

BINDURA UNIVERSITY OF SCIENCE EDUCATION

**ENHANCING ROAD SAFETY THROUGH INTEGRATION OF TECHNOLOGY
AND COMMUNITY ENGAGEMENT IN ZIMBABWE**

BY

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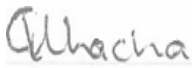
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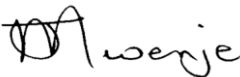
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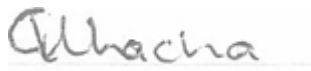
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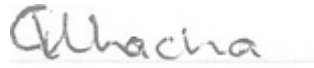
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DECLARATION

I, Gertrude Gamuchirai Whacha Student Reg Number B250514A, 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 full for any other degree to any other university.

STUDENT SIGNATURE

A handwritten signature in black ink, appearing to read 'Whacha', written over a light blue horizontal line.

DATE: 27 June 2026

DEDICATION

This dissertation is dedicated to my mother.

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I am immensely grateful to my mother and sister for their constant encouragement and emotional support during every step of my academic journey. I also want to thank my colleagues and fellow students; their inspiration, guidance, and encouragement were invaluable in making this university experience truly memorable. My deepest thanks go to my research supervisor, Prof J. Mwenje, who generously dedicated her time guiding me and share her expertise. May God bless you all abundantly.

ABSTRACT

The purpose of this study was to develop a model that enhance road safety through integration of technology and community engagement in Zimbabwe. The study was triggered by the realisation that Chitungwiza, one of the busiest commuter corridors, the Seke Road, has become emblematic of deterioration, with potholes, congestion, and inadequate lighting contributing to frequent accidents there by losing hundreds of lives in the road and also leading to thousands of injuries. Precisely, the study sought to identify the principal contributors to road safety challenges in Chitungwiza districts and to evaluate the acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies. The research also aimed to determine the social, institutional, and economic barriers that affect sustained community engagement in road safety initiatives. The fourth goal of the study was to co-design an integrated road safety model with stakeholders, producing a model ready for institutional adoption and scaling and lastly to develop a sustainability and financing plan that supports model durability for 10–20 years. The major theory underpinning the study entail the Safe System Approach which originated from Sweden's Vision Zero policy (1997) and the Dutch Sustainable Safety philosophy. Literature reviewed confirmed contextual and geographical gaps filled by this research. Grounded in a pragmatic philosophical framework, this study employed a mixed-methods concurrent triangulation design, further adopting an abductive research approach. Data were gathered from a diverse sample comprising 180 survey respondents and 15 key qualitative informants, including municipal engineers, ward councillors, law enforcement officers, and representatives from transport associations, and Civil Society Advocates, among others. The study demonstrated that obstacles to road safety in Chitungwiza are primarily attributable to a confluence of infrastructural shortcomings, problematic human conduct, and deficiencies in regulatory enforcement. These entail over speeding, inattentive vehicle operation, substandard road upkeep, poor lighting and widespread occurrence of potholes. The study also revealed that acceptable, usable, and operational effective low- and medium-cost road safety technologies comprise of Speed feedback signs, Geographic Information System (GIS)-based hazard mapping systems and Mobile crash reporting applications. The study showed that the social, institutional, and economic barriers that affect sustained community engagement in road safety initiatives comprise of lack of awareness, lack of trust in authorities, limited access to information or technology and time constraints. The research also revealed that the comprehensive road safety model, specifically devised for Chitungwiza, established a unified framework that seamlessly integrates public involvement, robust institutional backing, enhancements to infrastructure, and technological advancements alongside educational programs into a cohesive and mutually beneficial system. The final result of the research showed that the strategic plan for sustainability and financing in Chitungwiza is fundamentally built upon four interconnected pillars that comprise of diversified financial streams, robust mechanisms for generating income such as traffic penalties, strategic capacity building and comprehensive training and rigorous monitoring and evaluation protocols. The study concluded that the predominant challenges to road safety within Chitungwiza are primarily attributable to deeply ingrained human factors. Another conclusion was also made that Speed feedback indicators and Geographic Information System (GIS) based hazard mapping platforms are effective low- and medium-cost road safety technologies. A further conclusion was reached that enduring community participation is significantly hampered by insufficient public trust in governing bodies, inadequate public understanding and restricted access to pertinent information. A recommendation was made to Government authorities to implement more rigorous speed regulations through heightened patrols, automated detection systems, and consistent penalty application.

Keywords: Model, Road safety, Community engagement; Geographic Information System (GIS); Civil Society Advocates; Chitungwiza; Government

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List Of Abbreviations and Synonyms

ANPR :Automatic Number Plate Recognition

ARSO: African Organisation for Standardisation

GIS : Geographic Information Systems

IoT : Internet of Things

IRAP :International Road Assessment Programme

NGOs : Non-Governmental Organizations

OECD : Organisation for Economic Co-operation and Development

SADC : Southern African Development Community

SPSS : Statistical Package for the Social Sciences

SSATP :Sub Sahara Africa Transport Policy Program

TSCZ : Traffic Safety Council of Zimbabwe

UITP : Union Training and Innovation Program

WHO : World Health Organization

CHAPTER ONE: INTRODUCTION

1.0 Introduction

Road safety has remained a critical concern in the world, with road traffic crashes and deaths being one of the leading causes of death worldwide, particularly in younger age groups. The United Nations' Decade of Action for Road Safety 2021-2030 aims to halve these numbers by 2030, highlighting the importance of technological incorporation and the active participation of public as key strategies (WHO, 2017; DEKRA Roadsafety, 2025). Artificial Intelligence (AI), Internet of Things (IoT), and advanced data analytics are garnering global attention for their ability to improve traffic efficiency, structural safety, and compliance with regulations (Intertraffic, 2025). France, Belgium and the United States are following suit in implementing proactive solutions that leverage AI technology and intelligent transportation solutions to improve road safety (Intertraffic, 2025).

In contrast the African continent faces a particularly critical road safety challenge, despite its relatively low motorization rate, with the continent suffering the highest incidence rates for road traffic deaths globally (UITP, 2023). These consequences affect vulnerable road users, such as pedestrians, cyclists and motorcyclists, more than others (UITP, 2023; SSATP, 2025). This is a serious problem that requires a holistic and multi-faceted approach, including the TRANS-SAFE project that brings together European and African cities and road safety stakeholders to pilot integrated 'Safe System' solutions (UITP, 2023). The African Union's Road Safety Action Plan 2021-2030 aligns with the goals set for the world, with the five key pillars of the plan being road safety governance, improved infrastructure, vehicle security, responsible road users and effective response after a crash (SSATP, 2025). Road safety policy packages are being implemented in several countries, including Ethiopia, Ghana and Uganda, with a mix of policy changes, infrastructure redesign and enhanced enforcement, often with philanthropic support from organisations such as Bloomberg Philanthropies (Atalay et al., 2025). Importing effective road safety interventions from other regions of the world, suitably

modified to suit local needs, is considered a potential source of good practice in Africa (Bullard et al., 2023).

Road safety remains a very serious problem in SADC region and has not met the international standards. Injuries and fatalities caused by road accidents negatively affect regional integration and economic development, with thousands of deaths reported every year (Randall, Matusevich & Goldstein, 2025). The SADC Alliance of NGOs for Road Safety aims to coordinate regional initiatives and promote improved safety measures (Randall et al., 2025). Consistent work is currently being done to harmonise road policies and technical specifications in the member countries, including Zimbabwe, to improve the security of the SADC road network (Randall et al., 2025).

In Zimbabwe, the country is tackling the challenges of road safety, with the number of road traffic accidents rising with increasing traffic densities, especially in the urban conurbations (Ministry of local government, 2025). The national administration is accelerating the piloting of a locally developed Smart Traffic Management System based on the use of Artificial Intelligence, IoT devices and extensive data analysis to optimize traffic flow and improve safety (Ministry of road and infrastructural development, 2024). It is a sophisticated system, which includes AI-based surveillance devices with automated number plate recognition (ANPR) and facial recognition system, linked to national databases for real-time identification of regulatory violations (ibid). In addition, Traffic Safety Council of Zimbabwe (TSCZ) is researching on how AI can be used in the monitoring of vehicles as an additional tool to improve the effectiveness of enforcement (TSCZ, 2025). However, great challenges remain for Zimbabwe to meet its SDG targets in road safety, given that road traffic collisions and fatalities have been on the rise since 2021 (Ministry of road transport and infrastructural development, 2023). Community involvement is also recognised as a key ingredient to success, for example, through the use of road safety audits training, which involves local communities in enhancing project success rates (IRAP, 2025).

Chitungwiza is one district where technology and community participation in road safety are developing as a new focus. Academic research in particular that directly addresses the technological integration for road safety in Chitungwiza specifically in the time horizon 2020-2025 may be scarce but the general national programmes provide a relevant context. The Traffic Safety Council of Zimbabwe (TSCZ) has held road safety awareness creation workshops in Chitungwiza where community stakeholders and government officials have participated in discussions on the topics of overloading passengers in passenger vehicles, as well as safe driving practices (Traffic Safety Council, 2025). They are essential and when integrated with the deployment of Intelligent Traffic Management software at a nationwide scale have the potential to establish a stronger road safety structure for the municipality. Additionally, the continuing upgrade and extension of Chitungwiza Road are expected to further enhance road safety in Chitungwiza, by reducing traffic jams (Traffic Safety Council, 2025). The long term success of these schemes in Chitungwiza will depend greatly on the effective introduction of technological solutions to local demands and on the active and ongoing participation of the local population.

1.2 Research Problem

The issues facing road safety in Zimbabwe, especially in Chitungwiza, is not a figment of imagination, but has been documented many times in government reports and through tragic accidents (Ministry of local government, 2025). The road network has long been characterized by low road quality with more than 90% of the roads being previously rated poor or fair (Traffic Safety Council 2025); this figure will be eliminated by implementing these road safety measures. These measures for road safety will eliminate this figure, as the country's road network is estimated to be around 90,000 km with poor quality roads accounting for more than 90% of the road network previously. The Seke Road is one of the most heavily trafficked commuter roads in the Municipality with frequent accidents reported due to pothole issues, traffic congestion, and poor lighting (Chitungwiza Municipality, 2025). Enforcement gaps add to these infrastructural shortcomings. Road safety campaigns are typically a seasonal affair, with more background effort focused on festive periods, during which periods, reckless driving, speeding and drunk driving may be unchecked for extended periods (Traffic Safety Council, 2024). This makes it harder to trust and effective to enforce measures, perpetuating dangerous driving habits. The lack of visibility, signs is also a problem. Lack of proper lighting of the roads and inconsistent or poorly maintained signage makes it difficult to navigate the roads,

particularly during the night in Chitungwiza municipality (2025). Consequently, the community bears the brunt of recurring accidents and infrastructural neglect. This study addresses the problem by developing an integrated, measurable, and sustainable road safety model that combines technology, community engagement, and institutional reforms. The model is designed specifically to ensure permanence through capacity building, system ownership, and low recurrent-cost mechanisms.

1.3 Purpose of the study

The purpose of the study is to develop a model that enhance road safety through integration of technology and community engagement in Zimbabwe

1.4 Research Objectives

Main objective

To develop a model that enhance road safety through integration of technology and community engagement in Zimbabwe.

Sub objectives

- i. To identify the principal contributors to road safety challenges in Chitungwiza districts.
- ii. To evaluate the acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies
- iii. To determine the social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives.
- iv. To co-design an integrated road safety model with stakeholders, producing a model ready for institutional adoption and scaling.
- v. To develop a sustainability and financing plan that supports model durability for 10–20 years.

1.5 Research Questions

Main research question

How can an integrated model that combines technology and community engagement enhance road safety in Zimbabwe, with specific application to Chitungwiza?

Sub research questions

- i. What are the main factors contributing to road safety challenges in Chitungwiza districts?
- ii. How acceptable, usable, and operationally effective are selected low- and medium-cost road safety technologies in addressing challenges in Chitungwiza?
- iii. What social, institutional, and economic facilitators and barriers influence sustained community engagement in road safety initiatives in Chitungwiza?
- iv. How can stakeholders in Chitungwiza collaboratively co-design an integrated road safety model that is ready for institutional adoption and scaling?
- v. What sustainability and financing strategies can support the durability of an integrated road safety model in Chitungwiza for 10–20 years?

1.6 Assumptions of the study

It is assumed that residents of Chitungwiza will engage in road safety awareness creation activities and be open to sharing their experiences.

It is assumed that the local authority, police and transport operators will work together and make available relevant data and support for co-designing the model.

The assumption is that the data obtained from the survey and interviews conducted shall be accurate, valid and represent actual road safety condition in Chitungwiza.

It is assumed that all the targeted respondents are able to answer correctly the research questions which are assumed to be literate enough.

1.7 Significance of the study

This research recognises that transport safety is not only a technical problem but a socio-economic problem and connects the improvements in transport safety with other economic

development objectives. The enhanced safety of the roads can help decrease vehicle downtime, reduce transport costs, and boost productivity which can have a positive impact on Zimbabwe's economic resilience and align with Education 5.0's focus on technological innovations and community and economic development. Recent scholars like Rogers, (2003) and Levy et al. (2020) emphasize that co-design and diffusion theories are necessary for diffusion of sustainable technologies in LMICs. Their frameworks serve as the foundation for the participatory approach of this study and help to ensure that interventions are socially anchored and institutionally supported in the long-term.

1.8 Delimitations of the study

This study focused on urban Chitungwiza, located in Mashonaland East Province, Zimbabwe. Chitungwiza was selected due to its representative road safety challenges, including high pedestrian and vehicular traffic, frequent accidents, and active stakeholder participation. The city's diverse socio-economic and infrastructural landscape makes it an ideal case for exploring scalable solutions. The primary focus of the study entail Mobile Crash Reporting Systems, Speed Feedback Signs, GIS-Based Hazard Mapping, Safety Committees and Awareness Campaigns among other theoretical issues. The study focussed on the period 2020 to 2026, as severe accidents were experienced during that period. Methodologically, the study employed both qualitative and quantitative research methods in order to effectively address the research problem.

1.9 Limitations of the study

There are three limitations of the study, as stated below.

Data reliability issues

Self-reports of survey and interviews can be biased. The researcher made use of triangulation in both qualitative and quantitative approach to establish validity of findings.

Stakeholder resistance

There was some resistance to new technologies or engagement processes from some institutions or members of the community. Trust was built by engaging in participative co-design, and ongoing communication with stakeholders.

Political sensitivity

Political issues related to governance and enforcement of road safety are sensitive. Confidentiality, ethical safeguards and clear communication were used to ensure that participants were protected and credibility was maintained.

1.10 Definition of key terms

Road safety

Road safety is a general term that refers to the programs, policies and procedures implemented to reduce incidences of crashes, injuries and fatalities on our roadways. This encompasses establishing strong infrastructure, promoting safe driving and walking behavior by motorists and pedestrians, and enforcing traffic regulations.

Integration of technology

Technology integration is the application of current, modern, digital tools/ systems (e.g., mobile reporting systems, interactive speed displays, hazard mapping and geographical systems), to enhance the way that aspects of the activity are observed, collected and enforced. This results in better road safety outcomes in the end!

Community engagement

Community engagement involves involving people from the community, safety organisations and other stakeholders in developing, implementing and sustaining work to improve the safety of the road network. This way, it helps to foster the feeling of responsibility in the local community, boosts confidence and ensures that solutions are suitable for the culture, thus guaranteeing that these changes are accepted and can be sustained for the long-term.

1.11 Dissertation outline

This dissertation will be comprised of five chapters. The first chapter will provide a comprehensive overview, outlining the main research question, the study's purpose, and highlighting the need for technological advancements and community involvement in improving road safety. This will be followed by a detailed literature review that will examine the history of the views on road safety improvements and civic participation at various spatial scales. The methodology section that follows will thoroughly explain the investigative design,

data collection methods, and data analysis tools used to analyze the incorporation of intelligent traffic systems in grassroots campaigns. The chapter on empirical findings will then present the results, drawing attention to the success of technological interventions, as well as the dynamics of community participation. These findings will be discussed in the context of current scholarship and relevant policy frameworks in a critical manner. Finally, the conclusions and the main lessons learned will be summarized, and recommendations will be provided for policy makers and municipalities, as well as directions for further research.

CHAPTER TWO: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

The prior chapter has introduced the study on frameworks that enhance road safety through integration of technology and community engagement from a global context to the local context. This chapter presents the theoretical framework and literature review guided by the study objectives. It will commence by presenting the major theory guiding the study. This will be followed by detailed review of empirical and theoretical literature on each study objective. The next section will then cover a summary of knowledge gaps filled by this study. The chapter will conclude by presenting a concise chapter summary.

2.2 Theoretical framework

The study is based on the Safe System Approach. The Safe System Approach is based on the Vision Zero policy (1997) in Sweden and the Sustainable Safety approach in the Netherlands. The two approaches both challenged the inevitability of road death. These basic philosophies were then incorporated into the overall Safe System in the early 2000s. The international recognition and acceptance of its use has been greatly advanced by its use by countries that are committed to ending severe road-related trauma (Corben, Peiris & Mishra, 2022). The theoretical construct has been developed and disseminated by a number of key academics, including Bruce Corben, and also a number of prestigious organisations including International Transport Forum.

