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Evaluating the role of traffic surveillance cameras in enhancing road safety in Greater Gaborone

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Abstract

This paper evaluates the role of traffic surveillance cameras an application of Intelligent Transportation Systems (ITS) in enhancing road safety in Greater Gaborone. Recognizing that Botswana faces significant road safety challenges and limited ITS infrastructure, the study focuses on the implementation and perceived effectiveness of surveillance cameras. Drawing on a purposively selected sample from the Department of Road Transport and Safety, the study used structured questionnaires to gather descriptive data. Results indicate a generally positive perception of surveillance cameras in promoting road safety, though findings are limited by sample size. The paper applies the Risk Homeostasis Theory and the Haddon Matrix to contextualize findings and offer evidence-based recommendations.

Keywords: Intelligent Transportation Systems; Traffic Surveillance Cameras; Road Safety; Risk Homeostasis; Haddon Matrix

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1. Introduction

Road transport remains the dominant mode of transportation in Botswana due to its extensive road network and the country's landlocked nature, which limits reliance on maritime trade and other modes such as rail and air (Ministry of Transport and Communications, 2022). As a result, the road network serves as the backbone of socio-economic activity, facilitating the movement of goods and people within urban and rural areas and across borders. However, this heavy dependence on road transport has been accompanied by a persistent rise in road traffic crashes, making road safety a pressing public health and development issue.

According to the World Health Organization (2023), approximately 1.19 million people die annually in road traffic accidents globally, with low- and middle-income countries accounting for 93% of these fatalities despite having only 60% of the world's vehicles. Botswana is no exception. Statistics Botswana (2022) reported 5,052 road traffic crashes in 2020, resulting in 325 fatalities and over 800 serious injuries. These figures not only reflect a loss of life but also impose significant economic burdens on families, healthcare systems, and the national economy (Smit and Peters, 2021).

Efforts to mitigate road crashes have traditionally relied on manual enforcement and driver education programs. However, the increasing complexity of urban traffic and limitations in human enforcement capacity have necessitated the adoption of advanced technological solutions. Intelligent Transportation Systems (ITS), which include tools such as traffic surveillance cameras, adaptive signal control, and automated incident detection, are increasingly being recognized as effective interventions to enhance road safety and efficiency (Zhang et al., 2021; Kumar and Kumar, 2022).

In Botswana, the deployment of ITS has been slow due to infrastructure and financial constraints. However, recent years have seen the introduction of traffic surveillance cameras in selected urban areas, particularly Greater Gaborone. These cameras are intended to support law enforcement by monitoring driver behavior, detecting violations, and improving response to accidents (Lee and Wong, 2020). Despite their growing presence, there is limited empirical research evaluating their effectiveness or public perceptions of their impact on road safety in the local context.

This study aims to fill that gap by evaluating the role of traffic surveillance cameras in enhancing road safety in Greater Gaborone. The research is grounded in two theoretical models Risk Homeostasis Theory (Wilde, 2017), which addresses driver risk behavior, and the Haddon Matrix (Tapera, 2021), which provides a framework for understanding and mitigating traffic injuries across different phases. By analyzing perceptions from key stakeholders within the Department of Road Transport and Safety, this study contributes to the growing body of literature advocating for data-driven and technology-based solutions to road traffic challenges in developing countries.

2. Literature review

2.1. Factors contributing to road accidents

Road traffic accidents are typically caused by a complex mix of human error, environmental conditions, and vehicular issues. In Botswana, studies indicate that driver behavior including speeding, distracted driving, and non-compliance with traffic regulations accounts for the majority of road traffic accidents (Moseneke et al., 2020; Masipa et al., 2019). Inadequate infrastructure such as poor signage, potholes, and poorly lit roads further exacerbate these risks (Khamis and El-Gohary, 2021).

The urban areas of Greater Gaborone, with increasing vehicle density and limited road expansion, have seen a rise in accident frequency due to congestion and insufficient traffic management systems (Nguyen and Rahman, 2020).

