitative analysis is heavily dependent on the researcher's analytic and integrative skills and personal knowledge of the social context where the data is collected. The emphasis in qualitative analysis is "sense making" or understanding a phenomenon, rather than predicting or explaining. (Bhattacharjee, 2011). Various theme analysis will be done to data collected through FGDs in order to understand the main messages derived from the quantitative interviews.

3.10 CHAPTER SUMMARY

This chapter outlined the research methodology employed for the empirical study to understand the role of predictive analytics in improving road safety in Zimbabwe. The use of questionnaires and focus group discussions formed the framework of the research methodology to answer the research objectives and questions outlined in Chapter 1. The chapter also labored on prerequisites of the data collection process like constructing a questionnaire, pilot testing them, standardizing them and reframing the poor questions. An in-depth analysis of the collected data set as well as recommendations on the way forward will follow in the subsequent chapters.

4.0 CHAPTER 4 – DATA PRESENTATION AND ANALYSIS

4.1 CHAPTER INTRODUCTION

This chapter shows an analysis and presentation of the data collected on the understanding of how predictive analytics can be used to reduce the number of road accidents in Zimbabwe. The chapter follows research objectives which are to assess the effectiveness of predictive analytics to forecast road accidents in Zimbabwe, identification of contributory factors around road traffic accidents, inform policy and decision making towards enhancing road safety accidents as well as promote awareness about the potential of predictive analytics to reduce road traffic accidents. The results are discussed in detail through descriptive statistics and correlation analysis models to provide suggestive conclusions to the subject under research.

4.2 DEMOGRAPHY OF PARTICIPANTS

4.2.1 Gender

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	118	30.18
	Male	273	69.82

Table 1: Respondents by Gender

A total of 391 participants responded to this survey with 118 (30.18%) being female which is a fair representation of females considering the general gender bias in tech related subjects which this survey was largely based on.

4.2.2 Age

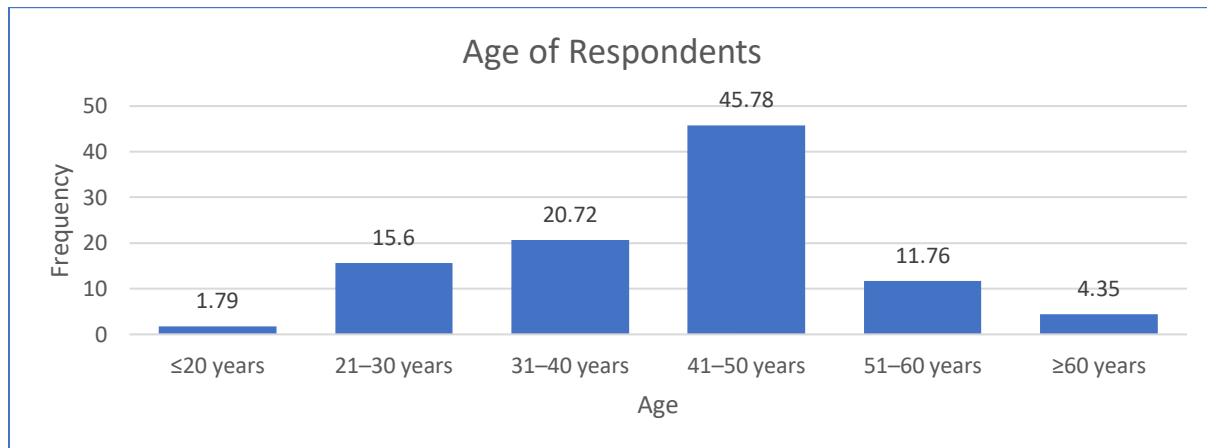


Figure 1 – Age of respondents

All age bands were represented in the survey with the largest proportion (45.78%) falling within the 41–50-year age group, followed by those aged 31–40 years (20.72%) and 21–30 years (15.60%). Only a small minority were younger than 20 years (1.79%) or older than 60 years (4.35%), indicating that the majority of respondents were in the economically active age bracket. Participants represented a broad age spectrum.

4.2.3 Education Level

Variable	Category	Frequency (n)	Percentage (%)
Educational Level	Primary	5	1.28
	Secondary	7	1.79
	Certificate	28	7.16
	Diploma	24	6.14
	Degree	279	71.36
	Other	48	12.28

Table 2 – Education level

In terms of educational attainment, the majority of respondents held a tertiary qualification, with 71.36% reporting a degree, and an additional 6.14% holding a diploma. Those with certificates constituted 7.16%, while individuals with secondary or primary education represented a smaller proportion (1.79% and 1.28%, respectively). This suggests that the study sample was generally well-educated and possessed a degree high likely due to the widely available study opportunities in Zimbabwe.

4.2.4 Drivers Licence

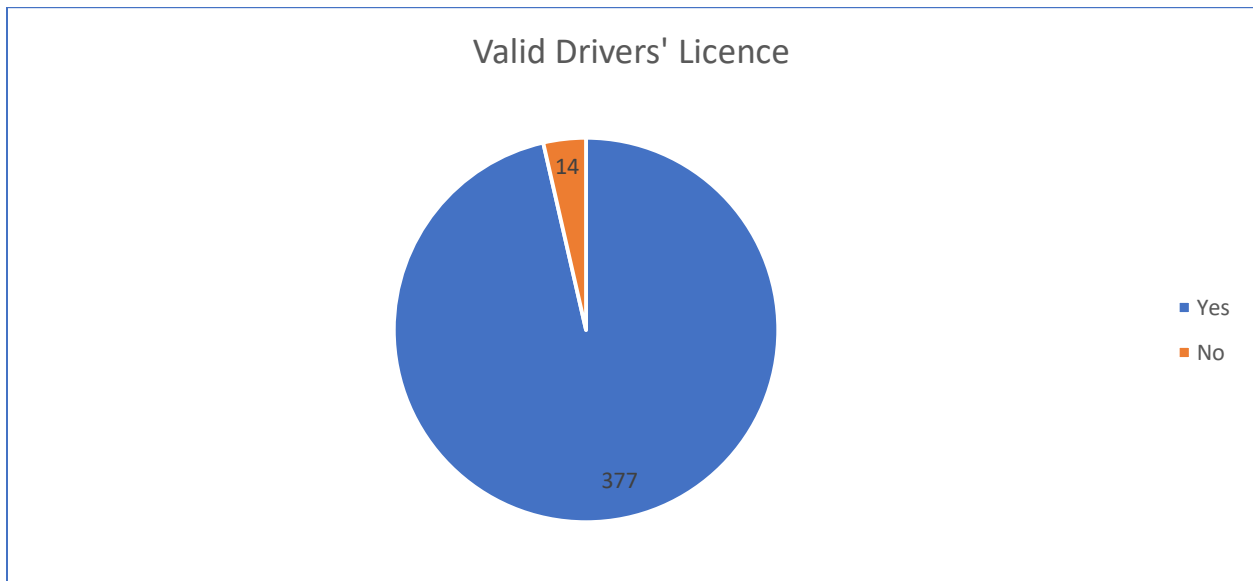


Figure 2 – Holder of licence

Regarding licensing status, an overwhelming majority (96.42%) reported having a valid driver's licence, which is consistent with the interest for road safety by most active drivers. Only 3.58% indicated that they did not possess a valid licence.