This theory is based on humans' inherent fallibility and tendency to make mistakes. (Babalola, Olorunnimbe & Salaam, 2025). This implies that the road network should be designed in a way that these errors do not result in serious damage and fatalities. One of the important issues is proper control of kinetic energy, such that forces that can be applied in a collision are within the limits of the human body's physiological tolerance (Alavi, Jones, & Hunter, 2023).

The Safe System foundational assumptions and guiding principles are based on a concept of a collective responsibility shared between road users, policy makers and infrastructure designers (Bjornberg et al, 2022). The basic elements of its include supported infrastructure, safeguarding

vehicles, speed control, responsible riding behavior and effective post-crash healthcare. One of the key underpinning principles is that safety should be built into the design of the system and not just relied on by individuals to comply with regulations. The principles highlight the unacceptable level of deaths and serious injuries, stress the need to assume that humans will make mistakes, and state that a system must be inherently forgiving (Elvik & Nævestad, 2023).

The advantages of the Safe System Approach are its holistic design, ethical foundations and widespread adaptability in different operational contexts (European Commission, 2022). This structure shifts responsibility from person to person to the institutional level, increasing responsibility, and improving the robustness of the system. On the other hand, its restrictions include significant implementation challenges, especially in resource-scarce settings where the capacity to develop infrastructure and enforce regulations is limited (International Transport Forum, 2022). Its practical implementation in practice has often been slow, and critics argue that it can seem overly idealistic in contexts with deep-rooted institutional weaknesses (Job, 2017). For the scope of the current research, the pertinence of the Safe System Approach is substantial. Zimbabwe's implementation of the Smart Traffic Management System and its grassroots awareness initiatives, exemplified in localities such as Chitungwiza, directly mirror the principles of the Safe System. Specifically, technological advancements contribute to more secure road networks and vehicles, whilst communal involvement reinforces prudent conduct and collective accountability. This framework furnishes a conceptual instrument through which to assess how the synergy of technological innovation and community-level participation can collectively mitigate mortality rates. Furthermore, it presents a strategic trajectory for the amplification of interventions, transitioning from localized settings such as Chitungwiza to comprehensive national policy. This ensures Zimbabwe's congruence with international leading practices, concurrently addressing its distinct national exigencies.

2.3 Literature review

2.3.1 The principal contributors to road safety challenges.

Human factors

Human factors have long been identified as being the major causes of roadway safety problems, accounting for the bulk of roadway crashes worldwide (Bucsuházy, Matuchová, Zůvala, Moravcová & Mikulec, 2020). The studies that include Adedeji et al (2024) suggest

that about 90-95% of worldwide traffic collisions are human caused. This general category applies to different activities, cognitive functions and mental conditions in all users of roads (drivers, pedestrians and cyclists). In this context one pivotal aspect is the behavior of motorists. Excessive speed is a major reason for deadly collisions, significantly raising the likelihood of severe consequences (Tinella, Fondzenyuy, Turner, Burlacu & Jurewicz, 2024). Another significant factor is driving under the influence of alcohol or drugs; people under the influence are significantly more likely to be involved in fatal accidents (Dotse, Nicolson & Rowe, 2019). Inattentive driving, particularly using mobile phones, is also known as a significant contributor to road death in developed and developing countries (ibid). The other risky behaviors include unsafe driving, unsafe equipment use, including not wearing seat belts and helmets, operating a vehicle while fatigued, and violating road laws, such as ignoring traffic signs and signal lights or passing too near (WHO, 2023). Research projects involving Almatar (2024) also suggest that driver psychology (impulsivity, excessive self-confidence and lack of awareness of hazards) can also contribute to risk-taking, regardless of the design of the road. In addition, social and cultural factors such as personality traits, common driving behaviors, and community norms affect driving behavior, with the use of the roads reflecting broader social norms (Adejumo et al., 2023). Apart from driving, unprotected road users such as pedestrians and cyclists are also responsible for causing road safety problems in their behavior (ibid). Research by European Commission. Common risky behaviors among these groups are reckless road crossing, lack of a marked pedestrian area, walking on a road where a footpath exists, and ignoring traffic signals (2022). There is also complexity added to population-based and economic aspects. The data shows that men, younger drivers and people with limited formal education are at greater risk from a road incident (WHO, 2023). In developing countries, rising levels of vehicles, urbanisation and economic development have resulted in increasing incidences as a result of an increase in exposure and a lack of infrastructure (World Bank, 2021). In sum, research clearly shows that human factors (actions, attitudes, and social factors) are the most significant contributors to roadway safety problems. This calls for strategies to combine technology advancements and public participation to mitigate their impacts.

Infrastructure related issues

Problems with infrastructure are frequently emphasized as major factors contributing to road safety challenges. This is particularly true in developing nations, where flaws in road planning, building, and upkeep significantly increase the risk of accidents (Salaudeen, Adeniji &

Adebayo, 2019). Experts that entail Hagos, Tesfay and Berhane (2023) suggested that although human error is responsible for most collisions, the state and features of road infrastructure play a crucial part in either lessening or increasing these dangers. Certain road elements, such as major roadways, fast-moving thoroughfares, uncontrolled junctions, and undivided two-way roads, have been shown to markedly raise the likelihood of accidents (Hagos et al., 2023). Additionally, poor road conditions, including holes, insufficient lighting, and slick surfaces, also make accidents more severe (Lucas et al., 2024). Studies that include Bullard, Jones, Adanu, and Liu (2023) in Namibia point out that worn-out road surfaces and hazardous layouts like sharp bends and badly planned intersections are especially perilous. Insufficient traffic management features, such as absent speed limit signs, faulty traffic lights, or indistinct lane markings, endanger safety by making driving less predictable and increasing the chance of crashes (Babalola, Olorunnimbe, & Salaam, 2025).

Maintaining and overseeing road infrastructure are just as vital. A lack of consistent and effective road upkeep is a significant problem in developing countries (OECD, 2021). Limited budget and poor organizational capacity results in poor maintenance of roads and poor structures here, increasing the risk of accidents (Getachew, Tadesse & Gebremariam, 2024). Poor maintenance causes deterioration of the roadway as well as erodes public trust in the transportation system (Getachew, Tadesse & Gebremariam, 2024). Furthermore, the weak financing, political interference, and corruption in the management of roads constrain the quality and safety of the roads as indicated in (Tzortzi, Papadimitriou & Yannis, 2021). The problems in governance create system weaknesses that allow dangerous conditions to exist. At the same time, incorporating sophisticated technologies into the traffic management system adds new challenges. Although intelligent traffic systems and AI-driven oversight improve regulation and effectiveness, experts caution that these new technologies can create new safety issues if not properly planned for and adjusted (Brenda & Rumutsa., 2025). This may refer to over-reliance on automated tools, or digital monitoring processes that are not equally accessible (Chibaro, Moyo & Ndlovu, 2024). So, infrastructure issues are not just physical, they're organizational and technological too; comprehensive strategies are needed that combine design, management and new ideas.

Vehicle-related factors

While human factors and road design are often cited as major concerns, vehicle condition is also an important contributor to current problems with road safety (Colagrande, 2022). According to Dairo (2023), the proper maintenance and type of vehicles directly influence the occurrence of accidents, particularly in developing countries where the rules and maintenance standards are underdeveloped. Poorly maintained vehicles like vehicles with worn tires, poor brakes or inadequate lighting are a major risk on the road. These risks are magnified in many developing regions, where older vehicles are more common and possess fewer advanced safety features, so that drivers and passengers are at greater risk of vehicle breakdowns and crashes (Makgata, 2022). The type of car or truck you are driving also plays a major role in the severity of an accident. The results of the studies which include the one of Oladoja, Ogunbiyi and Adeyemi (2023) in Nigeria show that the car and the motorcycle are commonly involved in collision accidents and motorbikes and passenger minibuses are especially at risk due to their increased vulnerability and agility and their speed. Vehicle weight and speed also have a significant influence on injury severity and fatality risk in a crash: heavier vehicles and faster speeds result in more severe crashes, leading to an increased risk of injury and death (Rudin-Brown & Filtness, 2023). One additional layer of complexity added to this issue is technology. New systems such as advanced braking, lane departure warnings, and AI traffic management are expected to help make roads safer, but they also come with their own set of challenges (Al Aamri et al., 2025). These traffic management systems must be extremely safe themselves, because technical problems or poor implementation of the system in local conditions drastically affect their usefulness (Abounoas et al., 2020). Moreover, overreliance on high-tech vehicle safety systems can sometimes lead to unintended driver behavior (Arslan & Ozkan, 2024), such as increased risk engaging in unsafe activities due to feeling more protected by the technology.

Institutional and policy gaps

Road safety is exacerbated by institutional weaknesses. The Africa Status Report (2025) shows that many African countries have road safety agencies that are not adequately resourced, with the governance and coordination of the agencies being limited. In the SADC region, benchmarking studies reveal that there is generally a lack of capacity and budget for enforcing the frameworks (Brenda & Rumutsa., 2025). Lack of policy to address public transport, vehicle

import standards, and post-crash care, further compromises safety outcomes (Brenda & Rumutsa., 2025).

2.3.2 The acceptability, usability, and operational effectiveness of low- and medium-cost road safety technologies

The affordable road safety solutions have significant promise to improve road safety, particularly in developing countries where resources are often constrained. The level of acceptance, ease of use and effectiveness of these technologies is critical to their successful implementation and impact.

Acceptability

The adoption of these road safety tools is influenced by a range of factors such as local habits, community perceptions and expectations and the perceived benefits and costs. In many African countries, with the specific problem of road safety, there is growing awareness of the potential of technology. For instance, smart traffic systems equipped with sensors and cameras are being studied to monitor and identify hazardous areas, as are intelligent infrastructure and data-driven strategies (Alanazi, 2023). Mobile phones are also used to conduct public information campaigns, disseminating important road safety information to the general public (Ahangar, Sadeghi & Rahimi, 2021). Yet, a number of issues, such as unreliable internet access and power supply in some regions can stand in the way of these innovations. Furthermore, affluence is key to acceptance by the public, and projects involving the local community in the design and execution process are more likely to be embraced. Traffic calming measures, for example, tend to be well-received if they are perceived as enhancing local safety and quality of life, particularly when they are implemented at little or no cost, and are led by members of the community (Mehra, Singh & Kumar, 2021).

Usability

Ease of use is very significant for road safety technologies, particularly with regard to a variety of users and varying comfort levels with technology. These tools need to be easy to use and simple to use by the person installing them as well as the person using them on a daily basis. In the context of developing countries, where human resources in the field of complex tech

systems may be limited, simpler, more user-friendly options may be more suitable (Yao, Chen & Wang, 2023). Enhancing visibility and protection of vulnerable road users (VRUs), including by protecting pedestrians and cyclists, by improving street lighting or implementing pedestrian activated warning signals, must be easily understood and implemented (Makgata, 2022). Although mobile applications have great potential for collecting data and implementing awareness campaigns, they need to be designed in a way that will make them easy to use for all audience groups, considering the varying rates of smartphone ownership and technological familiarity among different groups (Bullard et al., 2023). The solution to something such as Vehicle-to-Vulnerable Road User communication is dependent on the smooth integration of the system into the existing mobile gadgets that are obtainable to many people (Bullard et al., 2023).

Operational effectiveness

The practical effectiveness of affordable road safety tools is shown by their capacity to bring about noticeable enhancements in safety results, such as fewer accidents, lower speeds, and a decrease in deaths. Traffic calming methods, for instance, have achieved considerable success. Rumble strips, installed on main roads in Ghana, led to a drop in collisions by roughly 35% and deaths by around 55% (OECD, 2022). Speed bumps and elevated crossings have been proven to lower the speed of 85% of vehicles considerably in different nations, including Tanzania (ibid). Entry treatments have also proven effective in lowering travel speeds and deadly and severe collisions (WHO, 2023). Road markings, an especially inexpensive measure, can decrease overall accidents by up to 15% and serious incidents by 19% (Brenda & Rumutsa, 2025).

From Africa, the use of intelligent infrastructure and data-driven solutions is seen as essential to improving road safety, and intelligent traffic management and communication systems, which can alert drivers to potential hazards and issue warnings in real time, can play a crucial role (Roopa, Patel & Khan, 2021). Advanced driver-assistance systems employed in less expensive vehicles can also prevent crashes or reduce their severity. Mobile applications and public information efforts are good at encouraging safer driving practices (Titus, 2024). However, lack of infrastructure and trained workforce may affect the effectiveness of these technologies (Vankov, 2021). In summary, technology has tremendous potential to contribute

to the development of safer transport networks across the continent, particularly when complemented by local involvement and appropriate regulations.

2.3.3 The social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives.

Social, organizational and financial factors contribute to the lasting involvement of the community in road safety in the African region. Research has shown that these can be both positive and negative in terms of maintaining regular involvement over time. Social factors often are the main source of community involvement. In countries such as South Africa and Malawi, community-led campaigns around schools, religious groups and local associations have been effective in creating a sense of confidence among communities and a sense of ownership of the initiatives. This has prompted residents to be actively involved in road safety programs (Randall, 2025). But some social factors obstruct this involvement, including risk attitudes, a "risky" culture in society, and poor traffic rule knowledge. In Zambia for example, drivers and pedestrians who are aware of the danger of accidents in the event of certain behaviors have been observed to think that these are normal habits and therefore, not engage in them (Mitullah, Wambugu & Omondi, 2022). Thus, strategies such as public education, peer influence and community-level awareness drives are crucial to shifting mindsets and encouraging ongoing participation.

Community involvement is also shaped by organizational influences. There is a need for strong leadership, a clear policy and good co-operation between all parties for successful involvement. In Botswana, for instance, the setting up of a well-funded primary road safety body has enabled organized partnerships with the communities to increase their regular involvement in road safety (ARSO, 2021). On the other hand, when there are problems in the institution, for example, disjointed management, non-observance of traffic law and dishonesty, people lose trust in the institution which makes them hesitate to participate in the activities. Another challenge in Tanzania was identified as inconsistent implementation of roads and traffic laws, which affect public trust in the programs from government (WHO, 2021). Commitment can be strengthened by using clear and open enforcement procedures, adequate allocation of resources to road safety organizations and involving community in policy decision making.

Another factor affecting the duration of community involvement is financial considerations. Positive factors: affordable interventions and encouragement such as discounted safety equipment and local micro financing schemes to support transportation groups. The use of affordable technologies such as speed bumps, reflective road signs, solar-powered traffic signals, and other measures is particularly beneficial in countries like Mozambique and Malawi. They are affordable and offer evident safety benefits (International Transport Forum, 2023).

But when families have to choose between food, clothing and fuel and other basic needs, and protecting their roads, financial constraints like poverty, unemployment and low incomes limit communities' ability to invest in road safety. In some countries, like Lesotho, the disadvantages of following guidelines have been observed to outweigh the economic costs, especially when economies are facing challenges (African Development Bank, 2024). Financial support is essential if communities are to continue their involvement over time, and monetary constraints restrict their participation.

Studies show that in the SADC region, factors affecting social, organisational and financial growth are interlinked and affect both positively and negatively. For sustainable community involvement in road safety, activities need to be culturally appropriate, have strong institutional support, and have economic plans which make it possible and attractive to achieve safety. In South Africa, Malawi, Botswana, and Tanzania, and a variety of other countries, the various components can be addressed together, and road safety programs have demonstrated that it is possible to achieve lasting community support and to offer valuable lessons for the region.

2.3.4 An integrated road safety model with stakeholders, ready for institutional adoption and scaling.

Many different groups are involved with road safety in Africa, and there is a need for a collaborative approach that would be appropriate to implementation and wider use within Africa. Disconnected approaches have proven to be obstacles and organized systems connecting public agencies, non-profit organizations, businesses and the local community are believed to be needed to make a long-term impact in reducing road-related fatalities. For example, in South Africa multiple stakeholders have formed a partnership to implement the

Safe System Approach including the Department of Transport, city councils, law enforcement and non-governmental organizations. They all have a distinct role to play in the maintenance of rules, teaching and infrastructure development (World Health Organization, 2023). The idea of this combined approach is to emphasize shared responsibility, with no single organisation being responsible for all road safety, but rather responsibility being distributed throughout the framework.

The need for organizational readiness to scale up such models is also highlighted in research. For instance, in Botswana, the creation of a one-stop road safety body has facilitated the collaboration of various government departments, police, and community organizations, and created a way to roll out activities across the country (African Development Bank, 2024). The effectiveness of this model is its capacity to connect high-level policies at the national or regional level with local action at the community level, ensuring that country-wide plans are supported by community action. Similarly, in Malawi, combined models have been piloted, with public information campaigns and collaboration between the government and global funders focusing on cost-effective interventions such as speed bumps and reflective signage, with the involvement of local people. The projects illustrate that flexible models, taking in available resources and with community participation, work best for official implementation (International Transport Forum, 2023).