2.2. Effectiveness of Intelligent Transportation Systems (ITS)

ITS represent a transformative solution to modern traffic management challenges. Globally, technologies such as surveillance cameras, adaptive traffic signals, vehicle-to-infrastructure (V2I) communication, and real-time analytics have shown considerable impact in reducing traffic congestion and improving road safety (Zhang et al., 2021; Lee and Wong, 2020). For instance, real-time traffic surveillance enables enforcement agencies to monitor high-risk zones and respond more efficiently to violations or accidents (Kumar and Kumar, 2022). Studies from developed countries have shown a reduction of up to 30–40% in traffic violations following the implementation of automated enforcement systems (Cicchino, 2017; Ravish, 2021). Moreover, adaptive signal control systems have been linked to smoother traffic flow, with measurable reductions in travel time and accident rates (Chen et al., 2023).

In the African context, ITS implementations remain limited, often due to cost and infrastructural challenges. However, in South Africa and Kenya, pilot ITS projects have demonstrated improved traffic compliance and reduced congestion when surveillance and signal systems were implemented in high-density urban corridors (Oketch et al., 2020). These regional examples support the potential scalability of ITS in Botswana.

2.3. Public awareness and acceptance

A key barrier to ITS success is public understanding and acceptance. Awareness campaigns and educational initiatives significantly influence the adoption and proper use of ITS technologies. Choi et al. (2022) argue that public trust in surveillance and automated enforcement systems is essential to ensure compliance and prevent misuse or backlash. In contrast, a lack of transparency and understanding may lead to public resistance, as seen in some developing countries where citizens view surveillance as invasive rather than protective (Odhiambo et al., 2021). Therefore, implementation must be accompanied by clear communication strategies.

2.4. Theoretical frameworks

2.4.1. Risk Homeostasis Theory (RHT):

Proposed by Wilde (1994), RHT suggests that individuals tend to adjust their behavior in response to perceived levels of risk. When safety measures increase (e.g., through ITS), individuals may subconsciously compensate by engaging in riskier behavior, maintaining their perceived equilibrium of risk.

This theory implies that ITS must be coupled with behavioral interventions and enforcement to produce sustainable safety outcomes (Wilde, 2017).

2.4.2. Haddon Matrix:

The Haddon Matrix, developed by William Haddon Jr., categorizes factors affecting injuries into human, vehicle, and environmental domains, and across pre-crash, crash, and post-crash phases (Khorasani-Zavareh et al., 2018). This framework aids in identifying targeted interventions. For instance, pre-crash interventions such as driver education and traffic law enforcement align with ITS tools like speed cameras and adaptive signals. In Botswana, applying the Haddon Matrix can help policymakers systematically assess where ITS can be most impactful especially in high-risk zones in urban areas like Gaborone.

2.5. Conceptual framework

This study adopts a framework in which ITS tools serve as independent variables influencing the dependent variable road safety outcomes. The framework posits that greater ITS deployment (e.g., traffic surveillance cameras, adaptive signals) leads to improved driver behavior, reduced accidents, and faster emergency response. The framework integrates principles from the Haddon Matrix and Risk Homeostasis Theory to account for both environmental and behavioral dimensions of road safety. The framework illustrates that the mediating variables such as driver behavior, real time traffic information and traffic flow optimization bridges the gap between ITS and road safety outcomes. The conceptual framework guiding this study is illustrated in Figure 1.

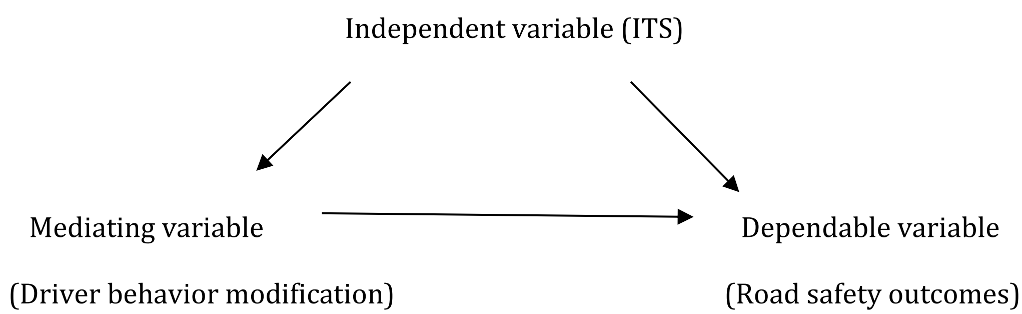

Figure 1. Conceptual framework

Intelligent transportation systems tools like traffic surveillance cameras can influence how drivers behave such as driving the correct speed limit consequently reducing car crashes. This is in accordance with the Risk Homoestasis Theory' principle of coupling ITS with behavioral enforcements in order to ensure great road safety outcomes (Wilde, 2017). Cicchino (2017) shows that vehicles with lane departure warning systems had 18 percent notable decreased involvement rates in crashes of all severities that is, when omitting driver demographics. A system like this would warn an individual when they are veering off their lane consequently helping to avoid car crashes.