4.2.5 Years of driving experience

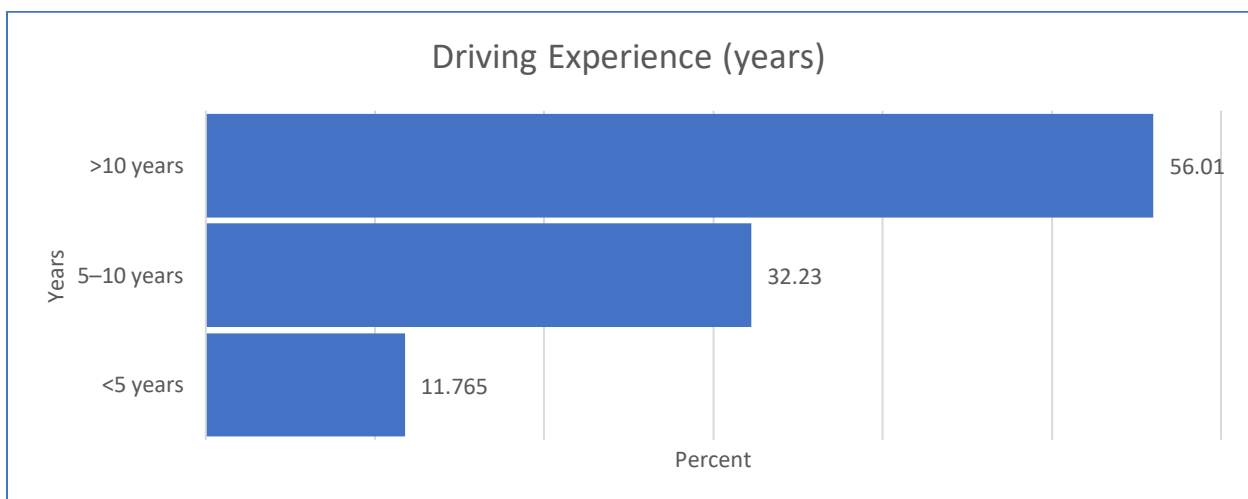


Figure 3 – Years of driving experience

Driving experience varied across participants. More than half (56.01%) had over 10 years of driving experience, signifying a largely experienced driving population. Approximately one-third (32.23%) had 5–10 years of experience, while only 11.76% had fewer than five years of driving experience. The distribution suggests that most respondents were seasoned drivers, likely with substantial exposure to road traffic conditions and safety issues.

4.3 EFFECTIVENESS OF PREDICTIVE ANALYTICS

The first objective was to measure the effectiveness of predictive analytics through understanding this relatively new phenomenon's ability to forecast road accidents.

Variable	Category	Frequency (n)	Percent (%)
Belief That Predictive Analytics Can Reduce Road Accidents	Missing	119	30.43
	No	14	3.58
	Yes	258	65.98

Table 3 – Predictive analytics impact on road accidents

60% of the respondents indicated that they envisioned the potential of predictive analytics to improve road safety as quite high. This suggests that a significant number of respondents are quite positive in the implementation of technology to improve road safety and can fore see this technology being a game changer to road traffic safety. This belief in such potential could be driven by the general acceptance of technology over years as well as progression of technological innovations globally. Interestingly young respondents under 20 years who where born into the 4th industrial revolution believed that the potential of predictive analytics would be moderate compared to the 41 to 50 year olds who were more optimistic in the potential of data usage for road safety.

Variable	Category	Frequency (n)	Percent (%)
Perceived Accuracy and Reliability of Data Used in Predictive Analytics	Missing	119	30.43
	High	154	39.39
	Low	26	6.65
	Moderate	92	23.53

Table 4 - Predictive analytics for accident identification

Predictive analytics can indeed identify high risk areas prone to accidents as shown by 97% of the respondents. Furthermore, 93% of the respondents believed that predictive analytics can prevent specific types of accidents. This view could be driven by the general use of data in various other industries and computer applications to determine future outcomes of various products, goods and services. The study shows that all the young people (under 20 years) believed in the future of technology by agreeing that predictive analytics can identify high risk accident prone areas. However only half the participants were aware of predictive analytics examples which have been used to enhance road safety. This was a cause of concern in the full understanding of respondents around areas of predictive analytics in road safety. On the other hand, a high number of respondents (154) believed that data collected for road safety would be highly accurate.

As much as respondents believed that predictive analytics can prevent accidents the majority of them foresaw challenges in collecting and analyzing data to improve road safety. The challenges included resource constraints, driver commitment, keeping up with technologies, unavailability of relevant technologies, lack of stakeholder collaboration, staff technical abilities and continued policy changes in the country.

Lastly, a significant number of respondents at 74% had knowledge of countries that have used predictive analytics to improve road safety. Such knowledge can be attributed to information gathered in various media articles and types of media that continue to disseminate information of how other countries are progressing in various infrastructure developments.

4.4 IDENTIFICATION OF CONTRIBUTING FACTORS AROUND ROAD ACCIDENTS

The second objective was to identify factors that contribute to road accidents in Zimbabwe. The major causes of traffic accidents were categorized into 5 domains which were human related factors, vehicle condition, environmental factors which include the road itself, governance structures and enforcement as well as socio economic factors. The study participants cited human related factors such as speeding, negligent driving, driver fatigue, driver distraction, overloading as well as alcohol and drug abuse. Under vehicle conditions there was poor vehicle condition, unroadworthy vehicles and unnecessary modification of vehicles. The participants further went on to cite environmental factors which were road infrastructure defects, poor road lighting, poor road designs, bad weather conditions and livestock presence on highways. The governance factors discussed included weak enforcement of traffic laws, inadequate data systems, fragmented institutional coordination, limited emergency response services and poor public empowerment. Finally the socio factors mentioned included increased motorization, poverty resulting in poor vehicle maintenance and public transport pressure for income maximisation.

The research also revealed that the Trabablas interchange had been built as a result of predictive analytics as well as the installation of some warning signs, speed humps and traffic calming rumble strips around the country. The dualization of some highways was also cited to be a result of predictive analytics. All these initiatives were meant to reduce contributory factors to road accidents.

Over and above the 5 domains of traffic accidents the research discovered that there were also certain components of data that could be digitally collected to further understand the cause of road traffic accidents and modelled to predict potential road accidents.