Financial factors are also important to the extent to which integrated models are implemented. Reading the literature from Tanzania shows that with a large traffic budget, sophisticated traffic surveillance can be effective; however, in lower budget environments it may not be feasible. Rather, a multi-faceted approach has been more successful that prioritizes low- and medium-cost technologies, while involving the public in participation and supervision. The African Development Bank (2024) notes that the wider spread of models is facilitated by their ability to include cost-effective processes that can be deployed and replicated in various contexts without the need for significant capital expenditure. In addition, the importance of donor support and partnering with private sector organizations has been recognized as key enablers, providing financial and technical resources to enhance the organizational capacity.

To conclude, research has shown that joint solutions to road safety issues in Africa must be multi-faceted that combine new technologies, partnerships among organizations and the involvement of the public. They are effective due to clear responsibilities of all parties, cost effectiveness and adaptation to local conditions. Countries such as South Africa, Botswana,

Malawi and Tanzania demonstrate how successful it has been to be proactive and embrace these models, and how it has positively affected road safety. The examples demonstrate that collaborative structures are not only good in theory, but they are also effective on the ground, too, and can serve as a model for the rest of the continent.

2.3.5 Sustainability and financing strategies that supports model durability.

The ability of comprehensive road safety programmes to be successful over time is increasingly recognised to depend on the effectiveness of sustainable and funding strategies, especially in resource-poor regions such as Africa. Experts emphasize that sustainability isn't about maintaining a program; it's about the efficiency, flexibility and financial commitment of ongoing programs. In Kenya, for instance, road safety initiatives are sustained based on a combination of government funding, foreign assistance, and private industry partnerships. This has created a diverse funding base reducing reliance on a single source, such as OECD (2023). This is also reflected in the implementation of projects in Ghana, where public-private partnerships have been adopted to fund low-cost solutions such as speed bumps, reflective signs, and solar traffic lights, which can still operate despite fluctuations in public funding (African Development Bank, 2024).

The importance of the existing architectures in supporting funding strategies is also emphasized in these writings. The Road Accident Fund in South Africa, for example, is considered to be an example of formalised funding. It facilitates a particular mechanism to assist those impacted by accidents and, at the same time, assists in preventing them (International Transport Forum, 2023). The formalized financial resources produce consistency and reliability and allow for long-range plans instead of the back-and-forth decision making process. However, the funding process can be undermined by corruption, leadership issues, and interference from the government. This is seen in a number of Sub-Saharan countries where road safety budgets are either misallocated or underutilised (African Development Bank, 2024). Thus, sustainability requires not only financial tools, but also a clear system of supervision and responsibility regarding the effective use of the funds.

The long-term success of a program is also greatly impacted by economic approaches. Research in Ethiopia and Nigeria shows that integrating road safety into broader development strategies, such as urban planning, transport improvements, and climate action, increases synergy and enhances sustainability outcomes over time. By integrating road safety into large-

scale construction projects, funding for road safety is integrated into overall economic investments rather than treated as a stand-alone cost, which increases the likelihood of continued support for road safety (World Health Organization, 2023). Other countries, such as Sweden and Australia, have successfully implemented funding methods that are tied to measurable outcomes, and allocate resources based on reductions in injury and death. This approach of funding is based on performance and ensures accountability and continuous improvement.

Funding strategies at the community level are highlighted as key contributors to sustained achievement in the submissions. For instance, in Malawi and Mozambique, small-scale loan schemes have been for local groups to purchase safety equipment, such as helmets and reflective vests, demonstrating that local funds can be used to support formal schemes (African Development Bank, 2024). These local approaches not only provide resources but also foster local buy-in and this is essential for their sustainability. But the economic deterrents, such as being poor or unemployed, are also significant, limiting local communities' participation in safety programs. However, external support from benefactors and public agencies needs to be complemented by the local contributions for long-term sustainability and maximum participation, experts have suggested.

Overall, the literature reviewed supports the need for a multi-faceted body of research in the areas of lasting success and funding approaches for road safety programs. This means integrating formal financial systems, different financing sources, linking into broader development plans and community contributions. Experience in countries in Africa and beyond demonstrates that there is a need for funding approaches to be clearly defined, diverse, and linked to measurable outcomes for long-term success. The integrated approach will have a lasting effect, is flexible and has room for expansion, and provides a model for long-term implementation in different contexts.

2.4 Knowledge gaps summary

Although there are some existing studies that have illustrated the potential of community engagement and low-cost technological solutions, there is a lack of integrated models which systematically integrate the two in the Zimbabwean socio-economic context. Furthermore, there is limited research on the institutionalization of the interventions to scale up and sustain them in the long-term, as have been argued by Mansuri and Rao (2013) and Kobus et al. (2022).

Although there has been an increasing body of research on road safety in Africa and elsewhere in the world, there are several gaps in the knowledge that warrant the initiative of the study "Enhancing Road Safety through Integration of Technology and Community Engagement in Zimbabwe" to address. Previous studies have largely emphasized the key role of human factors, infrastructural inadequacies, vehicle-related problems, and institutional issues in the context of road safety issues. There is, however, limited discussion of how these fit together synergically and how the role of emerging technologies, and community-driven approaches fit into a single framework. Research on the effectiveness of cost-effective technological solutions and the necessity for community involvement has been conducted in countries like South Africa, Malawi and Botswana; however, these studies treat these interventions separately and not analyse them as working together. Moreover, there is no systematic study addressing the scalability and sustainability of integrated models in resource-limited settings as found in the literature, despite their pilot implementation in countries such as Kenya and Ghana.

Discussions on financing strategies are generally about donor support and public private partnerships, but little analysis is provided about the role local communities can play in sustainable development. Another area of complexity is the lack of research focus on the cultural and behavioral aspects of technology uptake, especially the role of social norms and risk perceptions in shaping the acceptability and usefulness of road safety innovations. Last, although institutional readiness has been recognized as a crucial factor, it has not received adequate focus on how governance structures can be changed to simultaneously promote technological integration and grassroots participation. The deeply felt need for a research project that can identify the main causes of road safety problems and also develop a holistic model that combines technology development with long term community involvement, particularly reflecting the socio-economic and cultural context of Zimbabwe.

2.5 Conceptual framework

The study conceptual framework shows the independent and dependent variables of the study as demonstrated in figure 2.1 below.

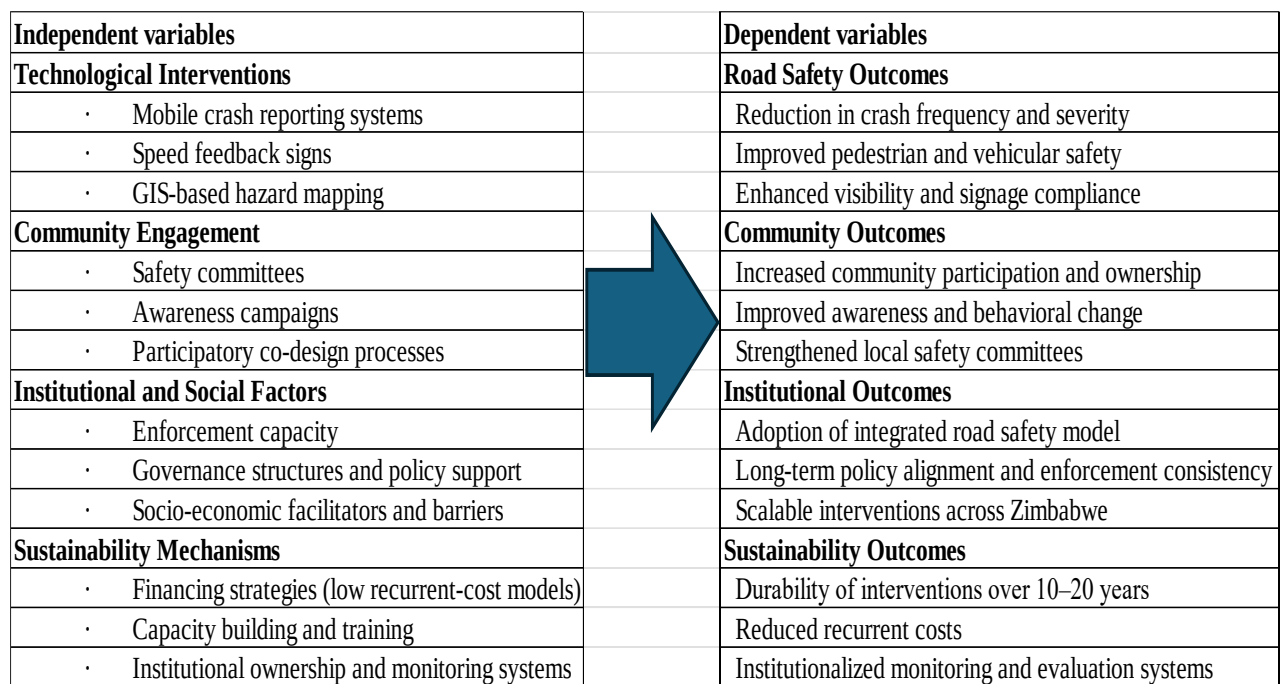


Figure 2.1 Conceptual framework

Source: Author (2026)

Based on figure 2.1 above, the conceptual framework relates four sets of independent variables to the outcomes in a structured and interrelated manner. Technological interventions including mobile crash reporting, speed feedback signs and GIS based hazard mapping have a direct effect on road safety outcomes through the reduction in crash frequency, increased pedestrian and vehicular safety and adherence to signage. Community outcomes such as increased participation, behavior change and increased local ownership of safety initiatives are achieved through community engagement mechanisms such as safety committees, awareness campaigns, and participatory co-design processes. Through enabling the adoption of integrated models, policy alignment, and social-economic conditions supporting scalability across contexts, institutional outcomes are influenced by institutional and social conditions, as well as enforcement capacity, governance structures, and socio-economic conditions. Lastly, sustainability mechanisms like financing mechanisms, capacity development and institutional monitoring systems ensure sustainability in the long-term, minimize the risk of recurrent costs and institutionalize evaluation practices. Combined, these dimensions reflect interactions between technology, community involvement, institutional support and sustainable financial mechanisms that result in a comprehensive, scalable, sustainable road safety model.

2.6 Chapter summary

Chapter two contained an in-depth literature review and theoretical background for the study on road safety improvement via technology and the community. It was founded on the Safe System Approach that originated from the Vision Zero in Sweden and the Sustainable Safety in the Netherlands. The literature review then reviewed the main sources of road safety problems such as human factors, infrastructure problems, vehicle problems and institutional issues, and then analysed acceptability, usability and operational effectiveness of low and medium cost technologies. It also identified social, institutional and economic enablers and inhibitors to sustain community engagement throughout the SADC region and highlighted the need for cultural fit, institutional capacity and affordability. The chapter also examined integrated stakeholder models in countries like South Africa, Botswana, Malawi and Tanzania which shows the possibility of scaling-up collaborative approaches for institutional adoption. Last but not least, sustainability and financing strategies were discussed. The knowledge gaps summary, based on geographical and contextual gaps, was presented. The chapter concluded by presenting a study conceptual framework. The methodology of the study is presented in the next Chapter.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

The literature review is addressed in the previous chapter. The methodological framework used in the present study is given in chapter three. This approach is grounded in a pragmatic philosophy that combines quantitative and qualitative analysis methods to address road safety challenges comprehensively and in full. The chapter elaborates in detail the convergent mixed-methods design, the abductive reasoning approach and a specific case study strategy when dealing with the realities of Chitungwiza, thereby providing empirical validation of the theoretical constructs. Moreover, it lists the target population, sampling methods, data collection processes, and analysis methods, while also highlighting the measures set up for validity, reliability and ethical integrity.

3.1 Research philosophy

The research in this study was held as pragmatic research. This is viewed as the best approach, as it focuses on practical solutions and adopts a multi-technique approach to solving practical problems (Babbie, 2021). The use of quantitative methods, such as assessing the effectiveness of mobile crash reporting, speed feedback signs, and GIS hazard mapping, can be combined with qualitative community perceptions, institutional barriers, and stakeholder engagement exploration. This argument is justified due to the fact that issues concerning road safety in Chitungwiza are complex and multifaceted, thus cannot be understood through one perspective (Creswell & Creswell, 2023). In addition, pragmatism fosters the designing of an integrated model collaboratively, because it is interested in what works in practice, not necessarily in one certain research method. As a whole, it is compatible with the goals of the study, which was to create a sustainable, community-based, and technologically advanced approach, with the strong focus on tangible outcomes, teamwork, and long-term viability.

Pragmatism was therefore most appropriate to this research because it enabled the researcher to move beyond rigid methodological boundaries and instead prioritize approaches that directly address the realities of road safety in Chitungwiza (Creswell & Creswell, 2023). Through

valuing practical outcomes over flexibility, pragmatism provided the flexibility to integrate different forms of evidence and stakeholder perspectives into a coherent framework. This adaptability ensured that the research design remained responsive to the complexity of the problem, while also fostering collaboration and inclusivity in the development of solutions that are both evidence-based and socially acceptable (Babbie, 2021).

3.2 Research Methodology

This study was a hybrid of two research methods: quantitative and qualitative, to gain insight into the ability of the technologies and the views of community members and relevant organizations (Creswell & Plano Clark, 2021). Quantitative methods are used to measure outcomes like reduction in accidents, ease of use of mobile crash reporting systems, etc., and real-world results of speed display boards or digital hazard mapping. Qualitative methods, on the other hand, explored perceptions, barriers, and facilitators to community involvement, as well as the receptivity of institutions to the integrated model. An integrated approach was used to achieve a complete and practical understanding of the road safety problems in Chitungwiza. This means that the proposed framework is evidence based as well as accepted by the local population (Saunders, Lewis & Thornhill, 2022). This partnership directly supports the objective of creating a sustainable, locally-owned, technology-based approach to lasting road safety improvements.

The integration of quantitative and qualitative methods addressed the multifaceted nature of road safety in Chitungwiza. Through combining measurable outcomes with community perceptions and institutional dynamics, the research ensured that its framework was both empirically validated and socially grounded. (Creswell & Plano Clark, 2021). The dual emphasis strengthened the credibility of the findings, because statistical evidence was contextualized through lived experiences, while qualitative insights were reinforced by quantitative trends. (Babbie, 2021). Such complementarity provided a richer, more holistic understandingcomprehending of the challenges and opportunities, ultimately enhancing the feasibility and sustainability of the proposed interventions.

3.3 Research Design

The study uses a convergent mixed methods design to get a holistic perspective on road safety issues and solutions in the study area of Chitungwiza. The need for this design stems from the fact that complex social problems such as road safety demand both in-depth contextual information or qualitative data and outcome data or quantitative data (Babbie, 2023). The qualitative analysis allows for the exploration of perceptions, behaviours and community dynamics of stakeholders, while the quantitative analysis provides empirical evidence of the patterns of incidents and adoption of interventions. These approaches, when used together, help to provide triangulation, ensure validity, and help to create feasible and contextually relevant recommendations. To address the ethical considerations of political issues of road safety, Guba and Lincoln (1985) will be used as a guide to safeguard confidentiality, protect participants and maintain data integrity with respect to ethical safeguards and stakeholder engagement plans.

The convergent mixed methods design was employed because road safety in Chitungwiza is a multifaceted phenomenon that cannot be sufficiently comprehended through a single methodological lens (Babbie, 2023). It involves interconnected dimensions that entail infrastructure conditions, driver behaviors, enforcement practices, community awareness, and institutional capacity, each of which operates at different levels of complexity and requires different types of evidence to illuminate. Qualitative data collection methods such as interviews enable the researcher to capture the lived experiences of road users, the contextual barriers and enablers to safe road practices and views of key stakeholders such as traffic authorities, transport operators, and community members who navigate the road environment daily (Saunders, Lewis & Thornhill, 2022). On the other hand, quantitative methods provide the statistical power to identify patterns in road accident data and measure the prevalence of unsafe behaviors. Through integrating the two approaches, the study was positioned to move beyond surface-level descriptions of road safety problems toward a comprehensive understanding that honours both the human dimensions of the issue and the empirical realities reflected in accident statistics (Creswell & Plano Clark, 2021). Moreover, the triangulation afforded by the approach employed strengthens the credibility and transferability of findings, thereby enabling the researcher to validate qualitative insights through quantitative verification and vice versa.

3.4 Research approach

The research method used by the study was abductive. This is based on its ability to allow for a dialectic interaction between theory and data, to help determine which theory best accounts

for what is observed with respect to road safety problems (Babbie, 2023). This method is more useful for solving problems that involve specific circumstances; for example, if a problem involves a specific context, like Chitungwiza, then it is insufficient to have deductive (theory-driven) or inductive (data-driven) reasoning. The rationale for this approach is that the intent is to co-design an integrated model that combines the findings from existing theoretical models (such as diffusion of innovation, participatory governance) with data collected from the field in the form of surveys and interviews. Furthermore, in this abductive approach, unexpected results, for example when the community resists certain technologies or there are institutional obstacles to enforcement, can be interpreted and the conceptual framework adjusted as a result. Ultimately, this ensures the research remains adaptable, pragmatic and focused on actionable solutions, resulting in a robust and viable model for continual improvement in road safety in Zimbabwe (Crotty, 2020).