According to Khoasani (2012), ITS contributes to reducing congestion and, consequently, the number of accidents. ITS achieves this by providing real-time information to travelers, assisting with travel planning, facilitating rapid responses to accidents, and offering alternative routes and travel times. These technologies shift the focus of road safety from merely reducing the consequences of crashes to actively preventing them. For instance, adaptive traffic signal control, real-time hazard detection, and dynamic lane management systems contribute to proactive crash prevention by addressing traffic risks as they arise. The Haddon Matrix does not only address factors causing accidents but phases of crashes as well and it is shown here by showing ITS tools that can be deployed during the crash phase of an accident.

3. Methodology

3.1. Research design

This study employed a mixed-methods research design to comprehensively evaluate the role of traffic surveillance cameras an Intelligent Transportation System (ITS) intervention in promoting road safety in Greater Gaborone. The mixed-methods approach was selected to capture both quantitative trends and qualitative insights, enabling triangulation of results and improving the validity of the findings (Creswell and Plano Clark, 2017). This design was particularly appropriate given the complex, multifactorial nature of road safety, which involves both measurable data (e.g., awareness levels, perceptions of effectiveness) and subjective opinions (e.g., recommendations and experiences).

3.2. Study area and population

The study was conducted in Greater Gaborone, the capital city and economic hub of Botswana. The target population consisted of personnel working at the Department of Road Transport and Safety (DRTS), including traffic officers, road safety analysts, planners, and decision-makers directly involved in the implementation and monitoring of ITS technologies.

3.3. Sampling procedure

A purposive sampling technique was used to select participants with specialized knowledge and experience regarding traffic surveillance systems and road safety. This non-probability sampling method is appropriate for expert-based studies that require input from individuals with informed opinions on the research topic (Palinkas et al., 2015). The sample size was 25 participants, determined based on accessibility, relevance to the study objectives, and the typical size for exploratory ITS research in developing contexts (Turoń and Czech, 2020).

3.4. Ethical considerations

Ethical clearance was obtained from the Batswana Accountancy College Research Ethics Committee and administrative authorization from the Department of Road Transport and Safety (Approval Ref: DRTS-RD/2023/15). All participants were given informed consent forms, and data confidentiality was maintained by anonymizing responses and securing digital data in encrypted formats.

3.5. Instrumentation and validation

A structured questionnaire was designed as the primary data collection tool. It consisted of both closed-ended questions using Likert scales to capture quantitative data and open-ended questions to explore opinions, attitudes, and suggestions. The questionnaire was divided into sections: demographics, awareness and perceptions of ITS, effectiveness of surveillance cameras, and personal recommendations. The questionnaire underwent expert validation by three academic reviewers and practitioners in transport policy and ITS. A pilot test was conducted with five participants at DRTS to ensure clarity and reliability. Feedback was used to refine ambiguous items and improve logical flow (Saunders et al., 2019).

3.6. Data collection procedures

Data collection was conducted over a one-week period using the drop-and-collect method, ensuring high response rates while minimizing disruption to participants' work routines.

Respondents completed the questionnaires at their convenience, and follow-up reminders were provided. This method is effective in organizational contexts and ensures both privacy and participation (Dillman et al., 2014).

3.7. Data analysis

Quantitative data was analyzed using SPSS. Descriptive statistics (frequencies, percentages, and cross-tabulations) were used to summarize variables such as age, gender, awareness levels, and perceptions of ITS effectiveness. Where relevant, cross-tabulation was used to explore relationships between variables (e.g., gender).

Qualitative responses were analyzed using thematic analysis, a method that enables the identification of key patterns and themes in open-ended responses (Braun and Clarke, 2006). This approach allowed the researchers to capture rich insights on ITS challenges, suggestions for improvement, and experiences from the field.