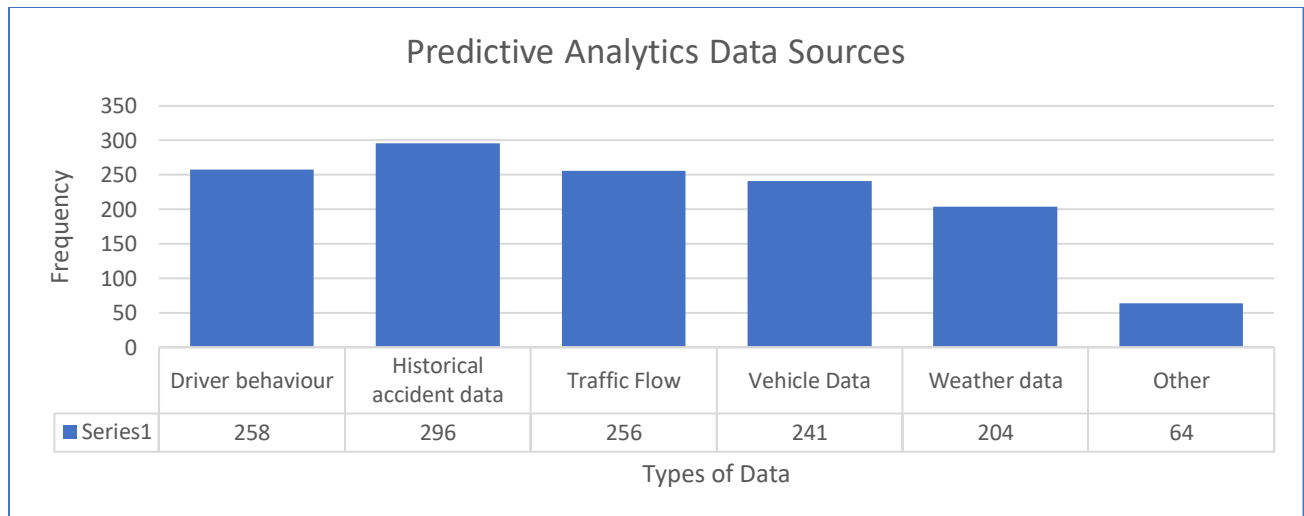


Figure 4 – Data sources for predictive analytics

Historical accident data was identified as the most important data for predicting potential road accidents by 296 participants followed by driver behavior (258), traffic flow data (256), vehicle data (241) and other forms (64) of data respectively.

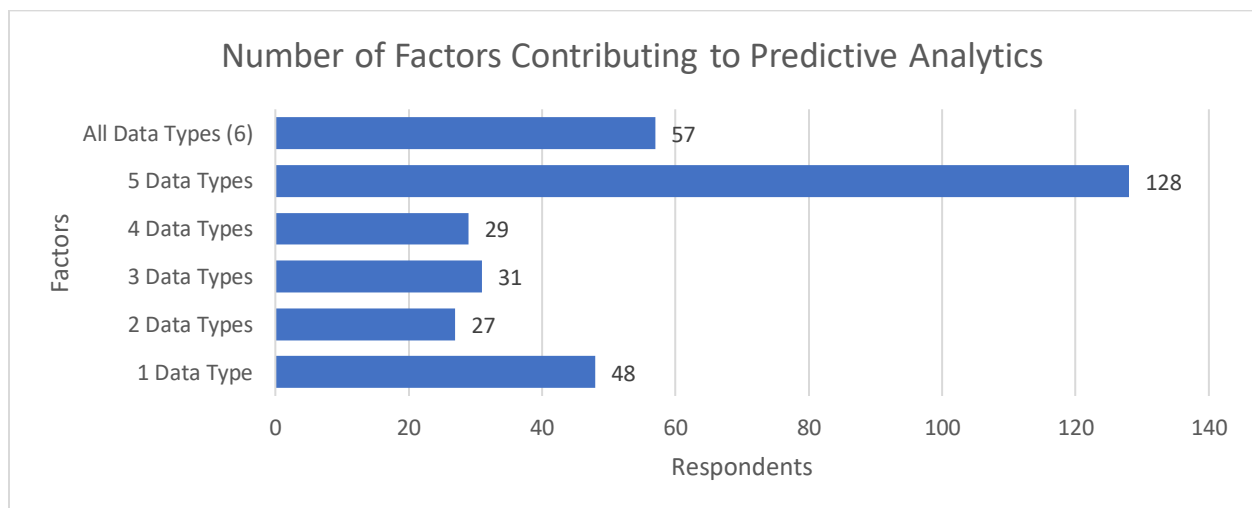


Figure 5 – Data types contributing to predictive analytics

The survey allowed participants to select more than one data type which was likely usable for predicting road accidents. 128 participants identified 5 data types, whilst 57 respondents identified all data types and 48 respondents identified only 1 data type as important for predictive analytics in road safety. This proves that respondents are aware that to have an accurate prediction of road accidents there is need to take advantage of as many data sources as possible.

4.5 INFORM POLICY AND DECISION MAKING

General gravitation towards data for decision making is a turning point even in road safety with almost all respondents believing that predictive analytics will help in resource allocation towards road safety. Over and above allocation of resources decision making processes for road safety stakeholders like transport authorities will also be enhanced. Furthermore, traffic police will also be able to do their job more effectively. The future of predictive analytics in road safety was deemed as bright by 239 respondents with only 14 respondents citing its future as limited. The success of this technology will be driven by a multi-stakeholder approach.

Predictive analytics resulted in positive outcomes in road safety as cited by 65% of the respondents. Targeted road awareness campaigns, Danger warning signs installed along some Zimbabwean roads, increased police patrols in high accident areas, major infrastructure projects like the construction of a bypass road for haulage trucks enroute from Mozambique to Harare in order to avoid the Christmas Pass, multiple road blocks along Seke Road, construction of intersection bypasses along Borrowdale Road and road about bypasses on airport road and Warren Park amongst just a few positives reported in the study.

The focal group discussions revealed that a significant number of policy changes have been implemented driven by data collected over years in order to improve road safety which had now grossly deteriorated over the years. The government introduced a new regulation to protect public commuters from young inexperienced drivers through gazetting minimum age for public transport drivers to 30 years coupled with at least 5 years driving experience. Over and above that the general public is also expected to apply for a SADC complaint licence which will be renewed every 5 years. The Zimbabwe Republic Police has also started shifting its approach through introduction of motor cycles on the road to ensure faster roadside enforcement of traffic laws as well as deliver road safety interventions in a cost effective manner. City councils starting with the City of Harare have introduced smart traffic management systems which are AI driven such as red light detection systems, traffic sensors, speed readers and automatic number plate recognition systems all in an effort to improve road safety. The latest move by government has seen the vehicle inspection department being largely confined to comprehensive depot inspections in comparison to roadside inspections which are limited in their approach to determining roadworthiness of vehicles. The

government has also started resuscitating road maintenance unit which continuously monitor road conditions and design repair schedules to improve road conditions. The signage on any newly constructed road is now being changed to SADC compliance which is more visible and understandable to any driver. Zimbabwe also is considering adopting a demerit points systems for traffic related offences leading to licence suspension or cancellation. Finally there has been efforts to introduce flights and rail transport on busy routes to reduce road traffic e.g Harare to Mutare however the uptake of such services remains very low.

4.6 PROMOTE AWARENESS OF PREDICTIVE ANALYTICS

One of the goals of this survey is to promote awareness of predictive analytics and this is only possible through first establishing the levels of understanding within the population.

Variable	Category	Frequency (n)	Percent (%)
Understanding the Meaning of Predictive Analytics	No	45	11.51
	Yes	346	88.49

Table 5 – Understanding of predictive analytics

The general understanding of predictive analytics was quite high at 88.49% due to the proliferation of technological aspects driven by the fourth industrial revolution. Predictive analytics has become more common with the continued use of the internet and mobile technologies which provide predictive technologies such as estimated time of arrival by common applications in Zimbabwe like Indrive, Google Maps and running applications for fitness exercises which estimate time left on a targeted run.