The abductive approach was thus vital in bridging theoretical constructs with empirical realities, ensuring that the study remained both conceptually rigorous and practically responsive (Denzin & Lincoln, 2023). Through allowing for iterative refinement between data and theory, abductive reasoning provided the flexibility to adapt the research framework when confronted with unexpected findings, while still maintaining coherence with established models (Crotty, 2020). This adaptability strengthened the study's capacity to generate context-specific insights and actionable strategies, making it especially effective for addressing the dynamic and multifaceted road safety challenges in Zimbabwe.

3.5 Research strategy

A case study research strategy was used in the study. This method is valid due to the study being conducted in Chitungwiza, a particular municipality, as a representative sample of the problems of road safety in Zimbabwe. The approach enabled a deep exploration of the interaction between the use of technology, the participation of the community and the institutional aspects within an actual context (Denzin & Lincoln, 2023). The researchers concentrated their studies on the Chitungwiza community to gather in-depth qualitative data using semi-structured interviews, and strong quantitative data by way of surveys. It also noted the impact of local social, economic and infrastructure factors on road safety outcomes. The case study design is particularly appropriate for this study because it was a mixed methods study and the analytical reasoning process used allowed the researchers to relate theory and

practice (Babbie, 2023). It checks that the developed model is conceptually solid and, at the same time, is grounded in reality, sensitised to the context and is transferable to other urban centres in Zimbabwe.

The case study strategy allowed this research to capture the complexity of road safety challenges within the lived realities of Chitungwiza (Silverman, 2021). Through situating the study in a specific municipality, the research was able to contextualize technological interventions within local socio-economic and infrastructural conditions. This ensured that the findings were not abstract but grounded in everyday experiences (Babbie, 2023). This depth of contextualization strengthened the transferability of the developed model, making it adaptable to other urban centres in Zimbabwe while still retaining sensitivity to local variations in community engagement and institutional capacity.

3.6 Target Population

This study focuses on the target population that include different individuals and stakeholders that are impacted by the road safety problems in Chitungwiza, Zimbabwe. This pertains to all road users like drivers, motorcyclists, cyclists and pedestrians who come on the road on a daily basis. Further, traffic authorities and law enforcement officials are also taken into account, as they are involved in traffic management and ensure that traffic safety standards are observed. The people in the community and residents of Chitungwiza are also part of the research process as they are affected by road safety. Another important sector in the populace is that of transport service providers such as public and private transport operators, which play an integral part in everyday movement. Finally, policy developers and government officials play a crucial role in formulating and enacting road safety policy as a key stakeholder and perspective that needs to be considered in the study and subsequent recommendations.

3.7 Sampling

Qualitative Sampling: Purposive sampling was used to identify key informants and community stakeholders with knowledge and experience of, or influence on, road safety issues in Chitungwiza. Local government officials, local traffic enforcement officials, local members of the safety committee, community leaders and residents were among the participants. The number of interviews was determined using data saturation principles, aiming for a sample of 20 interviewees to capture a variety of viewpoints without repetition. The figure of 20 was the

saturation point as no more new themes emerged at that point. Purposive sampling ensured that participants were selected based on their direct relevance and expertise in road safety issues within Chitungwiza (Denzin & Lincoln, 2023). Through engaging local government officials, enforcement officers, safety committee members, and community leaders, the research captured perspectives from those most actively involved in shaping and experiencing road safety outcomes. This targeted approach enhanced the richness and credibility of the qualitative data, as it prioritized informed voices while the principle of saturation safeguarded against redundancy, ensuring that the final dataset was both comprehensive and diverse (Babbie, 2023).

Quantitative Sampling: Quantitative data was collected through the administration of surveys to the road users, the Chitungwiza municipality officials and community members. Surveys were carried out using stratified random sampling to ensure representation within the various neighborhoods, age groups and user groups (pedestrians, drivers and cyclists). This method provided sound and representative data for analysis (Crotty, 2020). The use of stratified random sampling ensured that the survey data reflected the diversity of Chitungwiza's population and road user categories. Through inclusion of different neighborhoods, age groups, and user groups such as pedestrians, drivers, and cyclists, the study minimized sampling bias and enhanced the representativeness of the findings. This technique strengthened the reliability of the quantitative analysis, because it allowed for meaningful comparisons across subgroups and ensured that the conclusions drawn were not skewed toward any single demographic, thereby increasing the validity and generalizability of the results (Babbie, 2023).

3.8 Data Collection Methods

3.8.1 Qualitative Methods:

Semi-Structured Interviews were used for this research. Semi-structured interviews are appropriate for this study because they have a good balance between consistency and flexibility (Silverman, 2021). A structured interview guide provides a consistent structure to explore key themes, including community perceptions of road safety technology, barriers to community involvement, and institutional readiness. Concurrently, this format provides an opportunity for different people and groups in Chitungwiza (such as transport operators, community leaders, accident victims and local authorities) to share their distinct experiences and provide relevant

suggestions (Bernard, Wutich & Ryan, 2022). The comprehensive approach is necessary; road safety issues are complex and sometimes local. Rich qualitative insights are needed to complement any numerical data, to ensure that the model developed together is viable, culturally relevant and sustainable.

3.8.2 Quantitative Methods:

Structured survey questionnaires were employed to collect quantitative data from the research. This is because they provide tangible data about road users' knowledge, actions and views. The researcher had the opportunity to get firsthand information from the various groups including drivers, local officials, pedestrians and commuter drivers in Chitungwiza, through the use of questions on matters ranging from speeding, adherence to road signs, and a willingness to use cost effective technologies like mobile apps for crash reporting, and display of speed signs. This method is useful since it affords input from a large populace since the researcher will be able to get information from different socio-economic groups in Chitungwiza (Kumar, 2021). The uniform question structure allows research to compare answers to the questions and to identify patterns using statistical analysis. Through capturing road users' attitudes and actions, these surveys perfectly complement more in-depth qualitative interviews. They offer credible evidence to create a lasting, technology-enabled and community-driven road safety model (Miles, Huberman & Saldaña, 2023).

3.9 Data Management and Analysis

3.9.1 Data Management:

All the qualitative data (interview transcripts) were transcribed, coded and stored securely using qualitative data analysis software such as NVivo. Data was entered into a statistical software program, such as SPSS, with careful data cleaning to ensure accuracy to obtain quantitative data. Anonymization and password protection and secure storage were used to ensure data confidentiality. Other than the above technical measures, the data management strategy was motivated by the need to balance research integrity with ethical safeguards. Secure handling of both qualitative and quantitative data was crucial to protect participants' identities, maintain trust, and ensure compliance with ethical standards (Miles, Huberman & Saldaña, 2023). Through combining robust software tools with strict confidentiality protocols, the

research preserved the accuracy and validity of its findings but also reinforced its credibility and accountability to stakeholders.

3.9.2 Data Analysis

Qualitative Data

Thematic analysis was used to detect patterns, themes, and perceptions from the stakeholders, community practices and barriers to safety interventions. Thematic analysis was selected owing to the fact that it allows for the systematic identification of patterns, themes, and perceptions emerging from stakeholder voices, community practices, and barriers to safety interventions (Saunders, Lewis & Thornhill, 2022). This method was the most appropriate with respect to road safety research in Chitungwiza, where comprehending the lived experiences of drivers, pedestrians, and institutional actors is essential to unravel the social dynamics that shape risk and intervention uptake (Creswell & Poth, 2023). Thematic analysis also provides flexibility while maintaining methodological discipline. This enabled the researcher to capture nuanced insights into attitudes, behaviors, and contextual challenges that quantitative data alone cannot reveal.

Quantitative Data

For the quantitative section, descriptive statistics were employed to summarize incident trends, providing a clear picture of the frequency, distribution, and severity of accidents in the study area. This was substantiated by inferential statistics, which were employed to evaluate relationships between interventions and safety outcomes. The choice of these techniques was motivated by their ability to test associations between variables such as the presence of safety measures and the occurrence of accidents, thereby providing empirical evidence of intervention effectiveness (Tashakkori, Johnson & Teddlie, 2020). Together, such statistical tools ensured that the quantitative analysis was not only descriptive but also explanatory, offering insights into causal and correlational dynamics.

3.10 Validity and reliability

Effort was made to make the research results valid and reliable, first by improving the validity and reliability of the methods of qualitative interviews, and second by improving the validity and reliability of the quantitative survey instruments. The development of an interview protocol

was carefully designed and closely tied to the overall research goals for the qualitative component, thereby enhancing the validity (Tashakkori, Johnson & Teddlie, 2020). This will help ensure consistent coverage of key issues such as attitudes towards technology, barriers to community involvement, and organizational readiness. In addition, there was an element of reinforcement of construct validity, in that the quantitative survey data could be used to cross check the insights emerging from the qualitative surveys (Saunders, Lewis & Thornhill, 2022). Standardized procedures were adopted in all the interview sessions to increase reliability, in terms of consistency in the way the questions were asked and documented. Furthermore, all interviews were audio-recorded with the consent of the participants and then transcribed, with the aim of reducing researcher bias and making clear interpretation.

In the case of the quantitative instrument (structured questionnaire), validity was achieved through the pilot surveys which were conducted in the context of Chitungwiza. This confirmed the clearness of items, their culture relevance and the matching of the road safety situation with the local context (Bryman, 2021). To ensure content validity, questions were created that directly relate to the study's specific sub-objectives including adherence to speed limits, compliance with road signage, and receptiveness to solutions made available with technological elements (Creswell & Poth, 2023). To increase reliability, the items were phrased similarly across all respondents, and the administration of the items were standardized across all respondents (Sekaran & Bougie, 2022). The internal consistency of the participants' answers was statistically calculated, for example, with Cronbach's alpha of the instrument for participants' answers, to be sure that the instrument was reliable. The instrument that was used was reliable and at least had a Cronbach Alpha score of above 0.70 (Neuman, 2020).

3.11 Ethical considerations

Informed consent

Since the research involves the people of Chitungwiza, the people affected by accidents as well as the representatives of the organisations, they were given a detailed explanation about the aim of the research which was to bring together the technological tools and community involvement for road safety. Their consent, based on their informed agreement, is crucial for their willingness to share their experiences: no sense of pressure is felt.

Privacy and anonymity

In the course of the study, all personal information was removed, and records were kept safely as mobile accident reporting systems and information from key people was gathered delicately. This measure protected the participants from any negative social or political impact, especially in a context where, when it comes to some enforcement shortcomings, it's a politically sensitive issue.

Minimizing harm

Discussions on failed enforcement and accidents may be upsetting. The study aimed to safeguard those who participated by allowing them to withdraw at any time and treating sensitive topics with sensitivity. This method enabled the researcher to collect the important knowledge needed to create a long-term safety strategy.

Stakeholder engagement

There needs to be openness in order to co-create this framework, together with local safety groups, public transport providers and official authorities. Confidence and a sense of shared responsibility developed as a result of ongoing involvement, in line with the aim of the research, which was the achievement of official integration and long-term viability under community leadership.

Ethical approval

This research was given legitimacy by official ethics committees approval and compliance with the national ethical guidelines for research in Zimbabwe. This made sure that technological applications (geographical information system hazard mapping and speed display signs) and community-based activities are implemented with awareness.

3.12 Chapter summary

Finally, in chapter three, a comprehensive methodological framework was developed, which combines pragmatism, mixed methods and abductive reasoning. This integration aims to produce useful information relevant to road safety. As a localized case study approach, the investigation offers contextual relevance and successfully balances the measurement of empirical data with stakeholder perspectives in Chitungwiza. The chapter highlights the implementation of rigorous data management procedures, measures, and ethical considerations

to provide a solid foundation for creating a robust, community-based, and tech-supported approach to improving road safety. Next chapter presents and discuss data obtained from participants.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Introduction

The research methodology used in collecting data from the respondents was explained in the previous chapter. Data presented in tables and bar graphs are provided in this chapter. The main areas of focus are the research question on study response rate, demographic profile of respondents and responses to the five research questions stated in chapter one. Literature is discussed regarding the results.

4.1 Descriptive statistics

4.1.1 Response Rate

Table 4. 1: Response rate

Instrument	No. Administered	Actual returned	Response rate
Questionnaires	300	180	60%
Total	300	180	60%

Instrument	Targeted	Responded	Response rate
Interviews	20	15	75%
Total	20	15	75%

Source: Primary data (2026)

The response rate results from the above presented data in table 4.1 shed light to commendable aspects of the data collection methodology of this investigation. In particular, 300 questionnaires were sent out and 180 were received and returned, which is a 60% return rate. This ratio is regarded as moderate, but it is still above the accepted minimum threshold of 50% for survey research, providing strong support for quantitative statistical analyses (Bryman, 2021). In contrast, the semi-structured interviews had a much higher participation rate (75%): 15 of the 20 identified participants were able to participate in the engagement. This high level of engagement adds a strong level of credibility and trustworthiness to the qualitative results, which reflects the high level of willingness amongst key informants to share their views and experience. These findings, taken together, show that the questionnaire data has strong

empirical grounds for statistical analysis, but that the higher rate of interview participation adds rich depth and contextual meaning, and strengthens the overall validity of the study.

While a 60% response rate is generally acceptable for survey research, it is vital to acknowledge the potential for non-response bias, as those who did not return questionnaires may differ systematically from those who did. For instance, non-respondents might include individuals less engaged with road safety issues or those with limited access to mobile technologies, which could skew the representativeness of the findings. To mitigate this risk, the study employed strategies such as stratified sampling to ensure coverage across diverse neighborhoods and user groups, follow-up reminders to encourage participation, and triangulation with qualitative interviews to validate and enrich the survey data. These measures helped to reduce the impact of non-response bias and strengthened the overall reliability and validity of the study's conclusions.

Table 4. 2: Demographic profile of respondents

	Male	Female
Gender	44%	56%
	Less than 5 years	More than 5 years
Duration of residence in Chitungwiza	11%	89%
	Formal	Informal
Occupation	48%	52%

Source: Primary data (2026)

As shown in table 4.2 above, the demographic composition of the participant pool provides crucial context for the study's findings.

4.1.2 Gender distribution

44% of respondents were male and 56% were female. This means to some extent, more women will be involved, and more complete capture of gender perspectives, especially women's voices. Women are often faced with different road safety issues particularly as pedestrians and carers, and this was reflected in their strong representation, which brings additional light to the inquiry as a whole, as well as highlighting issues of concern across the community beyond just driver behaviour.

4.1.3 Duration of Residence in Chitungwiza

Majority of participants (89%) indicated that they had been staying in Chitungwiza for more than five years while 11% had been staying for less than five years. The pattern indicates that the majority of the sample carries a high level of awareness and knowledge about local traffic patterns, infrastructure and existing institutional structures. This extended exposure certainly increases the authenticity of the findings of the research since they are in an exceptional position to evaluate lasting problems and assess the effectiveness of past interventions.