3.8. Limitations

The small sample size and purposive sampling technique may limit the generalizability of findings. However, the depth of expertise and relevance of the respondents mitigate this limitation. Additionally, the reliance on self-reported data may introduce bias, although anonymity was preserved to encourage honest responses.

4. Results

This section presents the findings from the structured questionnaire distributed to 28 participants at the Department of Road Transport and Safety (DRTS), with a final response rate of 92.6% (25 completed responses). Results are organized according to key thematic areas aligned with the study objectives.

4.1. Response rate and participation

Out of 28 distributed questionnaires, 25 were returned fully completed. This 92.6% response rate indicates high engagement from the target participants and strengthens the reliability of the descriptive data.

4.2. Demographic characteristics of respondents

Age: The majority of respondents (44%) fell within the 30–40 age range, reflecting a workforce with intermediate to advanced professional experience. Respondents aged 20–30 accounted for 40%, while those above 40 made up only 16%, aligning with expected retirement trends. As shown in Figure 2, the majority of respondents were aged between 30–40 years, with smaller proportions in younger and older categories.

AGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30YEARS	10	16.7	40.0	40.0
	30-40YEARS	11	18.3	44.0	84.0
	MORE THAN 40YEARS	4	6.7	16.0	100.0
	Total	25	41.7	100.0	
Missing	System	35	58.3		
Total		60	100.0		

Figure 2. Age of respondents

Gender: Of the 25 respondents, 64% were male and 36% were female. The response rates among both genders were consistent, though the gender imbalance reflects broader trends in technical transportation roles in Botswana. Table 1 presents the response status by gender, showing that male respondents had a higher completion rate compared to female respondents.

Table 1. Response status by gender

	RESPONSE STATUS		
GENDER	**Answered**	**Unanswered**	**Grand Total**
Female	9	3	12
Male	16	0	16
Grand Total	**25**	**3**	**28**

Professional Experience: Over 70% of participants had more than five years of experience in road safety and transport management. This indicates a high level of institutional knowledge and practical familiarity with ITS.

4.3. Awareness and understanding of ITS

Respondents were asked to self-assess their knowledge of Intelligent Transportation Systems (ITS). Respondents' self-assessed understanding of Intelligent Transportation Systems (ITS) is presented in Figure 4. Results showed that:

- 32% had a high level of understanding
- 32% had a moderate understanding
- 24% had basic or low understanding
- 12% demonstrated a very high level of expertise

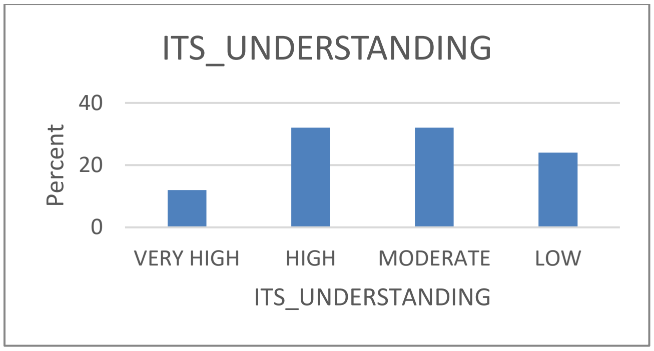

Figure 3. ITS Understanding

These results suggest that while ITS is familiar to a majority, there remains a significant portion of the workforce that may benefit from training and awareness programs to optimize ITS usage and support.

4.4. Identified causes of road accidents

The leading causes of road crashes reported by respondents are summarized in Figure 4. Respondents identified the following as leading causes of road crashes in Greater Gaborone:

- Reckless driving (40%)
- Speeding (32%)
- Drinking and driving (28%)

CAUSES_OF_CAR_CRASHES

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	RECKLESS DRIVING	10	40.0	40.0	40.0
	OVER SPEEDING	8	32.0	32.0	72.0
	DRINKING AND DRIVING	7	28.0	28.0	100.0
	Total	25	100.0	100.0	

Figure 4. (Causes of car crashes)

These responses align with prior national reports and indicate that human behavior is the dominant factor, highlighting the urgent need for behavioral interventions alongside technological deployment.