Variable	Category	Frequency (n)	Percent (%)
Heard About Predictive Analytics in Road Safety	Missing	45	11.51
	No	74	18.93
	Yes	272	69.57

Table 6 – Predictive analytics awareness

11.51% of the respondents did not attempt this question hence discontinuing the study as all other subsequent questions were no longer relevant to the participants. The significant number of respondents who never heard about predictive analytics in Road Safety could be deemed as normal due to reduced interest in areas of road safety in comparison to the above table that generalizes predictive analytics.

Understanding of Predictive Analytics	Certificate	Degree	Diploma	Other	Secondary	Total
Extensive	6	40	0	7	7	60
Limited	0	48	0	7	0	55
Moderate	11	168	24	28	0	231
Total	17	256	24	42	7	346

Pearson $\chi^2(8) = 53.01$, $p < 0.001$

Table 7 – Understanding awareness by level of education

The analysis examined whether understanding of predictive analytics differed across levels of education. There was a statistically significant association between educational attainment and understanding of predictive analytics ($\chi^2(8) = 53.01$, $p < 0.001$). Participants with degree qualifications demonstrated the highest levels of understanding, contributing 40 of the 60 respondents (66.7%) who reported an extensive understanding. Conversely, limited understanding was more common among participants with lower qualifications such as certificate holders and those within the “Other” category. Moderately high levels of understanding were observed across all education groups, particularly among degree holders ($n=168$) and diploma holders ($n=24$). These findings suggest that higher educational attainment is strongly linked to better comprehension of predictive analytics, highlighting the need for targeted capacity-building interventions among drivers with lower educational backgrounds.

4.7 CHAPTER SUMMARY

The chapter presented and interpreted data on research findings obtained from the responses on questionnaires and focus group discussions in the context of predictive analytics for road safety improvement. Data was presented by use of pie charts, bar graphs and tables based on analysis done using the Pearson’s correlation coefficient, so as to align the research with the objectives.

5.0 CHAPTER 5 - SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 CHAPTER INTRODUCTION

This chapter presents the conclusions from the study to assess the role of predictive analytics in improving road safety in Zimbabwe. It gives a compacted final examination of the findings against the outlined objectives of the study. It concludes the research document with a snapshot of the role and importance of predictive analytics in transforming road safety. the chapter goes on to proffer practical recommendations for strengthening data use in improving road safety. Finally, it provides recommendations on areas for further research around data analytics for road safety.

5.2 SUMMARY OF FINDINGS

This study investigated the role and effectiveness of predictive analytics in enhancing road safety in Zimbabwe. The research focused on four key areas: the effectiveness of predictive analytics in forecasting road accidents, the factors contributing to road traffic accidents, lessons that policymakers can learn from applying predictive analytics, and the awareness among road users about predictive analytics and its potential benefits. The study employed a mixed method approach which combined quantitative data analysis of responses as well as qualitative interviews for key stakeholders such as traffic enforcement authorities, road management and administration agencies, traffic management organisations as well road use regulatory authorities. Interviews were administered to assess awareness and perception of road users in the subject of predictive analytics in line with road safety.

The research postulated that predictive analytics can indeed be used in forecasting road accidents in Zimbabwe through identification of various driver and road related variables. There were various factors that contribute to road traffic accidents classified into 5 domains which were human related factors, vehicle condition, environmental factors which include the road itself, governance structures and enforcement as well as socio economic factors. Policy makers can use predictive analytics in road safety for purposes of decision making around areas of resource

allocation prioritization, improving traffic enforcement strategies, installing various road safety interventions and conduct targeted road safety awareness campaigns to name just but a few. The study revealed low to moderate understanding of the in-depth understanding of the subject at hand by most respondents and definitely proved a need for educational campaigns and public engagement to improve understanding of road traffic safety data driven interventions.

5.2.1 DEMOGRAPHIC INFORMATION OF RESPONDENTS

5.2.1.1 Age

The survey sample was largely distributed in the 41 – 50 year age group who made up 46% of the survey followed by the 31 – 40 year age group who constituted 21% of the respondents. The large number of older individuals was merely driven by individuals in formal work settings who have internet access privileges to complete an online google forms questionnaire in comparison to surveys that are deployed on Facebook or WhatsApp which is more accessible to a younger populace through limited network data bundles. Access to the unrestricted internet was strongly associated with formal employment, household wealth and education level which favors the middle aged population in Zimbabwe (Martin et al, 2024).

5.2.1.2 Gender

The results showed that only 30% of the respondents in the survey were females. The UN Women (2022) Gender Analysis Guidance Digital Inclusion cites the fact that women are reluctant to go online due to concerns around online abuse, limited affordability constraints from accessing and using digital technologies as well as reduced interest of digital content in comparison to men hence all surveys conducted online will result in less women participants. This understanding of gender behavior in tech related issues cements the normality of having a lower proportion of women being represented in the study.

5.2.1.3 Educational level

The DataReportal (June, 2023) reports that higher education levels are strongly associated with increased internet use and, by extension, a greater likelihood of participating in a specialized survey on a complex topic like predictive analytics hence in agreement with why 71% of the

respondents hold a university degree. The complexity of the subject involved reveals why there was a low response in holders of lower qualifications such as primary to Diploma level.

5.2.2 EFFECTIVENESS OF PREDICTIVE ANALYTICS IN ROAD SAFETY

This study reveals that in order to come with an effective predictive analytics mechanism there must be collection of data from as many sources as possible. The majority of respondents indicates at least 5 significant data dimensions to predict potential accidents. Existing Zimbabwean studies recommend evidence-based, data-driven road safety but do not examine whether citizens understand or trust such approaches (Rumutsa, 2025). The fact that 19.5% were not too knowledgeable on predictive analytics in the context of road safety and 11.51% did not know what predictive analytics was shows that a number of citizens are not concerned with technological approaches to road safety.

Predictive analytics can indeed be used to improve road safety in Zimbabwe. Elovate (2025) postulates that by leveraging vast amounts of data from traffic enforcement cameras, predictive models can help transportation authorities anticipate and prevent crashes before they happen. They go on to mention that predictive analytics is revolutionizing automated traffic enforcement, making roads safer through data-driven decision-making. By leveraging insights from traffic cameras and real-time data, transportation authorities can prevent crashes, optimize enforcement, and ultimately save lives. The above-mentioned data sources were also largely identified as important for predictive analytics in road safety.

5.2.3 CONTRIBUTORY FACTORS AROUND ROAD TRAFFIC ACCIDENTS

The study identified various contributors to road accidents which also relate to study by Chibaro (2024) that unsafe road vehicles, unlicensed drivers, overloading, speeding, and drunk driving are listed as the most frequent crimes leading to road traffic accidents. These factors were also mentioned by the study participants during the course of focus group discussions. Colagrande (2022) further substantiates some of the findings that road accidents essentially depend on four interrelated factors which are user behavior (attitude, skills, experience, etc.), vehicle characteristics (performance, maintenance, etc.), road infrastructure (geometry, paving, signage, intensity and type of traffic, etc.) as well as environmental conditions (climate, morphology,

exposure, etc.). Contributory factors of accidents in Zimbabwe can also be generally categorized in the above mentioned interrelated factors as revealed by the study.