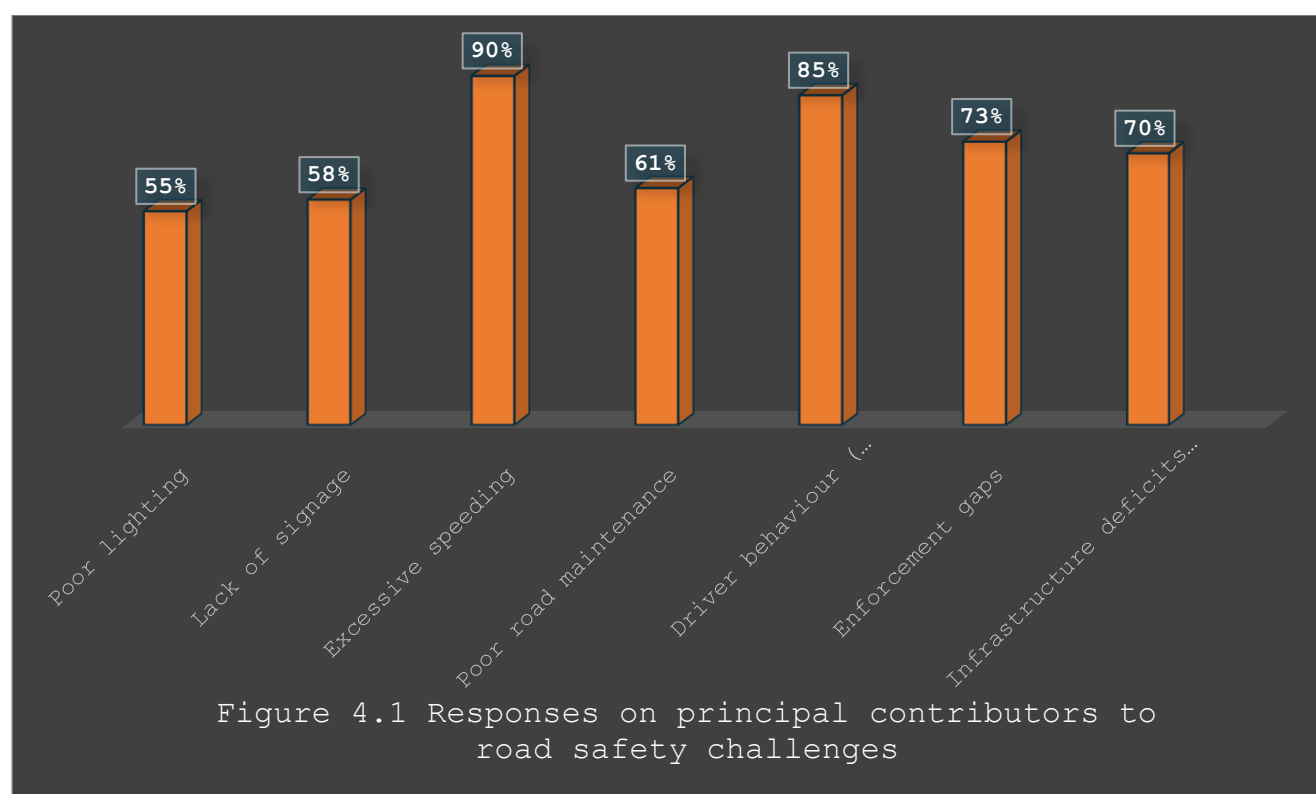
4.1.4 Occupation of respondents

As far as workers' status is concerned, the profile shows that almost equal numbers of people are employed in the formal sector (48%) as are involved in informal economic activities (52%). This even balance reflects the social-economic diversity of the group, ranging from those with a regular day job to those relying on informal means of earning a living. The high proportion of people in the informal sector highlights the importance of taking into account the realities of the economy, such as irregular working hours and limited resources, when developing road safety strategies. Interventions therefore need to be designed in a way that is inclusive, and recognises the different needs of both formally employed people and those whose mobility is determined by their involvement in informal commerce. As a whole, this demographic overview shows that the study was able to recruit a diverse and representative group of the population in Chitungwiza. The following are key elements: First, it is important to have meaningful women's participation; Second, it is important to have a long-standing community presence that provides deep context, understanding, and inputs from the community, and Third, it is important to balance formal and informal work sectors, including people who have been in the formal sector, but are not formal employers. This wide representation then increases the

validity of the results and provides a strong base for any recommendations that may be made in the future.

4.3 The principal contributors to road safety challenges in Chitungwiza districts

The first study objective was to identify the principal contributors to road safety challenges in Chitungwiza districts. The responses are summarised in figure 4.1 below:



Source: Primary data (2026)

4.3.1 Poor lighting (55%)

The fact that 55% of the participants found that lack of lighting was a contributor to the problem of road safety indicates that there is an inherent danger posed by lack of lighting on the highways in Chitungwiza. These conditions directly affect the visibility of drivers and pedestrians, especially at night, and increase the risk of vehicle crashes. In addition, it compounds the risks of associated activities like traffic accidents and traffic violations, as well as criminal behavior. While this percentage is lower than other factors, it does reveal that poor lighting is a significant issue that needs to be addressed and new streetlights installed or existing

streetlights maintained and is therefore a cause for concern. The ward councillor in the interviews spoke about the lack of street lighting having been an ongoing issue within the ward. There is lack of street lighting, particularly in areas where pedestrians are likely to be found at night; many collisions are preventable and we have been asking for more street lighting, but keeping them well maintained is problematic. This first-hand evidence is robust in confirming that insufficient light can clearly have a negative impact on visibility and public safety, particularly at night, as seen in the statistics collected, and is supported by empirical evidence.

4.3.2 Lack of signage (58%)

The results show that there was a substantial proportion (58%) who said that they had not received enough information from road markings, suggesting people who are using roads are frequently travel without enough signage or cautionary information. Lack or lack of clarity of such indicators always leads to poor traffic control, driver confusion, risky vehicle behavior and general lack of respect of traffic laws. The lack is accentuated in the urban setting where there is high vehicle traffic. This high number therefore highlights the need to strategically place and maintain directional signage to encourage people to follow traffic rules and significantly reduce the number of road traffic accidents. Evidence with interview responses. One regularly finds intersections without a stop sign or speed limit sign:” says a local traffic safety official. Drivers are then forced to engage in speculation, which can be dangerous. There would certainly be less confusion and better compliance with traffic laws if there were adequate signage. This statement is an example of how inadequate signage affects proper traffic control and leads to unsafe driving habits.

4.3.3 Excessive speeding (90%)

When asked what the greatest issue was, respondents identified excessive speed, with 90 per cent of them stating it was a big problem. This is indicative of the seriousness of irresponsible driving behaviours in Chitungwiza. The way one reacts to a situation on the road is clearly affected by speed, making collisions more serious and endangering motorists and pedestrians. The data clearly indicates that speeding is more than just a behavioral problem, it is a systemic issue; a more aggressive enforcement policy and a public awareness campaign to highlight the dangers of excessive speed alongside potentially adding some traffic calming measures like speed humps or automated speed detection systems will be needed. The study results match up

with the conclusions that were reached during the interviews. The Chair of the community policing committee highlighted the pervasive problem of people being at risk of using their cars in dangerous ways. Enforcement is lax here: many drivers are more likely to speed on newly resurfaced roads; and there are too few speed humps and patrols visible. These are shared spaces; more police intervention and speed bumps are needed to remind drivers to respect the speed limits. This claim is in line with empirical evidence and invariably points to unchecked velocity as the most important cause of worrying aspects of vehicles

4.3.4 Poor road maintenance (61%)

Sixty-one percent of respondents named substandard road maintenance as one of the main causes for concerns of safety. Such an observation reveals widespread dissatisfaction with the state of the roads, water supply and infrastructure in general. Thoroughfares in poor condition – fissured, uneven terrain and damages to the structure – increase the risk of vehicle accidents and harm to vehicles. These are examples of the Lacks Island's chronic situation of lack of maintenance rather than being random, as it mandates a continued investment in restoring and preserving infrastructure. Interviewed, a municipal engineer was able to give an opinion on deteriorating state of local roads. He said, "Our roads have lots of surface defects and irregularities, even if they get fixed, the fix is often not good enough for long – and too little, too late maintenance efforts create additional safety problems and then cause vehicle deterioration, resulting in far-reaching roadside mistrust by citizens of the roads. This commentary reinforces the principal topic of the poor quality and condition of infrastructure maintenance and calls it out as a widespread problem with a need for significant and sustained investment.

4.3.5 Driving Driver behavior (distracted driving) (85%)

This discovery means that motorists in Chitungwiza use mobile communication device extensively, lack concentration and are inattentive in many other possible ways. This behavior hampers drivers' ability to react and makes it harder for them to "see" what's happening around their vehicle and contributes to preventable vehicle incidents. These high numbers highlight the necessity of immediate behavioral change efforts, including tighter laws to be enforced, rather than tearing up and replacing them, as well as broader public awareness campaigns and improvements in driver training courses. Individuals' interviews and reactions have been consistent with the results. Mobile device use by motorists while driving is a routine spectre, a

problem that is "regrettably common" but often deadly," said a representative from a transportation group. "Stronger regulations designed to address the issue and increased public awareness through community education outreach will be central to changing the culture of driver inattention." This statement confirms the high percentage of respondents named driver's attentional deflection as a key behavior contributor.

4.3.6 Enforcement gaps (73%)

The great majority, 73% of the respondents, highlighted major weaknesses with regard to enforcement, suggesting that participants perceive lack of law enforcement mechanisms as a key concern. The observation indicates that there is not enough policing; there is an uneven application of pertinent regulations; and it is the same way there is less deterrence on potential transgressors. As such, the conclusions suggest that often existing protocols, even when available, are not well managed and poorly implemented, thus reducing their effectiveness. Strengthening institutional capacities, increasing surveillance activities, and judiciously using technology as an aid for surveillance are recommended to treat these inequalities. There is a consensus in the results with answers during the interview. A high-level police official admitted there are gaps in their existing system of police action. As traffic laws are drafted, there are times when they are not enforced. At times there is insufficient staffing or availability required to ensure its enforcement. When there is no clear sign of traffic enforcement, drivers feel free to engage in transgression. This vision reinforces the notion that the extent of compliance gaps necessarily reduces the preventative effect and challenges any compliance processes in place to ensure public adherence.

4.3.7 Infrastructure deficits (potholes, lack of sidewalks) (70%)

Importantly, respondents noted that heavy vehicle loads, and poor infrastructure (deteriorated road surfaces and lack of special facilities for pedestrians) were important factors in commuting hazards of road use, accounting for around 70% of the respondents who indicated this. This observation highlights the two-fold issue of poor road quality and inadequate infrastructure for pedestrians as well. Cracks made on roads are clearly correlated with the probability of traffic accidents, while elimination of special pedestrian walking tracks allows people walking on the

road direct exposure to traffic hazards. This result clearly supports the use of integrated infrastructure planning where the safety and security of vehicles and pedestrians can all be comprehensively taken care of. The results are consistent with the interview results. A community leader expressed their concerns on why many roads don't have any pedestrian infrastructure and noted that people have to walk along the shoulder or verge of the road, which poses a considerable hazard, especially if you are a vulnerable group like a child, or elderly. There is a real need to provide adequate pedestrian infrastructure and road surfaces that will make everyone safe as a user of the road. This is thus a reiteration of the ongoing challenges of poor road network and lack of pedestrian infrastructure facilities reported earlier based on the available data. The assessment shows that although some aspects of the physical structure, for example poor illumination, are of concern, human behavior and enforcement are of particular concern due to poor attitudes and deficiencies in enforcement related to operating vehicles at high speed and without attention. The experiences highlight that the likelihood of accidents on the road is multifaceted and hence the need for a holistic approach that addresses improvements to physical infrastructure, monitoring and practicing responsible driving, and more effective enforcement of regulations.

4.3.8 Pearson correlation test results between the factor and frequency of accidents

Table 4.3: Pearson correlation test results between the factor and frequency of accidents

Factor	Frequency of road accidents
Excessive speeding	.863**
Driver behaviour (distracted driving)	.785**
Enforcement gaps	.771**
Infrastructure deficits (potholes)	.742**
Poor road maintenance	.731**
Lack of signage	.532**
Poor lighting	.513**

**** Correlation is significant at the 0.05 level (2-tailed).**

The Pearson correlation results provide clear evidence of the most influential factors contributing to road accidents in Chitungwiza. The strongest correlation was observed with excessive speeding (.863), highlighting it as the principal contributor to road safety challenges. This finding aligns with global literature that consistently identifies speeding as a leading cause of road crashes, particularly in urban areas where enforcement may be inconsistent. Similarly, driver behaviour such as distracted driving (.785) also showed a very strong correlation, underscoring the role of human error in accident causation. These results suggest that

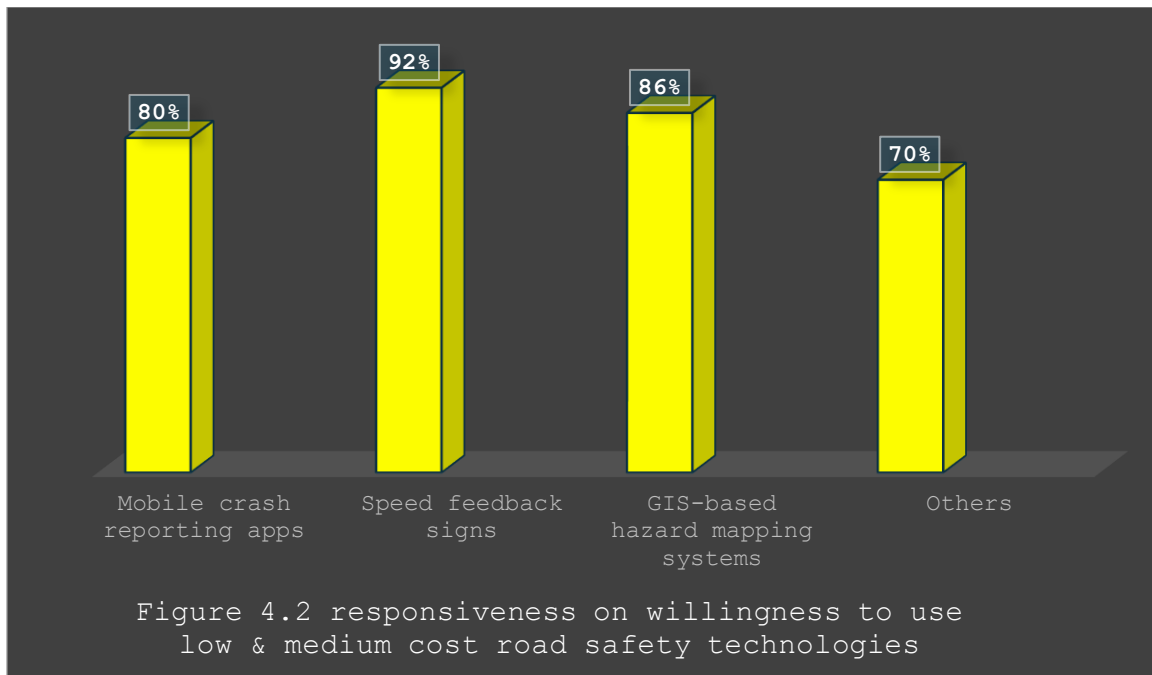
interventions targeting driver conduct through education, stricter enforcement, and technology such as speed feedback signs are likely to yield significant reductions in accident frequency.

Institutional and infrastructural factors also emerged as critical contributors. Enforcement gaps (.771) and infrastructure deficits such as potholes (.742) both demonstrated strong correlations with accident frequency. This indicates that weaknesses in institutional capacity to enforce traffic laws, combined with poor road conditions, substantially increase accident risks. The findings emphasize that road safety challenges in Chitungwiza are not solely behavioural but are compounded by systemic shortcomings in governance and infrastructure maintenance. Addressing these issues requires strengthening enforcement mechanisms and prioritizing road rehabilitation to reduce hazards that exacerbate driver errors.

Other factors such as poor road maintenance (.731), lack of signage (.532), and poor lighting (.513), while showing slightly lower correlations, still represent significant contributors to accident frequency. Their moderate associations suggest that while they may not be the primary drivers of accidents, they interact with behavioural and enforcement issues to worsen outcomes. For example, inadequate signage and lighting can amplify the dangers of speeding or distracted driving, while poor maintenance perpetuates unsafe conditions. Taken together, the analysis confirms that road safety challenges in Chitungwiza are multifaceted, requiring a holistic approach that integrates behavioural interventions, institutional strengthening, and infrastructural improvements to achieve sustainable reductions in accidents. The correlation results are similar to descriptive results as human factors are the major principal contributors to road safety challenges in Chitungwiza districts as demonstrated in figure 4.1 above.

4.4 The acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies.

The second study goal was to evaluate the acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies. In response to the research objective, results are summarized in figure 4.2 below.



Source: Primary data (2026)

4.4.1 Mobile Crash Reporting Apps (80% Willingness)

The 80% willingness to use mobile apps for incident reporting represents a strong support, but not full support, for the application of mobile technology as a tool to improve road safety. This high adoption rate can be attributed to the availability of smart phones and their high penetration in society plus the popularity of digital applications. The attraction of technology, of course, is that it is easy to use people can record incidents on the spot without needing any special equipment or preparation. The other 20%, however, warrants a deeper look. This non-adoption may indicate concerns around data privacy, uncertainty around the accuracy of community incident reporting, or a lack of trust in the value of reporting for tangible improvements to safety. As operational, this degree of acceptance implies the technology has the potential for significant integration, provided that careful application and clear communication of benefits, and data security, are delivered. Finally, they rely on a user-friendly interface and a smooth reporting mechanism. Although inclination to quick documentation might be there, obstacles can be significant to prompt documentation in real-world implementation. The findings also found that, "A significant percentage of the local community is receptive to using mobile apps to report road traffic accidents, supported by the high mobile

phone penetration rate, but the key challenge is ensuring that reported incidents are acted on promptly and effectively to ensure users continue to trust and use the mobile apps.

4.4.2 Speed feedback signs (92% Willingness)

Among the interventions explored, speed feedback signs emerge as the most popular intervention with an impressive acceptance rate of 92%. The common endorsement probably is caused by the simplicity of technology, its non-punitive nature and the immediate tangible benefit to the individual motorist. This type of sign provides instant feedback on driving behavior without the threat of punishment, which makes them less psychologically threatening than automated cameras or actual police officers, but just as effective at encouraging safer driving. Technology has been found to be highly accepted because of its fit with drivers' previous expectations, as it requires little change of behavior, just a natural, spontaneous change in response to the given feedback. In terms of practical application, this high level of acceptance implies that this technology would be expected to be rapidly and widely adopted, with little resistance. The smaller opposition, which is about 8%, could be because professional drivers' schedules are disrupted by speed restrictions, or because they have a principled objection to speed management efforts. Its usability is natural, everyone using the road can use the signage without any prior training or specialized aptitude; the visual signals and the psychological feedback that is triggered as a part of the process are easily understood by all users of the road. This is supportive of qualitative feedback received by a community leader, who stated that motorists responded very positively to the speed feedback signage, largely because they believed it was a positive reminder - not a punishment - and therefore a constructive approach to improve road safety.