4.5. Perceptions of traffic surveillance cameras

Perceptions of the effectiveness of traffic surveillance cameras in improving road safety are displayed in Figure 5. When asked to rate the effectiveness of traffic surveillance cameras:

- 32% rated them as “extremely effective”
- 20% as “very effective”
- 36% as “moderately effective”
- 12% as “least effective”
- 0% considered them ineffective

TS_EFFECTIVENESS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	EXTREMELY EFFECTIVE	8	13.3	32.0	32.0
	VERY EFFECTIVE	5	8.3	20.0	52.0
	MODERATELY EFFECTIVE	9	15.0	36.0	88.0
	LEAST EFFECTIVE	3	5.0	12.0	100.0
	Total	25	41.7	100.0	
Missing	System	35	58.3		
Total		60	100.0		

Figure 5. (ITS effectiveness)

Overall, 88% of respondents believed that traffic cameras contribute positively to reducing traffic violations and enhancing safety. Several noted improvements in driver discipline in monitored zones and easier prosecution of offenders through visual evidence.

4.6. Reported improvements in road safety

Respondents were asked whether ITS particularly surveillance cameras have contributed to tangible improvements in safety. Figure 6 shows respondents’ views on the contribution of ITS implementation to overall road safety improvements. 82% of the sample agreed that improvements were visible, including:

- Faster incident detection and emergency response
- Deterrence of red-light running and speeding
- Improved data collection for planning and law enforcement

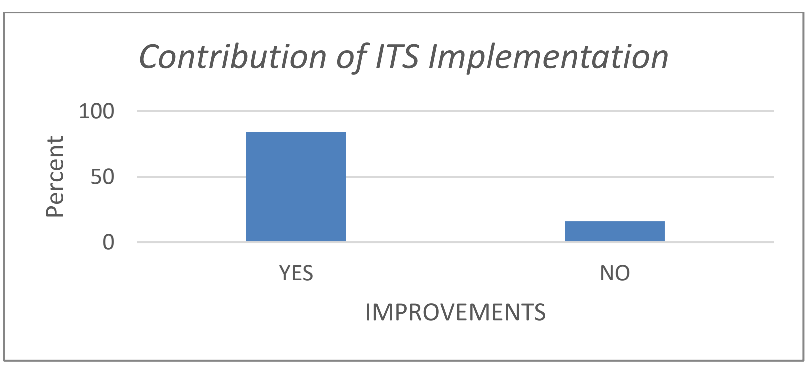

Figure 6. (Contribution of ITS Implementation)

This sentiment underscores the growing institutional trust in ITS as a policy tool, even in its limited form.

4.7. ITS technologies encountered

The types of ITS technologies encountered by respondents locally and internationally are presented in Figure 7. Respondents were asked which ITS systems they had interacted with locally or internationally. The most common included:

- Traffic signal control systems (40%)
- Traffic surveillance cameras (24%)
- GPS and navigation systems (16%)
- Electronic toll collection (12%)
- Vehicle telematics systems (8%)

ENCOUNTERED_ITS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TRAFFIC SURVEILLANCE CAMERAS	6	24.0	24.0	24.0
	VEHICLE TELEMATICS	2	8.0	8.0	32.0
	TRAFFIC SIGNAL CONTROL SYSTEMS	10	40.0	40.0	72.0
	ELECTRONIC TOLL COLLECTION SYSTEMS	3	12.0	12.0	84.0
	GPS NAVIGATION SYSTEMS	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

Figure 7. Encountered ITS

Interestingly, many of the systems (especially GPS and tolling) were experienced during international travel, suggesting Botswana lags behind in ITS diversity.

4.8. Recommendations from respondents

Respondent's recommendations on which ITS tools should be prioritized for road safety improvement are summarized in Figure 8. When asked what ITS technologies or strategies should be prioritized to improve safety:

- Adaptive signal control systems (28%)
- Collision avoidance systems (24%)
- Vehicle-to-vehicle communication (8%)
- Automatic incident detection systems (8%)
- Enhanced camera coverage (4%)
- Infrastructure-to-vehicle communication systems (4%)

RECOMMENDATIONS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MORE CAMERA COVERAGE	1	4.0	4.0	4.0
	ADAPTIVE TRAFFIC SIGNAL CONTROL	7	28.0	28.0	32.0
	AUTOMATIC INCIDENT DETECTION	2	8.0	8.0	40.0
	COLLISION AVOIDANCE SYSTEMS	6	24.0	24.0	64.0
	VEHICLE TO VEHICLE COMMUNICATION	2	8.0	8.0	72.0
	INFRASTRUCTURE TO VEHICLE COMMUNICATION	1	4.0	4.0	76.0
	ROAD WEATHER INFORMATION SYSTEMS	1	4.0	4.0	80.0
	NO COMMENT	5	20.0	20.0	100.0
	Total	25	100.0	100.0	

Figure 8. (Respondents Recommendations)

Respondents emphasized the importance of expanding ITS beyond cameras, particularly through adaptive signal systems that adjust traffic lights in real time based on traffic flow perceived as both feasible and impactful.