5.2.4 INFORM POLICY AND DECISION MAKING

A review by UNECE (2021) highlights gaps in data transparency, public communication and stakeholder engagement, indicating that the public is more likely to encounter traditional safety messages than explicit information about predictive tools. This relates to what the respondents indicated that there were gaps in partnerships between various agencies that are concerned with road safety. The agencies continue to operate in silos and isolation with not much collaborative efforts to improve road safety. A study by Chibaro et al (2024) further stresses the importance of a multi-sectoral approach involving government agencies, private stakeholders, and communities to address systemic weaknesses comprehensively. Without a collaborative approach to road safety then saving lives on Zimbabwe's road remains a pipe dream in our generation. The path forward requires a collaborative approach involving government authorities and community stakeholders to build a safer and more efficient transportation system for all citizens. (Rumutsa, 2025). By recognizing that road safety follows a systematic nature, policymakers can avoid simplistic overnight recommendation and instead develop interventions that cover the entire aspects of road safety, from improving road design, road signage to enhancing vehicle safety, user engagement as well as enforcing traffic regulations. Such an approach requires the identification of all relevant stakeholders involved in reduction of road traffic accidents.

The study revealed that Zimbabwe had a significant number of policies and initiatives by policy makers to improve road safety through use of available data. However (UNECE, 2022) reveals that the framework's main weakness is that it is outdated and in need of updates benchmarked to international standards and good practices, particularly of the United Nations conventions on road safety, the African Road Safety Charter, and regional SADC/SATCC. This shows that as much as predictive analytics had huge potential to inform policy and decision making it will suffer from challenges experienced in the country's governance structure to review policies in line with prevailing road accident related factors. Findings by Muzondo (2025) reveal critical barriers, including inadequate ICT infrastructure, high implementation costs, and weak regulatory frameworks in institutional readiness for technology adoption of Internet of Things (IoT). Despite

these constraints, his study identifies considerable opportunities for improving transport safety through targeted IoT interventions. Such findings are in line with the study's results that predictive analytics had potential in influencing effective resource allocation and enhance decision making for road safety stakeholders.

5.2.4 PROMOTE AWARENESS AND EDUCATION

The general public's knowledge of predictive analytics is likely to be low, even in settings where predictive tools are technically in use (Jaji, 2024). This aligns with the fact that only a small percentage (15.35%) of the respondents in the study indicated they had extensive knowledge of predictive analytics. Predictive analytics remains a largely complex phenomenon which generates little interest amongst the generality of the population worse off coupled with issues of road safety. However, the use of a technical term such a predictive analytics could have contributed to increased complexity of the subject notwithstanding the fact that most drivers dominantly use google maps for navigation which has predictive analytics capabilities.

5.3 RECOMMENDATIONS

In order to strengthen the use of data analytics to improve road safety in Zimbabwe the following recommendations should be considered:

5.3.1 Strengthen data infrastructure - Establish a centralised and standardized national road safety computerised data collection, reporting and repository system which integrates data from ZRP Traffic, VID, ZINARA, Zimbabwe Traffic Safety Council and local authorities amongst other key stakeholders. Such a system will reduce missing, inconsistent, incomplete as well as inaccurate records through data validation mechanisms. It will also ensure timeliness of data availability for decision making.

5.3.2 Build institutional and technical capacity - The country must of focus of capacity building of staff from various agencies in relevant technologies such as big data analysis, geographic information systems as well as evidence based decision making. There is further need to collaborate with institutions of higher learning who are strong in research, training and stimulating ideas around road safety. Deliberate efforts must be channeled towards upskilling data

scientists, statisticians, geosystems specialists as well as ICT personnel to implement and manipulate data modelling systems.

5.3.3 Support multi-sector collaboration - Establish a technical committee on road safety to discuss road safety, share generated data, analyse collected data and recommend areas of research and improvement. Collaboration of key stakeholder is key in a unified approach to road safety. There is need for engagement of ZINARA, ZRP, VID, local authorities, and any other player deemed important in road safety improvement to participate in such an important initiative. Furthermore the stakeholders must implement standardised data-sharing agreements ensuring privacy, security, and ethical use of information in compliance to the Data Protection Act.

5.3.4 Deploy technology-driven road safety interventions - The entry point to data driven decision making systems is collection of accurate and timely data. This should be done through installing CCTVs, smart sensor technologies, computerized traffic monitoring systems to collect as much data as possible. Local authorities must increase AI driven technologies like speed cameras and red light detection systems at high risk traffic intersections like the one installed in Harare along Rekayi Tangwena Avenue. The reinforcement of public transport operator monitoring systems is key to understand driver behavior and patterns such as speeding, rapid acceleration, hard braking, impromptu and unwarranted lane changes as well as unsafe overtaking practices.

5.3.5 Implement public awareness strategies - The most important intervention on road safety is the human aspect whose cognitive ability is way above machine intelligence. Commuters, road users and community leaders must be continuously engaged to promote safe driving behaviours and accountability by private and public transport drivers. Existing road accidents information can form the basis of targeted road safety campaigns focusing on high risk areas. On the other hand key findings from various data sources must be incorporated in road safety awareness programmes.

5.3.6 Ensure secure and ethical data access and use - A road safety data governance policy must be developed in line with the Data Protection Act to address issues of entity privacy,

cybersecurity and responsible use of analytics within set guidelines. Anonymity and encryption standards are key to protect personal sensitive information for unauthorized public consumption through data breaches.

5.3.7 Pilot and scale-up predictive analytics projects - The key to systems success is to start implementation with pilot projects in urban areas like Harare, Bulawayo, and Mutare, where data availability is higher as well as high volume sections of the highway such as Harare to Norton, Marondera, Beatrice and Mazowe as well as Gweru to Kwekwe and Kadoma to Chegutu. These roadways will provide enough information to evaluate outcomes and improve predictive models before scaling to national implementation. Policy makers can also create enabling environment for public-private partnerships, innovators, idea hubs and think tanks focused on transport safety solutions.

5.3.8 Allocate sustainable funding - Over and above the policy frameworks, collaborative efforts, public engagement and technological provision the government must prioritise investment in the whole road safety chain. This can be through provision of resources from the fiscus, bilateral agency partnerships, public-private sector initiatives or through international donor funds. All agencies such as ZRP, VID, ZINARA, ZBC, ZTSC and Insurance companies who collect fees, licences, fines and levies from motorists must set aside resources for road safety data driven initiatives.

5.4 CONCLUSION

This research has proven that predictive analytics has significant potential to turn around road safety significantly on Zimbabwe's road network. By taking advantage of historical crash data, real-time traffic information, weather patterns, vehicle behaviour, and driver actions, comprehensive data analysis models can accurately identify multiple facets of road safety dynamics. the use of data can easily be used to deduce high risk locations, time periods, driver and driving characteristics well before accidents are likely to occur. The use of data is a significant deviation from the traditional reactive road safety decision making strategies being used in the country at the moment. Data driven prevention strategies are well positioned to take over the future

of road safety decision making especially with a research population that sees the huge potential of data driven decision making.

The study shows that integrating data use for decision making into various stakeholder systems as well as promoting cooperation amongst various players is the ideal strategy to improve road safety. The stakeholders identified in this research included local authorities, traffic police operations, emergency response teams, traffic safety agencies such as the Vehicle Inspection Department (VID), Zimbabwe National Road Agency (ZINARA), Zimbabwe Traffic Safety Council (ZTSC), Central Vehicle Registry (CVR) and tour operators as well as policy makers. The integration of stakeholders and various data system combined with public awareness campaigns, improved road infrastructure, information technology systems and enforcement of traffic laws can significantly reduce road casualties and fatalities.