4.4.3 GIS-Based Hazard Mapping Systems (86% Willingness)

The high rate of approval (86%) for hazard mapping systems based on Geographic Information System (GIS) indicates significant support for technologically-based approaches to hazard identification and management. This significant acceptance reflects a recognition by relevant stakeholders of the usefulness of spatially and analytically oriented, empirically-based methods in the planning of infrastructure safety. These systems appeal especially to urban planners, civil engineers, and policy makers, providing concrete, actionable information about areas where incidents occur and significant environmental risk factors. Moreover, the "neutrality" of the technology itself provides a strong foundation for its acceptance, because it helps to overcome

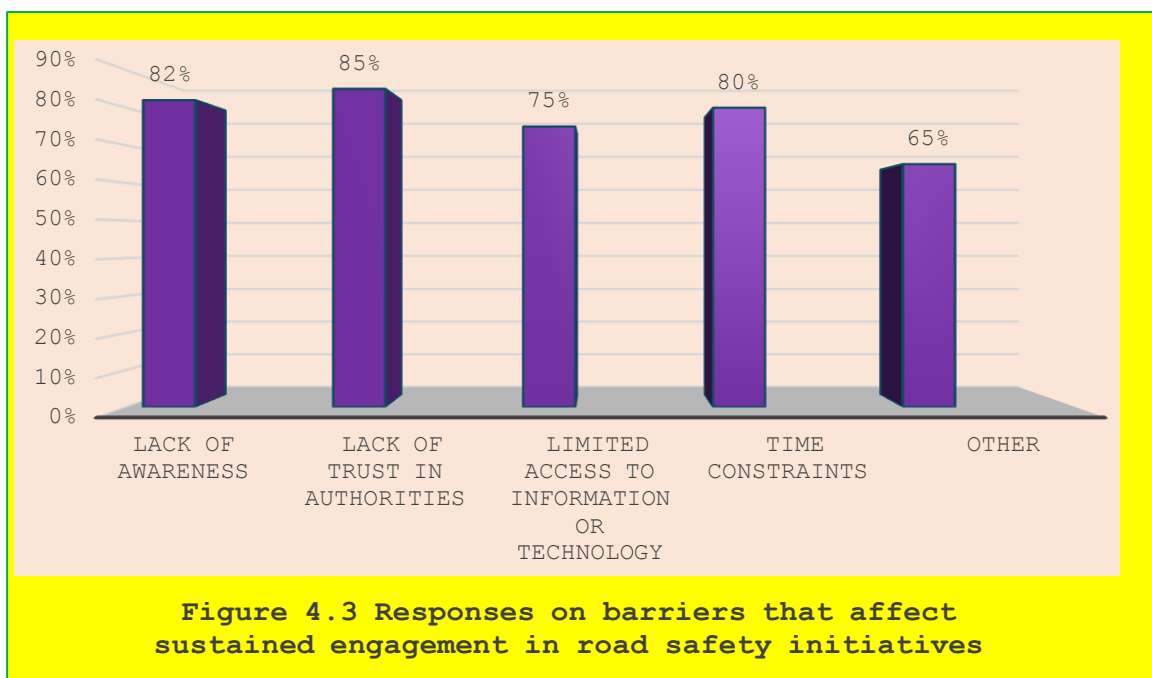
the subjective nature of hazard identification, thus grounding further action on the basis of empirical evidence. On the other hand, the other 14% of non-integration could be due to practical factors like high deployment costs, the need for specialized technical skills, or a lack of comfort among organizations that have traditionally worked with the linear planning approach. GIS systems show some promise from an operational efficiency point of view, but their direct effect is highly dependent on the identification of hazards leading to sufficient investment in remediation works. Moreover, the use of the GIS may encounter challenges in operation because the staff are not technically trained to use the GIS. This indicates that implementation requires much more than just the technology, as it also requires a strong capacity building initiative and the integration of technology within the current planning process. Results are consistent with interview findings that indicate that "Geographic Information System (GIS)-based hazard mapping systems are very useful in identifying hazard-prone areas and in the proper planning of cities; however, the systems are only useful if they are equipped with an appropriate number of trained personnel and financial resources.

4.4.4 Others Category (70% Willingness)

The category 'Others', which includes a variety of unspecified innovations, had the lowest acceptance rate of 70%. This means either that people are not knowledgeable about these specific advances or there is a significant level of confusion about what they can achieve. This level of adoption represents a baseline indicator, below which the key stakeholders exhibit some hesitation to adopt new road safety measures. This 30% non-adoption rate is interesting and may be due to several factors: perhaps a general lack of trust in technology, or concerns about its economic feasibility or return on investment, or perhaps the information on the specific benefits available from the use of these technologies is not widely disseminated. Overall, this reduced evaluation suggests that further robust demonstration programs, in-depth pilot studies and empirical testing are required to create a climate of trust and confidence among potential adopters for these technologies. The operational aspects of solutions in this classification can have a long deployment period and will need to be promoted for long periods to achieve sufficient market penetration. Lacking specific knowledge of the specific technologies included, the aspect of user-friendliness is undefined. However, the reduced predisposition toward adoption indicates that these solutions might entail heightened intricacy or necessitate more extensive user education and significant adjustments in prevailing behaviors, when contrasted with the readily embraced alternatives.

4.5 The social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives.

The third study aim was to determine the social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives. The results collected from respondents are shown in figure 4.3 below.



Source: Primary data (2026)

4.5.1 Lack of awareness (82%)

The results show that lack of awareness in the public is one of the major challenges as 82% of the participants confirmed that it has a negative effect on continued public involvement in road safety activities. This suggests possible gaps in the general understanding of the danger of unsafe road behaviors, the goal of a road safety program, and the real-world strategies to reduce road collisions in their communities.

When people lack understanding key road safety issues like speeding dangers, pedestrian safety tips, seatbelt and helmet use, or the importance of reporting unsafe conditions, they are less likely to consider road safety to be relevant to them and therefore will not have a strong

motivation to engage with it beyond moments on the drive. In this context, awareness is not limited to a mere ability to recall facts, but it also involves an understanding of the role of road safety activities in everyday life and in the well-being of the community. Overall, a high level of agreement among respondents reinforces the need to continue with public engagement and provide bespoke public information programmes rather than one-off, episodic sensitization.

The outcome is in line with the Community Safety Committee Chairperson's qualitative feedback which outlines that "many residents do not understand how their day-to-day actions affect road safety and, if no ongoing education efforts are made, view safety campaigns as one-off events that are forgotten.

4.5.2 Lack of trust in authorities (15%)

One of the most important institutional constraints found in the results is a general distrust of governmental bodies, with a remarkable 85% agreement from the respondents. This means there is likely to be a significant proportion of the population that might have concerns about the objectives, impartiality or effectiveness of bodies that are responsible for ensuring road safety, which includes traffic management bodies, local administrative bodies and relevant enforcing bodies. Citizens may view new initiatives as imposed directives and not as collaborative efforts if they do not have a high degree of trust in government. In addition, they may believe that their issues and/or grievances will not be treated with seriousness or addressed appropriately. This environment breeds an attitude that discourages proactive involvement, sharing useful information, giving volunteer support, or long-term involvement.

In addition, the trustworthiness of official communication is directly affected by its level of trust. If the general population feels that the enforcement is not uniform, they will see a lack of accountability as incompetent, or they feel there is malfeasance, then their trust of the road safety advisories and initiatives will be questioned. To sum up, the results emphasize the need to implement strategies that are based on transparency, accountability and wide community participation. These are key strategies for strengthening the legitimacy and trustworthiness of road safety institutions and thus ensure that the public continues to participate and cooperate in road safety.

This is reflected in the interviews, in which a Local Ward Councillor stated that ‘the public feel that it is only when there is a crisis that authorities intervene. If that is how they do it all the time, and they are suspected of corruption, then the community won't keep interacting with them.’

4.5.3 Limited access to information or technology (75%)

The research findings show that majority (75%) agree that lack of information or technology affects their participation. This implies that, even in places where road safety awareness programmes are in place, their effectiveness in reaching out to all the segments of the community could be undermined because of differential access to communication channels. These channels may comprise mobile phones, Internet services, radio broadcasts that can be heard by everyone or any other digital platform for public announcements.

Moreover, where access is limited, this can reduce an individual's ability to receive timely information, understand exactly when and where certain activities are taking place that relate to safety, and therefore, the ability to follow instructions that would help them change their behavior to improve safety. Socioeconomically, technology access barriers often correlate with larger social inequities, suggesting greater likelihood of being out of reach of critical technology to socioeconomically vulnerable households, such as those in geographically isolated areas or with lower incomes. This core barrier can affect ongoing engagement as people can become less able to coordinate their participation, remain engaged over time or build greater levels of commitment when there are gaps in communication or communication is not easily accessible.

In high-density urban settings, digital connectivity or mobile communication devices are not available to everyone, and important safety messages don't always find everyone's ears, resulting in uneven participation.

4.5.4 Time constraints (80%)

Time constraints were reported by a very large proportion (80%) of respondents, meaning that everyday activities have a significant impact on people's ability to be engaged in road safety activities for an extended period. There is often little time for community members to attend participatory forums, instructional workshops, public engagement efforts or to oversee functions of the community. This limitation is especially harmful to the continued participation of the individuals, since traffic safety programs frequently require continued participation, such as attendance at regular sessions, involvement in ongoing school and community educational activities, or engaging in ongoing advocacy. If the activities don't fit the community schedule, participation will probably decline after the first few months, especially if participation is motivated by novelty, or if motivation is short-term. The results indicate that, in addition to understanding and confidence, this sustained involvement requires programmatic adjustments that account for the time constraints of participants, including flexible timing, brief sessions, and the incorporation of participants' current community organizations.

The outcomes are also consistent with the responses to the interview, which explained that the majority of residents are very busy with formal employment or informal economic activities, and therefore cannot participate in formal pedagogical sessions or community meetings unless these could be made a part of their existing daily life.

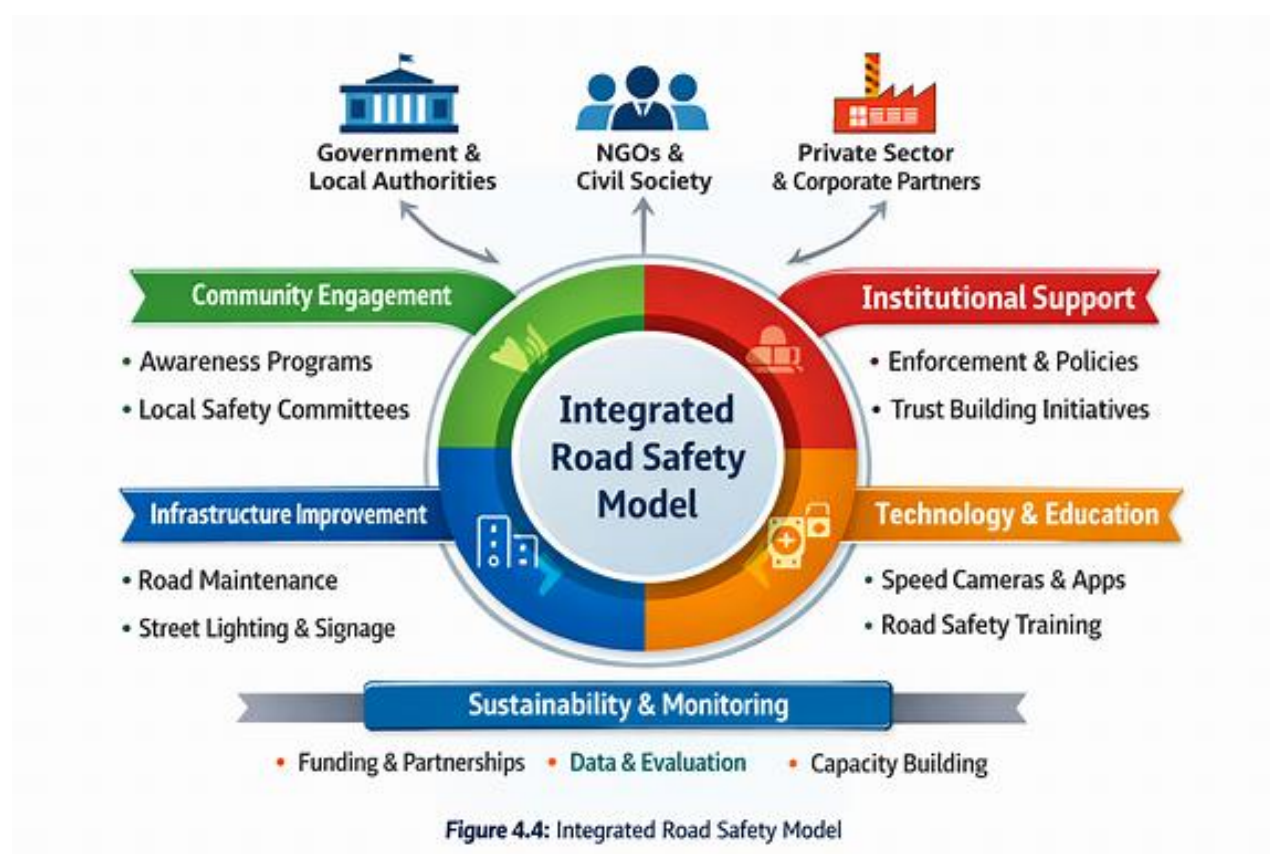
4.5.5 Other (65%)

One-fifth (65%) of the participants also identified "Other" factors, representing other enabling conditions and impediments that have a significant impact on sustained civic involvement, in addition to the factors that were listed above. It is essential to describe specifically the nature of these unspecific responses as part of the overall interpretation of this particular section in relation to the primary objective of the study. This is important because the generic classification does not explain the most influential components of the process, nor does it explain how they work in social, institutional, or economic aspects. Potential factors in this "other" category may include failure to provide adequate financial support or material resources for community projects, entrenched cultural norms and a resistance to change in behaviour, poor transport infrastructure and dangerous environments making it difficult to participate (such as lack of pedestrian facilities, public lighting etc), gender-related barriers, language barriers, or weak community governance structures and processes. The outcome was found to match the findings of the interviews as expressed by a Civil Society Advocate: "Socio-economic hardships can make it difficult for people to focus on issues of traffic safety for

walking and bicycling, and deeply rooted cultural attitudes and political interference can also be significant barriers to effective community engagement.

4.6 An integrated road safety model with stakeholders, producing a model ready for institutional adoption and scaling.

The fourth study goal was to co-design an integrated road safety model with stakeholders, resulting in a model which is ready for institutional adoption and scaling. This integrated model for road safety is presented in figure 4.4 below.



Source: Primary data (2026)

The study developed the above model shown in figure 4.4 from the responses obtained in the questionnaire and interview. The integrated road safety model developed for Chitungwiza provides a single framework within which all the key elements of community engagement, institutional support, infrastructure improvements, technology and education come together in

harmonious action instead of separate actions. The main objective of this model is to recognize that road safety is a shared responsibility of the people, organizations and business. The interplay between these four pillars creates a dynamic system in which each pillar supports the other: Community engagement provides the social fabric for behaviour change; good governance and enforcement and accountability are supported by institutional structures; infrastructure supports the physical environment for safety; and technology and education bring in innovative approaches and raise awareness of the public, ensuring continued progress. These linkages between the constituents and important stakeholders, including the government, non-governmental organizations and the private sector, represent ongoing interaction and feedback. The government provides policy direction and governance. NGOs and civil society more generally involve communities and promote inclusive practices, commercial partners provide financial resources, foster innovation and bring in specialised technical knowledge. This intrinsic connectiveness ensures that intervention is not a paltry collection of different and non-coordinated actions, but a coherent set of actions which are coordinated by all the layers of society. At the heart of the whole process are the essential mechanisms for sustainability – the financial mechanisms, the continuous monitoring and building local capacity. These provisions ensure that projects aren't just short-term, but also become long-term, institutionalized behaviours. Financial resources allows for the financial sustainability of undertakings, continuous monitoring allows for accountability, and capability enhancement equips local participants to maintain and expand safety programs on their own. Together they transform the model from a concept to a realistic, flexible system that will be able to resist the socio-economic and institutional challenges at hand. In conclusion, the model highlights the multifaceted nature of road safety in Chitungwiza, emphasizing the need for shared effort, trust, and commitment among all stakeholders. It integrates behavioural, infrastructural and institutional reform in a coherent fashion that is easily implementable by local governance and that can be scaled up and rolled out nationwide, so that improved road safety becomes a reality rather than a project.

4.7 A sustainability and financing plan that supports model durability for 10–20 years.

The final study objective was to develop a sustainability and financing plan that supports model durability for 10–20 years. Results are presented in figure 4.5 below.