4.9. Open-ended feedback and qualitative insights

Thematic analysis of open-ended responses revealed three dominant themes:

- Need for Legislative Backing: Many participants highlighted the importance of aligning ITS deployment with legal reforms for effective enforcement.
- Training and Awareness: Respondents emphasized the need for stakeholder workshops to bridge the knowledge gap among officers and the public.
- Infrastructure and Maintenance Gaps: Several noted that even effective ITS tools can fail without consistent maintenance and updated infrastructure.

Illustrative quote from a respondent:

> *"We have the cameras, but if road markings are faded and traffic lights are not working properly, it undermines their effectiveness."*

5. Discussion

The findings of this study affirm that traffic surveillance cameras, as a core component of Intelligent Transportation Systems (ITS), have a positive influence on road safety in Greater Gaborone. A significant proportion of respondents (88%) perceived that surveillance cameras contributed to reducing road crashes. This aligns with prior research by Lee and Wong (2020), who found that video monitoring systems substantially improve traffic law enforcement and driver compliance in urban areas.

Human behavioral factors specifically reckless driving, speeding, and drink-driving emerged as the leading causes of road accidents in the region. This is consistent with Khamis and El-Gohary (2021), who emphasized that human error remains the predominant factor in road fatalities worldwide. The prevalence of such behaviors supports the applicability of Risk Homeostasis Theory, which posits that drivers tend to adjust their behavior based on perceived safety levels, often maintaining a consistent level of risk (Wilde, 2017). This theory suggests that unless accompanied by behavioral change, technological improvements alone may not reduce accident rates significantly.

The Haddon Matrix framework was also useful in contextualizing the findings. Pre-crash measures like surveillance cameras contribute to risk identification and behavioral modification. However, post-crash interventions such as real-time emergency notification systems remain underutilized in Botswana, indicating an opportunity for future ITS development. Tapera (2021) emphasizes that post-crash readiness is essential in minimizing injury severity, and the integration of systems like automatic incident detection (AID) could fill this gap.

Despite the clear benefits observed, this study reveals that Botswana's ITS ecosystem remains underdeveloped, with only limited exposure to advanced systems like vehicle-to-vehicle (V2V) communication, road weather systems, or collision avoidance technologies. This is consistent with Choi et al. (2022), who highlighted how ITS deployment in many developing countries is impeded by financial, infrastructural, and regulatory constraints. Public knowledge and engagement with ITS technologies remain moderate, further affecting effective implementation.

Moreover, participants frequently recommended adaptive signal control systems, which dynamically adjust traffic light patterns based on real-time data. According to Zhang, Chen, and Zhou (2021), such systems can reduce urban congestion and crash occurrences by up to 25%. This recommendation signals a demand for proactive traffic management tools in Greater Gaborone. Another concern raised during analysis was the lack of qualitative feedback integration in many ITS evaluations.

This study addressed that by incorporating open-ended responses, which provided nuanced insights into user perceptions, perceived barriers, and local realities. These responses emphasized the need for increased investment in training and capacity building for both the public and professionals responsible for ITS management.

In summary, the discussion reveals that while traffic surveillance cameras have contributed positively to road safety, broader ITS implementation supported by policy reforms, public awareness campaigns, and continuous system upgrades is crucial. Botswana stands to benefit significantly from adopting a comprehensive ITS strategy guided by behavior-based and system-wide frameworks such as Risk Homeostasis Theory and the Haddon Matrix.