Unfortunately there are also so many other factors which Zimbabwe as an African country has to conquer in order to successfully adopt predictive analytics systems for the benefit of its populace in improving road safety. The country has to invest in reliable technology infrastructure, capacity building of various stakeholders as well as transparent and effective data governance policies. The country also has to put adequate measures to ensure

However, the successful adoption of predictive analytics requires investment in reliable data infrastructure, multi-agency collaboration, capacity building, and clear data governance policies. Challenges such as incomplete datasets, limited technical expertise, and inconsistent reporting must be addressed to fully realise the benefits of the power of data driven decision making.

In conclusion, predictive analytics presents a powerful tool for improving road safety in Zimbabwe. By embracing advanced data science capabilities and integrating them into road safety planning, Zimbabwe can strengthen its efforts to prevent road traffic accidents as well improved road networks, efficient traffic flow as well as road users empowerment in planning for travel.

5.5 AREAS OF FURTHER RESEARCH

The focus of this study was to assess the role of predictive analytics in improving road safety in Zimbabwe. The study proposes the following areas of research for improved data driven road safety strategies

5.5.1 Integration of real-time data sources - Most road safety datasets just like any other big data in Zimbabwe is historical, static, fragmented and incomprehensive. Further research should investigate how to institute and consolidate real-time road usage data such as GPS vehicle data, meteorological updates, traffic flow sensors, driver characteristics and behaviours as well as pedestrian movements to build dynamic predictive models capable of issuing real-time road safety information.

5.5.2 Predictive analytics for public transport safety - Given the high contribution of public transport (kombis, buses) to accident statistics, future research should focus specifically on modelling driver characteristics, road behaviour patterns, route risk scores and high-risk times and seasons. Availability of such information would support targeted enforcement, safer fleet management and informed decision making by relevant road user authorities.

5.5.3 Human factors and behavioral predictors - More research is needed on how behavioral data such as fatigue, alcohol use, risk perception, distraction, use of unroadworthy vehicles, poor lane discipline and compliance with traffic laws influences rate of accidents. This will enhance understanding of driver-level predictors that technology alone cannot detect.

5.5.4 Evaluating the impact of predictive analytics on policy decisions - There is limited evidence on how predictive data influences decision-making in Zimbabwe. Future studies should evaluate how policymakers use predictive dashboards, whether data-driven decisions lead to measurable reductions in crashes, barriers faced by agencies in adopting analytics as well as return on investment (ROI) of predictive technologies.

5.5.6 Ethical, legal and privacy considerations - The fifth industrial revolution brought with it multiple challenges of data ethics and legal considerations for data collection. Research is needed

on the legal frameworks required to safely collect and use human related data elements for decision making. Key areas to consider are data governance, privacy protection and public acceptance of human surveillance technologies.

5.5.7 Data analytics for targeted road users - There is a need for focused research on predicting risks faced by segmented road users such as pedestrians, cyclists, motorcyclists, school children and public transport users. Zimbabwe's crash burden heavily affects these groups difference, but current data is not precise due to limited segmented data sources and models.

5.5.8 Integration of predictive analytics into road infrastructure design - Further research should examine how predictive models can be incorporated into engineering decisions for improved road infrastructure instead of reliance of historic data and reactionary decisions. This would help create design standards that are informed by predicted risk, not just historical records, public outcry as well as undue influence by policy makers.

5.5.9 Localised data collection innovations - Because data quality, availability and effective collection mechanisms is a major barrier, research should explore low-cost sensor technologies, drone-based traffic monitoring, accessible community reporting tools, CCTV systems and affordable vehicle activity monitoring technologies. These innovations can improve the scope, availability, accuracy and completeness of datasets.

REFERENCES

- Al, K. W. (2021). Highway safety assessment and improvement through crash prediction by injury severity and vehicle damage using Multivariate Poisson-Lognormal model and Joint Negative Binomial-Generalized Ordered Probit Fractional Split model. *Journal of Safety Research*, 44 - 55.
- Al, Y. Y. (2018). Evaluating Highway Traffic Safety: An Integrated Approach. *Journal of Advanced Transportation*.
- Alison Twycross, L. S. (2004). Validity and reliability – What’s it all about? *Paediatric Care*, 36.
- Ammar Sohail, M. A. (2023). Data-Driven Approaches for Road Safety: A Comprehensive Systematic Literature Review. *Safety Science*.
- B, B. A. (2022). Data Presenting and Analysing. *LASU International Conference*.
- Bezabeth, G. e. (2013). *Road Safety in Africa: Assessment of Progress and Challenges in Road Safety Management System*. Abidjan: AFDB.
- Bhattacharjee, A. (2011). *Social Science Research: Principles, Methods, and Practices*. Florida: University of South Florida. Retrieved from Lumen Learning.
- Bianco, M. (2021). *Overcoming the social barriers of AI adoption*. Eindhoven: Eindhoven University of Technology.
- Buckley, D. (2024, April 6). *The Predictive Safety Analysis*. Retrieved from [www.montgomeryplanning.org: https://highways.dot.gov/safety/data-analysis-tools/rsdp/data-driven-safety-analysis-ddsa](https://www.montgomeryplanning.org/highways.dot.gov/safety/data-analysis-tools/rsdp/data-driven-safety-analysis-ddsa)
- Cathrine Marshall, G. R. (2021). *Designing Qualitative Research*. California: Sage Publications.
- Chibaro M, e. a. (2024). Human Factors and Road Traffic Safety: An Inquiry into the Causes of Road Traffic Accidents in Harare Metropolitan Province, Zimbabwe. *Asian Journal of Management, Entrepreneurship, and Social Science*.
- Colagrande, S. (2022). A methodology for the characterization of urban road safety through accident data analysis. *Transportation Research Procedia*, 504 -511.
- Cote, C. (2021, October 26). *Harvard Business School Online*. Retrieved from What is predictive analytics: <https://online.hbs.edu/blog/post/predictive-analytics>
- Creswell, J. W. (2015). *A concise Introduction to Mixed Methods Research*. California: Sage Publications.