Figure 4.5: Sustainability and Financing Plan

Source: Primary data (2026)

The sustainability and financing plan is carefully designed around four interdependent pillars, carefully designed to support the long-term viability of road safety programs for a projected 10-20-year horizon. The overall goal of long-term road safety durability is the unifying protective measure that brings together all the “parts” and promotes continuous operation and adaptability. The first pillar, diversification of funding sources, highlights the need for funds to be raised from a diversity of sources. These include public sector appropriations, philanthropic and international investments, and investments from the corporate sector that pass through organizational civic engagement. This strategic diversification is designed to avoid the risks associated with relying on just one source of income and helps to balance the books even during times of economic contraction. The second pillar is revenue raising, and includes aspects like regulatory penalties and penalties, user fees for thoroughfares, and public-private partnerships. These measures are designed to create independent revenue streams that would be allocated directly to initiatives that teach drivers and pedestrians how to stay safe in cars. These are designed to create independent revenue streams that would be allocated directly to initiatives that teach drivers and pedestrians how to stay safe in cars promoting responsibility

and increase compliance with regulations. The third pillar focuses on capacity development and training and strives to continuously upgrade the skills and proficiencies of locals, as well as public awareness campaigns. This approach lays the groundwork for the formal transfer of knowledge through structured teaching programmes and validates the independence of road safety projects, which cannot depend on outside bodies but will be maintained by local bodies and community involvement. The fourth pillar is devoted to monitoring and assessment and builds the necessary oversight. It ensures the effectiveness, clarity, and adaptability of interventions by regularly conducting fiscal and operational reviews, in-depth effectiveness assessments, and robust information management systems. The robustness of the financial reserves and a thorough policy and governance framework are the underpinnings of this entire construct. The financial resources are to ensure financial protection in the event of any surprise shocks and the administrative and regulatory framework ensures that policies are consistent and clear and can be implemented. Together, these interdependent components create a sustainable financing and sustainability strategy that helps ensure the continued effectiveness of the whole-of-road safety paradigm for 10 to 20 years. The design ensures that road safety is not a one-off project, but becomes a habit, which is part of governance, community culture and economic planning.

The sustainability and financing plan will certainly be associated with implementation challenges that could arise in practice. For instance, while the installation of speed feedback signs is a critical intervention, the government may face difficulties in securing upfront capital for such infrastructure, especially in the context of competing budgetary priorities. To address this, there is need to incorporate phased implementation, beginning with high-risk accident zones, and leverage partnerships with private sector actors through corporate social responsibility initiatives. Additionally, international development agencies and philanthropic organizations would be approached to provide seed funding, with the government gradually assuming greater responsibility as fiscal space improves. This staged approach ensures that essential interventions are not delayed indefinitely due to funding constraints, while also spreading costs over time to make them more manageable.

Equally important is the issue of community trust in authorities, which directly affects the success of road safety initiatives. In Chitungwiza, past experiences of weak enforcement and inconsistent service delivery have eroded public confidence, making it difficult for

communities to fully embrace new technologies or compliance measures. To mitigate this, the sustainability plan include mechanisms for transparency and accountability, such as regular public reporting on road safety outcomes, participatory monitoring committees, and visible reinvestment of collected revenues (fines and user fees) into local safety improvements. Through demonstrating tangible benefits and involving community representatives in oversight, authorities can gradually rebuild trust and foster a sense of shared ownership. This participatory approach not only strengthens legitimacy but also ensures that interventions are culturally sensitive and responsive to local needs, thereby enhancing the durability of the model over the 10–20-year horizon.

4.8 Discussion of Results

4.8.1 The principal contributors to road safety challenges in Chitungwiza districts

The investigation has clearly shown that excessive speed – which was found in 90% of incidents, and distracted driving – which was found in 85% of incidents – are the top causes of road safety problems in Chitungwiza. This observation aligns with other international scholarly works, which have consistently attributed human factors as the major cause of vehicle accidents accounting for 90-95% of global accidents (Adedeji et al., 2024). Excessive speed is a well-known major contributor to fatal road traffic crashes (Tinella et al., 2024). At the same time, driver distraction, especially phone usage, has been proven to be one of the leading factors contributing to fatalities in developed and emerging countries (Dotse, Nicolson & Rowe, 2019). Lack of infrastructure (lack of lighting; lack of road markings; bad road surface or absence of pedestrian path; 55%, 58% and 70% respectively) were also reported as significant problems. The findings observed are consistent with the research findings that have shown that poor road management, limited traffic controls, and the lack of pedestrian facilities increase the risk of roadway crashes (Lucas et al., 2024; Babalola et al., 2025). Additionally, gaps in regulation (73%) are a factor that can worsen the situation. The situation described is representative of the fact that there are systemic weaknesses, similar to those experienced in the Southern African Development Community (SADC) region, with the capacity to implement the laws and regulations always falling short (Africa Status Report, 2025). To conclude, the results from Chitungwiza clearly indicate that traffic safety issues have multiple factors and are complex in nature, encompassing behavioral, structural and organizational elements. This is in accordance with strong empirical evidence from across the continent and globally.

While the findings strongly confirm the global evidence that human factors such as speeding and distraction are the leading causes of accidents, they also highlight the limitations of the Safe System Approach when applied in Zimbabwe. The Safe System model assumes that infrastructure, enforcement, and institutional capacity are sufficiently robust to complement behavioral interventions. However, in Chitungwiza, systemic weaknesses in enforcement and infrastructure mean that the model cannot simply be transplanted without adaptation. The theory must be recalibrated to account for fragile institutional capacity and resource constraints, emphasizing incremental, community-driven interventions rather than relying heavily on centralized enforcement. This suggests that while the Safe System provides a useful framework, its effectiveness in Zimbabwe depends on tailoring it to local realities where governance gaps and infrastructural deficits are more pronounced.

4.8.2 The acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies

The study revealed that speed feedback signs, mobile crash reporting systems, and GIS-based hazard mapping systems had high willingness to adopt scores at 92%, 80%, and 86% respectively. The results align with previous academic research that highlights the need for economical and user-friendly technologies in resource-limited settings. For illustrative purposes, roadway calming features like rumble strips and speed bumps have actually resulted in a reduction of vehicle crashes by up to 35% and road deaths by up to 55% in countries like Ghana and Tanzania (OECD, 2022; WHO, 2023). The widespread adoption of velocity feedback indicators can be attributed to the fact that they are simple to implement, not punitive, and it appears that small investments such as road markings can reduce accident rates by 15-19% (Brenda & Rumutsa, 2025). Likewise, digital tools have begun to be recognized as effective tools for public awareness campaigns, and for documenting incidents, as long as they are designed to be easy to use across various user groups (Bullard et al., 2023). In addition, GIS based hazard mapping can support the transition to data-driven planning in line with world trends, but academic consensus warns that the effectiveness of the use of GIS depends on the allocation of sufficient financial resources and the necessary technical skills (Yao et al., 2023). The relatively low rate of uptake of 'other' technologies (70%) highlights the need to pilot and engage communities in building trust, as previous research has identified that local participation greatly improves uptake (Mehra et al., 2021).

The high willingness to adopt technologies such as speed feedback signs and GIS hazard mapping demonstrates their potential, but the findings also reveal that acceptability alone does not guarantee sustainability. The Safe System Approach assumes that once technologies are introduced, they will be consistently maintained and integrated into broader systems. In Zimbabwe, however, financial constraints and limited technical expertise pose significant barriers to long-term usability. This means the theory must be adapted to prioritize low-cost, community-managed technologies that can be maintained locally without heavy reliance on external funding or advanced technical skills. The findings suggest that while the Safe System emphasizes technological solutions, in the Zimbabwean context, the model must incorporate capacity-building and community ownership as critical elements to ensure operational effectiveness over time.

4.8.3 The social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives

The survey results highlighted that there was a high level of lack of public awareness (82%) and also a lack of trust in authorities (85%) as the greatest obstacles. This finding is supported by academic research which has suggested that wider engagement is hindered by the social acceptance of risky practices and by a lack of knowledge about traffic laws (Mitullah et al., 2022). Moreover, the loss of trust in institutions was highlighted in Tanzania, where the variability of enforcement has been found to affect levels of public trust. (WHO, 2021). Access to key information and/or technology is also limited (75%) and time pressures are high (80%), all of which compound the current disengagement, and highlight the socio-economic differences. Extensive research shows that communities commonly lack sufficient time and resources to properly invest in safety-focused projects due to destitution, joblessness and competing needs for food (African Development Bank, 2024). In Chitungwiza, the 'other' classification (65%) included financial hardship, cultural norms and attitudes, and situations where political interference harmed continued participation among the communities. This resonates with evidence in the region that financial constraints and administrative shortfalls negatively affect the communities' sustained involvement (Lesotho case, AfDB, 2024). On the other hand, research suggests that supporting community ownership and effectiveness can significantly be enhanced through enabling factors such as school-based education campaigns, engaging religious groups, and delivering affordable interventions (Randall, 2025; International Transport Forum, 2023).

The survey results underscore that lack of trust in authorities and socio-economic hardship are major barriers, which exposes a critical gap in the Safe System Approach. The model presumes a baseline of institutional legitimacy and public trust, yet in Chitungwiza, these conditions are weak. This means that the Safe System cannot function effectively without deliberate efforts to rebuild trust and address socio-economic inequalities. The findings suggest that the theory must be adapted to integrate participatory governance mechanisms, transparency in enforcement, and community-led initiatives that directly respond to local needs. In Zimbabwe, road safety cannot be divorced from broader socio-economic realities, and therefore the Safe System must evolve into a more socially embedded model that explicitly addresses poverty, inequality, and institutional credibility.

4.8.4 An integrated road safety model with stakeholders, producing a model ready for institutional adoption and scaling

The conceptual framework designed within the scope of this study encompasses the involvement of the community, institutional support, infrastructure improvement and technology and educational facilities, with mechanisms ensuring long-term viability. This approach is similar to the Safe System model used in South Africa, where there is shared responsibility between government organisations, non-governmental organisations, the police and the community (WHO 2023). Findings from both Malawi and Botswana reflect the Chitungwiza model, which relies on accessible technologies and community participation, and showed effectiveness: Traffic calming, reflective signage and public information campaigns (International Transport Forum, 2023; ARSO, 2021). Similar to Ghana and Kenya, who utilize public-private partnerships and donor funds to support fiscal resilience, multiple sources of funding are utilized (OECD, 2023, AfDB 2024). Centralization is a necessary element to ensure widespread implementation, like the centralized road safety authority in Botswana that enabled national orchestration (AfDB, 2024). The Chitungwiza model also combines regulatory compliance, public education, and infrastructural planning to ensure the model's ability to scale and sustain itself for 10 to 20 years. Academic scholarship confirms that a multi-stakeholder and holistic approach makes more impact than a fragmented approach, providing a clear blueprint for a systemic approach in Zimbabwe and the Southern African Development Community (SADC) region as a whole.

The integrated model designed in this study reflects the Safe System principles but also highlights the need for contextual adaptation. While the Safe System emphasizes shared

responsibility and multi-stakeholder involvement, the findings show that in Zimbabwe, institutional fragility and resource limitations require a stronger emphasis on decentralization and community empowerment. The theory must be adapted to ensure that local bodies and community groups are not just participants but central actors in sustaining interventions. Furthermore, the reliance on donor funding and public-private partnerships in the region suggests that financial resilience must be built into the model from the outset, rather than assumed. Thus, the findings reveal that while the Safe System provides a valuable blueprint, its application in Zimbabwe requires a hybrid approach that balances centralized coordination with grassroots ownership, ensuring that the model is both scalable and sustainable in a resource-constrained environment.

A comparative perspective further strengthens the integrated model by situating Zimbabwe's experience within broader African road safety interventions. For instance, in Ethiopia, large-scale community education campaigns combined with stricter enforcement of speed limits have shown measurable reductions in accident rates, but challenges remain in sustaining funding and institutional oversight (Bekele, 2022). In Uganda, the introduction of boda-boda (motorcycle taxi) safety programs illustrates how targeted interventions can address context-specific risks, though their success depends heavily on community buy-in and consistent enforcement (Nabirye, 2021). Similarly, Rwanda's centralized traffic management system demonstrates the benefits of strong institutional coordination, yet its replicability in Zimbabwe is limited by fiscal and governance constraints (Uwimana & Habimana, 2023). These comparisons highlight that while the Safe System Approach provides a useful framework, its application must be adapted to local realities: Zimbabwe's model must emphasize grassroots ownership and incremental implementation, rather than assuming the same institutional strength or financial capacity found in other contexts. This critical reflection underscores that international evidence offers valuable lessons, but successful adoption in Zimbabwe requires tailoring interventions to the country's socio-economic and institutional environment.

The heritage dimension of Education 5.0, Zimbabwe's unique cultural values and traditional community structures can be leveraged to strengthen the integrated road safety model. For example, the long-standing practice of chiefs and village heads mediating community affairs could be extended to road safety initiatives, where traditional leaders play a role in mobilizing awareness and enforcing community norms around safe driving. Similarly, religious

institutions and cultural associations, which hold significant influence in shaping moral behavior, can be incorporated into awareness campaigns to embed road safety within everyday cultural practices. Traditional storytelling, music, and drama already used in Zimbabwean heritage education could be adapted to communicate safety messages in ways that resonate with local identity and values. Through embedding road safety within cultural heritage and community structures, the model not only enhances legitimacy and trust but also ensures that interventions are sustained through social norms and collective responsibility, rather than relying solely on formal enforcement mechanisms.

4.9 Chapter summary

The chapter has discussed the response rate when using questionnaires and interviews and their significance for the research. The following section described the demographic characteristics of the respondents to this study. This was followed by presentation and interpretation of the responses to the five specific research questions. The chapter ended with a discussion of the results with the previous empirical results. Conclusions and recommendations of the study are described in the next section.

CHAPTER FIVE

STUDY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The empirical results of the study were explained in great detail in the previous chapter. This current chapter therefore presents a synthesis of these findings to be the key insights that underlie the investigation. It then moves onto summarizing the findings of the above analysis. The following sections expand on these findings, and the final portion of this chapter offers recommendations for future studies to advance and expand the academic contributions of this research

5.2 Summary of the study and findings

The purpose of this study was to develop a model that enhance road safety through integration of technology and community engagement in Zimbabwe. The study was initiated when it was realised that Chitungwiza, one of the busiest commuter corridors, the Seke Road has become a symbol of deterioration with potholes, congestion and poor lighting all contributing to the loss of hundreds of lives in the road and thousands of injuries in the corridor. Specifically, the study aimed to identify the main causes of road safety problems in Chitungwiza districts and performance and acceptability of the chosen low and medium cost road safety technologies. The study was also designed to identify the social, institutional and economic enablers and hindrances to continued community involvement in road safety programs. The fourth objective of the study was to co-design an integrated road safety model with stakeholders which results in a model that is ready for institutional adoption, institutional scaling, and finally a sustainability and financing plan to ensure the model's durability for the next 10–20 years. The major theory underpinning the study entail the Safe System Approach which originated from Sweden's Vision Zero policy (1997) and the Dutch Sustainable Safety philosophy. The literature reviewed validated gaps that were filled by this study, both contextual and geographical. This study was conducted using the design of mixed method concurrently executed by triangulation approach, within the framework of pragmatic philosophy. A wide range of survey respondents ($n = 180$) and key informants ($n = 15$) were selected. The key informants for Chitungwiza were identified as important community leaders and stakeholders, including individuals like the ward councillors, the transport associations, the Civil Society

Advocates, law enforcement and municipal engineers. The main results for each of the research objectives will be presented in the next section.

5.2.1 The principal contributors to road safety challenges in Chitungwiza districts

The study was able to show that the challenges facing road safety in Chitungwiza have more to do with a combination of poor infrastructure, unsafe behaviour and weak enforcement. Pervasive over speeding was determined as the leading contributing factor, with a significant 90% of all respondents stating it was the most common, followed closely by inattentive operation of a vehicle at 85%. Both illustrate that entrenched unsafe habits exist that pose risks to public safety. Furthermore, the rules were poorly implemented: 73% of respondents reported that the rules were poorly implemented, adding to these difficulties by reducing the effectiveness of preventive measures. There were also significant concerns about the physical infrastructure. Sixty-one percent of respondents said that substandard road maintenance was a problem, as was deficient road signage (fifty-eight percent) or insufficient illumination (fifty-five percent). Also, potholes as well as lack of dedicated pedestrian walkways (mentioned by a prominent 70 percent) add to the dangers for all road users, including driver of vehicles and pedestrians. Responses to the questionnaire were echoed by the key informant interviews.

5.2.2 The acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies

Based on the questionnaire and interviews that were conducted in Chitungwiza, the findings suggest that the communities are fairly accepting, applicable and are very effective at operating the economical road safety technologies. However, there are different levels of enthusiasm on this support, depending on interventions. Of the solutions analysed, 92% of the respondents wished to adopt the speed feedback signs. This positive take-up is testament to their ease of use and to the fact that there was no hard pressure and direct impact on driver behaviour. The geographic information system (GIS) hazard mapping systems were closely monitored with 86 % approval which reveals an appreciation of their significance in evidence-based planning even though there were a few concerns about cost of investment and technical skills. High interest was also expressed in the use of mobile application for crash reporting; 80% of the respondents indicated they were prepared to adopt mobile application for crash reporting. However, ongoing questions about data privacy and the receptivity of institutions to data have been raised. In contrast, data for the remaining category “Other” technologies got the lowest

response (only 70%), indicating a lower degree of societal confidence and familiarity with such new technologies. To conclude, the results suggest that communities are open to pragmatic tools that are easily adopted, and that they believe they innately benefit from the technology; however, use of these technologies is contingent on community-level barriers, such as available resources, trust in the reliability of the technology by administrators and the need for specialized training and technology development funding for use.