6. Conclusion

This study set out to evaluate the role of traffic surveillance cameras a key component of Intelligent Transportation Systems (ITS) in improving road safety in Greater Gaborone. The findings demonstrate that traffic surveillance cameras are widely perceived by transportation officials as effective in reducing road accidents, particularly those caused by reckless driving and speeding. Their value lies in real-time monitoring, deterrence of traffic violations, and the ability to provide visual evidence for enforcement and legal proceedings.

By framing the results through the Risk Homeostasis Theory (Wilde, 2017), it is evident that even when surveillance infrastructure is in place, driver behavior remains a critical determinant of road safety outcomes. The Haddon Matrix also guided our understanding of how ITS technologies can intervene at different stages pre-crash (e.g., through driver warnings), crash (e.g., event recording), and post-crash (e.g., faster emergency response) to reduce injury severity and improve system-wide safety.

However, the study also exposed limited public understanding of ITS and revealed that only a narrow selection of ITS tools (mainly cameras and adaptive signals) are currently implemented in Botswana. Expanding this technological base and aligning it with policy, education, and infrastructure development is essential.

7. Recommendations

Policy and Institutional Strengthening: The Department of Road Transport and Safety should adopt a national ITS strategy that integrates adaptive traffic control systems, vehicle-to-vehicle (V2V) communication, and AI-enhanced enforcement tools to complement surveillance cameras (Zhang et al., 2021).

- Public Awareness Campaigns: Government and road safety stakeholders should launch education programs aimed at increasing public and driver awareness of ITS technologies. Choi et al. (2022) emphasize that awareness and user engagement significantly enhance ITS effectiveness.
- Infrastructure Investment and Scalability: ITS infrastructure (especially cameras, traffic sensors, and data processing units) should be expanded beyond the central business district (CBD) into high-risk zones. Public-private partnerships (PPPs) could be considered for funding and implementation.
- Data-Driven Law Enforcement: Surveillance data should be analyzed routinely to identify patterns, inform resource allocation, and enable predictive policing, as recommended by Ravish (2021).
- Evidence-Based Legislation: Amend traffic legislation to include admissibility standards for surveillance footage in traffic violation and accident adjudication processes.
- Use of Theoretical Models in Road Safety Planning: Encourage road safety agencies to utilize frameworks like the Haddon Matrix for systematically addressing human, environmental, and mechanical causes of road accidents (Tapera, 2021).

Limitations

While this study offers valuable insights, it is limited in several ways:

- Sample Size: The purposive sample of 25 participants restricts statistical generalizability. Larger and more diverse samples are needed to validate these findings across Botswana.
- Descriptive Focus: The study relies on descriptive statistics. No inferential or multivariate analyses were conducted, which limits the ability to establish causality.
- Scope of Technologies: Though the broader ITS context is acknowledged, the study focused only on traffic surveillance cameras and excluded tools such as real-time navigation systems, automated speed enforcement, and crash detection sensors.

- Self-Reported Data: The reliance on self-reported perceptions may introduce bias, particularly social desirability bias.

Limited Public Voice: The study excluded public road users, whose perspectives could provide additional insights into the effectiveness and acceptance of ITS.

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Appendix: Questionnaire

SECTION A

1. Age

(a) 20-30years (b) 30-40years (c) more than 40 years

2. Gender

(a) Male (b) Female (c) Prefer not to say

3. Professional experience in road safety and transport management

(a) Less than a year-2 years (b) 3-5 years (c) More than 5 years

SECTION B

Awareness and perception of Intelligent Transportation Systems:

4. How would you rate your level of understanding of ITS?

(a) Very low

(b) Low

(c) Moderate

(d) High

(e) Very high

5. Causes of road accidents

(a) Reckless driving

(b) Speeding

(c) Drinking and driving

Impact of intelligent transportation systems on Road Safety:

6. In your opinion, how effective is traffic surveillance in improving road safety?

(a) Not effective at all

(b) Somewhat effective

(c) Moderately effective

(d) Very effective

7. Have you noticed any specific improvements in road safety due to the implementation of ITS (traffic surveillance cameras)? [e.g., reduced accidents, decreased congestion, improved traffic flow]

(a) Yes

(b) No

(c) Not sure

Please answer the following structured questions

8. Which ITS applications have you encountered before, (e.g transport management systems) and what is your opinion of the application?

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9. Do you have any additional comments or suggestions regarding ITS and how it can effectively improve road safety?

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Thank you for participating in this questionnaire. Your input is valuable for this research study.