- Dawson, C. (2019). *Introduction to Research Methods 5th Edition: A Practical Guide for Anyone Undertaking a Research Project*. London: Little, Brown Book Group.
- Elovate. (2025, February 24). *How Predictive Analytics Enhances Automated Traffic Enforcement (ATE) for Safer Roads*. Retrieved from [www.elovate.com: https://elovate.com/blog/how-predictive-analytics-enhances-automated-traffic-enforcement/](https://elovate.com/blog/how-predictive-analytics-enhances-automated-traffic-enforcement/)
- Essa, J. M. (2024). *Predictive Analytics of Road Traffic Incidents, A Machine Learning* . Dubai: RIT.
- Faan Chen, E. A. (2023). Road safety performance rating through PSI-PRIDIT: A planning tool for designing policies and identifying best practices for EAS countries. *Socio-Economic Planning Sciences*.
- Fan Y., Z. X. (2018). Network-constrained spatio-temporal clustering analysis of traffic collisions in Jiangnan District of Wuhan, China. *PLoS One*, 13.
- Faster Capital*. (2024, March 16). Retrieved from 1.Overcoming Challenges in Predictive Analytics Implementation: <https://fastercapital.com/topics/overcoming-challenges-in-predictive-analytics-implementation.html/1>
- Fleutiaux, F. (2018, February 19). *Vehicle data is more profitable than the car itself*. Retrieved from [www.creatingfutureus.org: https://creatingfutureus.org/vehicle-data-is-more-profitable-than-the-car-itself/](https://creatingfutureus.org/vehicle-data-is-more-profitable-than-the-car-itself/)
- Foya, D. (Oct 2019). Road Traffic Accidents, Causes, Trends and Preventive Measures: The case of the City of Harare. *International Journal of Research and Innovation in Social Science (IJRISS)* , 776 - 792.
- Galal, A. (16 - 19 August 2010). Traffic Accidents and Road Safety Management: A Comparative Analysis And Evaluation in Industrial Developing and Rich-Developing Countries. *29th South African Transport Conference*. Johannesburg: SATC.
- Gowthami C, K. S. (2025). Comprehensive approach to predictive analysis and anomaly detection for road crash fatalities . *AIP Advances*, 15.
- H, H. S. (May 2019). Road Accidents in Tanzania: Causes, Impact and Solution. *Global Scientific Journals*, 753 - 772.

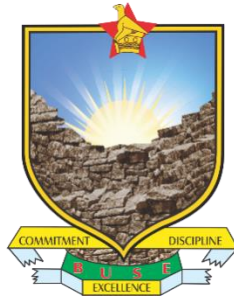
- Hinshaw, M. (2023, December 27). *www.highways.dot.gov*. Retrieved from US Department of Transportation: <https://highways.dot.gov/safety/data-analysis-tools/rsdp/data-driven-safety-analysis-ddsa>
- Insee. (2020, October 20). *Road accidents*. Retrieved from European Statistical System: <https://www.insee.fr/en/metadonnees/definition/c1116>
- K Folla Et Al. (2018). *Safer Africa: Data Analysis and Identification of Risk Factors*. Rome: Safer Africa.
- Kamoyo M, C. L. (2025). Public Transport Sector Challenges and Zimbabwe's Untapped Economic Opportunities. *Transportation in Developing Economies*, 11.
- Latent View. (2022, February 24). *Role of Analytics in Mitigating Road Accidents*. Retrieved from www.latentview.com: <https://www.latentview.com/blog/role-of-analytics-in-mitigating-road-accidents/>
- LGA UK. (2020, November 5). *Using predictive analytics in local public services*. Retrieved from Local Government Association UK: <https://www.local.gov.uk/publications/using-predictive-analytics-local-public-services>
- Mambo, A. (2023, December 23). *Zimbabwe records accidents every 15 minutes*. Retrieved from Sunday Mail: <https://www.sundaymail.co.zw/zim-records-road-accident-every-15-minutes#:~:text=According%20to%20the%20Traffic%20Safety,than%2038%20400%20accidents%20countrywide.>
- Martin Kevin, e. a. (2024). Factors associated with the use of digital technology. *JMIR*.
- Mossie, G. (2019). *Applying data mining with decision tree and rule induction techniques to identify determinant factors of drivers and vehicles in support of reducing and controlling road traffic accidents: the case of Addis Ababa city*. Addis Ababa: Addis Ababa University.
- Mutisi, J. (2024, May 3). *Lets use technology to make our roads safe*. Retrieved from www.newsday.co.zw: <https://www.newsday.co.zw/theindependent/opinion/article/200026429/lets-use-technology-to-make-our-roads-safe>
- Muzondo J, e. a. (2025). Integrating IoT in Public Transport Logistics: A Systematic Review of Fleet Management and Safety in Zimbabwe's Supply Chain. *Dibon Journal of Business*, 219 - 242.

- Narasimhan, G. E. (July 2017). Predictive analytics of road accidents in Oman using machine learning approach. *International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICT)*, 1058 - 1065.
- National Safety Council. (2023). *Using Data and AI to Gain Insights into Your Safety Programme*. NSC.
- OECD. (2016). OECD Factbook 2015-2016. In OECD, *OECD Factbook 2015-2016: Economic, Environmental and Social* (pp. 116 - 117). Paris: OECD Publishing.
- Olavrud, T., & Edwards, J. (2024, January 1). *What is predictive analytics? Transforming data into future insights*. Retrieved from CIO: <https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data-into-future-insights.html>
- Oyetunji M. O., O. F. (2017). Prediction of road traffic accident in Nigeria using naive baye's approach. *Advances in Multidisciplinary & Scientific Research Journal*, 23 - 30.
- Quddus, M. a. (2019). Crash data quality for road safety research: Current state and future directions. *Accid Anal Prev*, 84 - 90.
- Raosoft. (2024, April 17). *Raosoft*. Retrieved from Sample Size Calculator: <http://www.raosoft.com/samplesize.html>
- Rumutsa, B. (2025). Examining the Causes of Road Accidents in Zimbabwe. *Journal of Inclusive cities and Built environment*, 59 - 69.
- Rumutsa, B. N. (2025). Examining the Causes of Road Traffic Accidents in Zimbabwe. *Journal of Inclusive Cities and Built Environment*.
- S Roopa, M. S. (2012). Questionnaire Designing for a Survey. *The Journal of Indian Orthodontic Society*, 273 - 277.
- Sachin Raj Saxena, D. D. (2023). Preventing Road Accidents Using Cloud Computing: A Systematic Review. *International Journal of Research Studies in Computer Science and Engineering (IJRSCSE)* , 16 - 22.
- Selerity. (2021, August 6). *Can data analytics improve road safety?* Retrieved from [www.seleritysas.com](https://www.seleritysas.com/2021/08/06/can-data-analytics-improve-road-safety/): <https://www.seleritysas.com/2021/08/06/can-data-analytics-improve-road-safety/>
- SSATP. (2021). *Road Safety Data in Africa*. Washington: World Bank.
- TSCZ. (2022). Road Safety and Digitalisation. *Crash Data Analysis & Prediction in Zimbabwe: An Application of ARIMA Models* (p. 2). Greece: TSCZ.

- UN Women. (2022). *Gender Analysis in Technical Areas: Digital inclusion*. New York: UN Women.
- UNECA. (2021). *Road Safety Performance Review Zimbabwe*. Geneva: United Nations.
- UNECA. (2022). *Road Safety Performance Review Zimbabwe*. Geneva: United Nations.
- UNSW Sidney. (2020, January 29). *Descriptive, Predictive & Prescriptive Analytics: What are the differences?* Retrieved from UNSW Sydney Online:
<https://studyonline.unsw.edu.au/blog/descriptive-predictive-prescriptive-analytics>
- Vaibhav Kumar, M. L. (July 2018). Predictive analytics: A review of trends and techniques. *International Journal of Computer Applications*. *International Journal of Computer Applications*, 31 - 37.
- Wikipedia. (2024, February 10). *Road Traffic Safety*. Retrieved from Wikipedia:
https://en.wikipedia.org/wiki/Road_traffic_safety
- World Health Organisation. (2009). *Global Status Report on Road Safety: Time for Action*. Geneva: World Health Organisation.
- World Health Organisation. (2018). *Global Status Report on Road Safety*. Geneva: WHO.
- Yannis, G. (2020). TRA 2020. *Identification of Road Safety Risk Factors in Africa* (p. 7). Helsinki: Academia.
- Yetay Berhanu, E. A. (2023). Examining Car Accident Prediction Techniques and Road Traffic Congestion: A Comparative Analysis of Road Safety and Prevention of World Challenges in Low-Income and High-Income Countries. *Journal of Advanced Transportation*.
- ZINARA. (2023). *Transport Statistics Report*. Harare: ZINARA.