5.2.3 The social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives.

The questionnaire and interview data shows that there are multi-dimensional social, organisational and financial constraints that militate against high participation of the public in the traffic safety programmes in Chitungwiza. Overall, low levels of confidence in official institutions was the key barrier with a significant proportion of people feeling less than confident in the trustworthiness of government institutions (85%). But the lack of awareness of the population (82%) was another big problem too, as many of the residents were unaware of the significance of traffic safety to their lives. Access to information and technology was also found to be inadequate (75%), particularly in homes with low economic status and in location with low internet connectivity. Pressures on personal time (80%) also pointed to the difficulty of maintaining a balance between the economic and civic requirements. In addition, 65% of the respondents, other problems such as economics, culture, and political pressure made these difficult circumstances even more complicated.

5.2.4 An integrated road safety model with stakeholders, producing a model ready for institutional adoption and scaling

For a comprehensive and all-encompassing road safety model, the design was specifically developed for Chitungwiza and a model that would include a framework for public empowerment, institutional support, infrastructure development and technological development was drawn; these would all be incorporated into a seamless coordinated way into educational programmes that would benefit both the educational programmes as well as the model. The model highlights shared responsibility for road safety, and it places a particular emphasis on collaboration between the citizenry, government, non-governmental organizations and businesses. The different parts are targeted, reinforcing each other: civic participation leads to positive behavioral changes in citizens, the institutional part promotes good governance and adherence to the law, infrastructure enhances safety of physical environments, and the synergies of technology and education end up promoting an informed understanding and

innovative development. These are mutually dependent on each other, with ongoing communication with all concerned and ensuring interventions are integrated, coordinated and not fragmented or disjointed. The model is supported by solid instruments for continued implementation, e.g., financial planning, comprehensive monitoring, and professional development, which make for its continued effectiveness and incorporation into existing systems. The model, in its final form, transforms road safety from a collection of individual projects and interventions into a flexible, robust system, based on mutual trust, joint action and joint ownership, which is suitable for implementation by local governments and can be scaled up country-wide in Zimbabwe.

5.2.5 A sustainability and financing plan that supports model durability for 10–20 years

Chitungwiza's strategic plan for sustainability and funding of Chitungwiza road safety programs is built on four pillars which are interlinked to make sustainability of the programs possible for ten to twenty years. Public funding mechanisms (appropriation from the public sector), philanthropy and private sector investment options are used to ensure that there is fiscal strength and less dependence on the single source of funding. Secondly, there are excellent mechanisms to create income, such as fines from traffic violations, user tolls and public/private partnerships for generating the financial resources needed to develop smartly and carefully safety enhancement programs. Third, strategic capacity development and holistic training agreements are key to maintaining operations, not relying on external actors, building local expertise and raising awareness. Finally, the accountability process is built on very strict monitoring and evaluation frameworks, through the implementation of periodic audits, deep evaluation and the use of advanced monitoring software. In addition, they are supported by the establishment of contingency reserves and an efficient policy and governance process, thus mitigating risk of unforeseen incidents and strong policy implementation. The integrated plan as a whole transforms road safety from a campaign-focused initiative into a long-term institutional-based and resilient road safety practice that is embedded in Government work, civic engagements and economic development plans.

5.3 Study Conclusions

5.3.1 The principal contributors to road safety challenges in Chitungwiza districts

The study has shown that the major problems facing the road safety in Chitungwiza include problems from human factors which are strongly entrenched, including high speed traveling of vehicles and inattention of the drivers. This situation is compounded by inadequate regulatory systems and continued lack of adequate physical infrastructure. The combination of the different factors shows that road safety is not just a technical issue but a systemic problem that requires a systemic solution that includes behavioral changes, increased institutional accountability, and continued funding for infrastructure improvements.

5.3.3 The acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies

The results of the research clearly show the people of Chitungwiza have a clear appetite for pragmatic, economically viable technological innovations that will give them a tangible benefit. Especially, there were strong affirmations for velocity feedback indicators and Geographic Information System (GIS) based hazard mapping platforms. However, the seamless adoption of these developments is heavily dependent on the successful alleviation of multiple operational constraints, including, but not limited to, financial, technical and institutional capabilities. It is therefore suggested that as technological interventions have significant potential, they rely on effective and sustainable governance structures to be implemented and that user confidence is built through transparency and regularity.

5.3.4 The social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives

The results of this research indicate that trust in governing bodies, lack of knowledge, lack of access to relevant information and socioeconomic barriers, including time constraints and economic difficulties, are significant constraining factors for enduring community engagement. Overall, these collective obstacles highlight the need for institutional changes, such as developing credible and trustworthy institutions, making information available fairly to the public, and designing the programmes to reflect local contexts and societal realities. If the basic systemic barriers aren't addressed, for example the lack of road safety in some regions, programs, such as car-to-X communication, will have limited and temporary impact.

5.3.5 An integrated road safety model with stakeholders, producing a model ready for institutional adoption and scaling

The integrated model reveals that the active involvement of communities, sound institutional arrangements, strategic infrastructure development, and innovative technology development are crucial for ensuring effective road safety in Chitungwiza and that achieving such goals is a prerequisite for all of this. This model offers a scalable and resilient approach, capable of creating an integrated system of operations that is collaborative, accountable, and sustainable, even from the start, whilst ensuring the integration of previously disjointed interventions. Being an institutionally ready template makes it a good blueprint to be adopted and replicated nationally in Zimbabwe.

5.3.6 A sustainability and financing plan that supports model durability for 10–20 years

The study finds that the success of road safety programs is dependent on a holistic financial and sustainability plan. The framework should be supported by a variety of funding sources, independent income generation, improved institutional capacity and strong evaluation mechanisms. Most importantly, these core components, combined with contingency reserves and robust governance mechanisms, are key to creating resilience to fiscal and organisational shocks. This strategic approach brings road safety from the short-term, one-off project to an institutionalized practice, firmly integrated into the public administrative and social fabric and therefore with a long-term sustainability, which means it provides for a significant social impact.

5.4 Recommendations of the study

5.4.1 The principal contributors to road safety challenges in Chitungwiza districts

There is a need for joint action from various stakeholders to address the major causes of road safety problems in Chitungwiza districts. Government authorities are responsible for making stricter speeding laws a reality, with increased police presence, speed cameras, and consistent enforcement of penalties. At the same time, it is essential for municipal councils to prioritize investments in critical infrastructure such as road maintenance, installing proper signage on the streets and enhancing the lighting on the streets to address existing structural issues. Community leaders are at the forefront of leading behaviour change initiatives, including those that aim to reduce excessive speed and distracted driving and should be culturally congruent with local norms. Ministry of Police and Correctional Services are called upon to strengthen institutional responsibility to implement the traffic laws in a consistent manner and to provide public information on compliance with the law.

5.4.2 The acceptability, usability, and operational effectiveness of selected low- and medium-cost road safety technologies

Assessing the suitability, utility and practical effectiveness of the chosen low and medium cost road safety technologies plays an important role in their effective deployment. Local governmental agencies should allocate funds to install speed feedback displays and have Geographical Information System (GIS) hazard mapping platforms available. On the other hand, technology developers have to also evolve their mobile incident reporting applications to make them user-friendly and ensure that they have strong measures in place for data security. The involvement of civil society organisations in public awarenessbuilding to build public trust and acceptance of new technologies is encouraged. Additionally, technical skills and investment from private sector partners are recommended to enable the rollout of cost-effective technologies to different districts.

5.4.3 The social, institutional, and economic facilitators and barriers that affect sustained community engagement in road safety initiatives

A range of social, institutional and economic factors plays a role in maintaining community involvement in road safety programs. Government agencies are advised to have clear and effective processes for restoring public confidence in road safety agencies. Schools are encouraged to make road safety education part of their school curriculum and to continue to do so in other community education initiatives. Non-governmental organizations (NGOs) are invited to extend their scope of activities to the neglected groups, who lack access to technologies and information. More importantly, community associations should design flexible engagement strategies that meet community members' schedules and economic realities.

5.4.4 An Integrated Road Safety Model for Institutional Adoption

The creation of an integrated road safety framework, with a multi-participant approach, is intended to generate an institutionalization-ready model that is scalable as illustrated in figure 4.4. It is the responsibility of the municipal authorities to institutionalize this integrated model by bringing it into the local governance framework, thus securing its continuity. NGOs and civil society organizations are encouraged to be a key component of the implementation of the model and to help in promoting community participation and inclusivity. The private sector is encouraged to invest in key infrastructure and technological solutions, at the same time providing innovative contributions and special technical skills. The national government, ultimately, is responsible for scaling this model up in Zimbabwe by including it in national policies.

5.4.5 Sustainability and Financing for Long-Term Model Durability

Therefore, a detailed sustainability and financing plan is critical to sustain this model for a projected time of 10-20 years as shown in figure 4.5. Government ministries are urged to generate multiple sources of funding – including traditional budget funds, donor funds and funds from the private sector. There is a call for the private sector to further participate in public-private partnerships to create autonomous sources of funding for road safety projects. Training institutions are encouraged to share their capacity building and professional development opportunities with local stakeholders on an ongoing basis. Last, the oversight bodies are encouraged to put in place rigorous monitoring and evaluation mechanisms to ensure that programs are delivered in an accountable and responsive manner.

5.5 Suggestions for further research

Future studies should explore the applicability of the integrated road safety model to other urban and rural settings in Zimbabwe and investigate how different infrastructure, governance capacities and local culture influences the implementation's success and effectiveness. Cross-district analyses of regions with a range of socio-economic situations would provide deep insights into the effect of socio-economic differences on road user risk-taking behaviour and in the adoption of affordable technological solutions. Another important research thrust is long-term studies that measure the lasting impact of certain road safety strategies, like speed feedback signs, GIS-based hazard mapping and mobile crash reporting apps. This should be particularly focused on sustainability of behaviour change and adaptability of relevant institutional changes. In addition, further research may focus on the value of public trust and confidence in governance. This would include evaluating the impact of transparency, accountability, and anti-corruption on community engagement and support in road safety initiatives. Finally, the study is replicable in other high-density suburbs of other countries in the SADC where accidents abound.

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APPENDIX 1: QUESTIONNAIRE



My name is Gertrude Whacha, a Master's student the Bindura University of Science Education. It is part of the requirements of my Master's in Leadership and Corporate Governance programme that I carry out a study in an area that is related to my studies.

The study is on: ***“Enhancing Road Safety Through Integration of Technology and Community Engagement in Zimbabwe.”***

I am kindly requesting for your input by answering the following questions. The data collected will be used for **academic purposes only** and your identity will remain confidential. Participation is voluntary and should you feel like no longer want to continue answering the questions, you are free to discontinue.

Should you require any further information please do not hesitate to contact me.

Yours Faithfully,

Gertrude Gamuchirai Whacha

gertrudewhacha@gmail.com.

SECTION 1: DEMOGRAPHIC INFORMATION

Section 1: Demographic Information

1. Age: _____

2. Gender: Male ☐ Female ☐ Other ☐

3. Occupation: _____

4. Duration of residence in Chitungwiza: _____ years

5. Do you own or operate a vehicle? Yes ☐ No ☐

Section 2: Perceptions of Road Safety Challenges

6. In your opinion, what are the top three causes of road accidents in Chitungwiza? (Select up to three)

- ☐ Poor lighting
- ☐ Lack of signage
- ☐ Excessive speeding
- ☐ Poor road maintenance
- ☐ Driver behaviour (e.g., distracted driving)
- ☐ Enforcement gaps
- ☐ Infrastructure deficits (e.g., potholes, lack of sidewalks)

Other: _____

7. On a scale of 1 to 5, how severe do you think the problem of road safety is in Chitungwiza?

(1 = Not severe, 5 = Very severe) _____

Section 3: Use and Acceptance of Road Safety Technologies

8. Are you aware of any of the following road safety technologies? (Check all that apply)

- ☐ Mobile crash reporting apps
- ☐ Speed feedback signs
- ☐ GIS-based hazard mapping systems
- ☐ Other: _____

9. Would you be willing to use any of the above road safety technologies if they were implemented?

- ☐ Yes
- ☐ No
- ☐ Unsure

10. How likely are you to report road hazards or accidents using mobile reporting tools? (1 = Very unlikely, 5 = Very likely) _____

Section 4: Community Engagement and Barriers

11. How involved are you in community road safety initiatives?

- ☐ Not involved
- ☐ Occasionally involved
- ☐ Regularly involved

12. What are the main barriers to participating in road safety activities? (Select all that apply)

- ☐ Lack of awareness
- ☐ Lack of trust in authorities

☐	Limited access to information or technology
☐	Time constraints
☐	Other: _____

Section 5: Sustainability and Future Planning

13. What measures do you think are necessary to sustain road safety initiatives in Chitungwiza? _____

14. Would you support a community-based funding or governance model for ongoing road safety efforts?

☐	Yes
☐	No
☐	Maybe

Thank you for your participation!

APPENDIX 2: SEMI-STRUCTURED INTERVIEW GUIDE



Introduction:

My name is Gertrude Whacha, a Master's student at the Bindura University of Science Education. It is part of the requirements of my Master's in Leadership and Corporate Governance programme that I carry out a study in an area that is related to my studies.

The study is on: *“Enhancing Road Safety Through Integration of Technology and Community Engagement in Zimbabwe.”*

The purpose of this interview is to gather your insights on road safety challenges, the acceptability of technological solutions, community engagement, and sustainability of interventions in Chitungwiza.

I am kindly requesting for your input by answering the following questions. The data collected will be used for **academic purposes only** and your identity will remain confidential.

Participation is voluntary and should you feel like no longer want to continue answering the questions, you are free to discontinue.

Do you have any questions before we begin? Do you give your consent to participate and for this interview to be audio recorded? (If yes, start recorder.)

Thank you for taking the time to participate

Should you require any further information please do not hesitate to contact me.

Yours Faithfully,

Gertrude Gamuchirai Whacha

gertrudewhacha@gmail.com.

Interview with Community Leaders

Section 1: Identifying Causes and Challenges

1. From your experience, what are the main factors contributing to road safety issues in Chitungwiza?

2. How do you perceive the current state of road infrastructure, signage, and lighting?

Section 2: Technology Acceptance and Use

3. What is your opinion on the use of low-cost road safety technologies such as mobile crash reporting and speed signs?

4. What factors would influence your willingness or reluctance to adopt these technologies?

Section 3: Community Engagement

5. How can community members be encouraged to participate actively in road safety initiatives?

6. What challenges do you see in maintaining sustained community involvement?

Section 4: Model Development and Sustainability

7. Based on your experience, what should an effective integrated road safety model include?

8. What are the key barriers to ensuring the long-term sustainability of road safety programs?

9. What governance or financing mechanisms could support ongoing efforts?

Closing:

10. Do you have any additional comments or suggestions related to improving road safety in Chitungwiza?

APPENDIX 3: ETHICAL CLEARANCE LETTER

RESEARCH ETHICS COMMITTEE



P. Bag 1020
BINDURA, Zimbabwe
Email : rid@buse.ac.zw

BINDURA UNIVERSITY OF SCIENCE EDUCATION [BUSE]

11 June 2026

Getrude G Whacha
Bindura University of Science Education
Graduate School of Business
P. Bag 1020
Bindura

Dear Getrude G Whacha

**RE: INSTITUTIONAL RESEARCH COMMITTEE ETHICAL CLEARANCE-APPROVAL NUMBER:
BUSEREC/0261/2026**

Your application for research ethical clearance related to the topic, '**Enhancing Road Safety through Integration of Technology and Community Engagement in Zimbabwe**' has been approved and allocated approval Number: **BUSEREC/0261/2026**. You are to quote this approval number for all correspondences inclusive of consent forms and any other documents as and when appropriate. The approval period is as stated below:

Type of Meeting : 19th Research Ethics Committee meeting
Approval Date : 11/06/2026
Expiry date : 10/06/2027

The project will automatically discontinue on the expiry date. You can apply for renewal three months before the expiry date. The renewal application should be accompanied by a progress report.

You are not expected to make any changes/adjustments to the protocol including the consent documents. Any trials involving drugs, devices and biologics require approval of the Medicines Control Authority of Zimbabwe before commencement. All problems to do with the safety of participants must be reported to BUSEREC within three (3) working days.

Upon termination of the study, a report has to be submitted to BUSEREC.

Yours sincerely



BUSEREC CHAIRPERSON

APPENDIX 4 : SIMILARITY INDEX REPORT



Page 2 of 90 - Integrity Overview

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