APPENDICES

QUESTIONNAIRE



BINDURA UNIVERSITY OF SCIENCE EDUCATION GRADUATE SCHOOL OF BUSINESS (GSB) FACULTY OF COMMERCE

My name is **Mufaro Zhou Student ID: B226843A**, and I am conducting a research on the role of predictive analytics in road safety in Zimbabwe. This study is towards the fulfilment of my Masters in Entrepreneurship and Innovation Degree with Bindura University.

The responses you provide in this interview will assist all road users and policy makers with information to be used towards understanding the role of predictive analytics in road safety. This meeting will take approximately 30 minutes of your time. I would greatly appreciate your cooperation in this research as your experience and your suggestions are very important. The information that you provide in this interview will be kept in confidence and used for research purposes only. Your name will not be taken down, nor will it appear in any report that comes out of this research process. The information you provide will be used for improving road safety only.

It is still within your right to choose not to participate in this interview at this point in time. You can also opt out of this interview at any time without any problems. Please feel free to ask if you have any questions at any time, even before I start.

May you kindly assist by signing below if you consent to participating in this interview.

Interviewee signature: _____

For more details you can contact me on 0772806414 or email mufarozhou@gmail.com

QUESTIONNAIRE ON THE ROLE OF PREDICTIVE ANALYTICS IN ROAD SAFETY

Kindly tick the appropriate box

Section 1: Demographic Information

1.1.1 Gender: Male ☐ Female ☐

1.2 Age:
≤ 20 years ☐
21 – 30 years ☐
31 – 40 years ☐
41 – 50 years ☐
51 – 60 years ☐
Above 60 years ☐

1.3 Occupation: _____

1.4 Education Level:
Primary ☐
Secondary ☐
Certificate ☐
Diploma ☐

Degree ☐
Other ☐

1.5 Do you have a valid drivers Licence:
Yes ☐
No ☐

1.6 Years driving experience: _____

1.7 City of Residence: _____

Section 2: Knowledge and Awareness of Predictive Analytics

2.1 Do you understand the meaning of predictive analytics (The use of historic data to determine future outcomes)?

Yes ☐ No ☐

Please explain with an example: _____

2.2 Have you heard about predictive analytics in the context of road safety?

Yes ☐ No ☐

If you have answered No to the above 2 questions kindly discontinue answering this questionnaire. Thank you very much for your willingness to participate in this survey.

2.3 How would you rate your understanding of predictive analytics?

Limited ☐ Moderate ☐ Extensive ☐

2.4 Have you personally used or experienced predictive analytics in the field of road safety?
Yes ☐ No ☐

Section 3: Perception of Predictive Analytics in Road Safety

3.1 In your opinion, what is the potential of predictive analytics in improving road safety in Zimbabwe?

High ☐ Moderate ☐ Low ☐

3.2 Do you believe that predictive analytics can help identify high-risk areas prone to road accidents in Zimbabwe?

Yes ☐ No ☐

3.3 Can predictive analytics assist in predicting and preventing specific types of accidents?

Yes ☐ No ☐

3.4 Do you think predictive analytics can contribute to reducing the number of road fatalities?

Yes ☐ No ☐

3.5 Are you aware of any specific examples where predictive analytics has been successfully used to enhance road safety?

Yes ☐ No ☐

If yes kindly state the examples: _____

Section 4: Data Collection and Analysis

4.1 Which types of data do you think are important for predictive analytics in road safety?

Historical accident data

Traffic flow data

Weather data

Vehicle data e.g Speed, braking

Driver behaviour e.g lane changes

Other (please specify): _____

☐
☐
☐
☐
☐

4.2 How do you perceive the accuracy and reliability of the data used for predictive analytics in road safety?

High ☐ Moderate ☐ Low ☐

4.3 Do you foresee any challenges or limitations in collecting and analyzing data for predictive analytics in road safety in Zimbabwe?

Yes ☐ No ☐

If yes, please specify: _____

Section 5: Impact and Effectiveness

5.1 In your knowledge, has the use of predictive analytics led to any improvements in road safety in any country that you know?

Yes ☐ No ☐ Not sure ☐

5.2 Have you observed any specific benefits or positive outcomes resulting from the use of predictive analytics in road safety?

Yes ☐ No ☐

If yes, please provide examples: _____

5.3 Do you think predictive analytics help in allocating resources effectively for road safety interventions?

Yes ☐ No ☐

5.4 Do you think predictive analytics can enhance decision-making processes for road safety stakeholders, such as traffic police or transportation authorities?

Yes ☐ No ☐

Section 6: Future Potential and Recommendations

6.1 How do you envision the future of predictive analytics in road safety?

Promising ☐ Limited ☐ Uncertain ☐

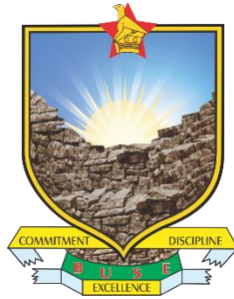
6.2 What are some potential challenges or barriers to the broader adoption of predictive analytics in road safety? _____

6.3 What measures or improvements do you suggest to maximize the effectiveness of predictive analytics in road safety? _____

6.4 Do you have any other comments?

Thank you for participating in this interview!

FOCUS GROUP DISCUSSION GUIDE



BINDURA UNIVERSITY OF SCIENCE EDUCATION

Mufaro Zhou Student ID: B226843A

Focus group discussion questions on role of predictive analytics in road safety in Zimbabwe

1. What are your general perceptions and understanding of predictive analytics? How about in the context of road safety?
2. Have you ever heard of or interacted with any road safety initiatives that incorporate predictive analytics? If yes, please share your experiences.
3. What potential benefits do you think predictive analytics can bring to road safety?
4. Are there any specific areas where you believe predictive analytics could be particularly effective?
5. What concerns or reservations do you have regarding the use of predictive analytics in road safety? Are there any ethical considerations that come to mind?
6. In your experience what are the most common causes for road accidents in Zimbabwe?
7. How do you think predictive analytics can contribute to reducing those road accidents and improving overall road safety outcomes?
8. Do you think Zimbabwe as a country collects adequate information on its roads to implement predictive analytics to improve road safety? In what ways can collection of information be improved?
9. Are there any specific data sources or types of data that you believe should be incorporated into predictive analytics for road safety? Why?
10. Do you think the use of predictive analytics in road safety could lead to any unintended consequences or biases? If so, what measures should be taken to address them?
11. In your opinion, what role should predictive analytics play in decision-making processes related to road safety? Should it be the primary driver or just one of many factors to consider?
12. How would you feel about the collection and use of personal data, such as location information or driving behavior, for the purpose of implementing predictive analytics in road safety? What privacy concerns, if any, do you have?
13. What steps do you think should be taken to ensure transparency and accountability in the development and deployment of predictive analytics models for road safety?

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