ADAPTING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) TO MITIGATE ACCIDENTS, CRIME AND CRIMINALITY ALONG BENIN–AUCHI ROAD IN EDO STATE

OSAGIEDE, I. Ph.D
Department of Vocational and Technical Education, Faculty of Education, Ambrose Alli University, Ekpoma, Edo State.
Email: Izuhunwa@aauekpoma.edu.ng

Abstract
The Benin–Auchi Road remains one of Nigeria's most economically significant federal highways, serving as a major transportation corridor between the southern and northern regions of the country. Despite its strategic importance, the highway has become notorious for frequent road traffic accidents, armed robbery, kidnapping, vehicle breakdowns caused by poor road conditions, and delayed emergency response. This paper argued that the integration of Information and Communication Technology (ICT) into highway management presents a sustainable solution for reducing accidents and criminal activities along the corridor. The paper advocated the deployment of Intelligent Transportation Systems (ITS), Geographic Information Systems (GIS), Internet of Things (IoT) devices, Artificial Intelligence (AI)-powered surveillance, drones, emergency communication systems, and predictive data analytics to improve road safety and strengthen security. It concluded that ICT should complement infrastructure rehabilitation, inter-agency collaboration, and community participation in achieving a safer Benin–Auchi Road.

Keywords: *ICT, Road Safety, Crime Prevention, Intelligent Transportation Systems, Benin–Auchi Road, Edo State*.

Introduction

Information and Communication Technology (ICT) denotes the broad range of technologies used to create, store, process, transmit, retrieve, and exchange information through electronic means. ICT includes computers, the internet, telecommunications, software applications, mobile devices, and digital networks that facilitate communication and information management (United Nations Educational, Scientific and Cultural Organization, 2023).

Transportation is fundamentally a secondary function that arises from the essential nature of human activities across various domains, including social, economic, academic, and political spheres. It represents an indispensable human requirement. According to Badejo (2023), without transportation, human civilization would remain primitive and severely challenged in terms of survival. Transportation acts as the vital artery of the economy and constitutes a multidisciplinary necessity. It serves as the link connecting any origin to its destination in terms of spatial and temporal utility. Consequently, five principal modes of transportation are recognized: aviation, maritime, pipeline, rail, and road. Among these, road transport is often regarded as the initial and final mile mode (Ogwude, 2020), signifying that every journey begins and concludes with road transport, whether it involves people, goods, or services. Therefore, road transport is often termed the progenitor of all transport modes. Within road transport, there exists an intra-modal division, meaning that it comprises various sub-modes within this category.

Road transportation remains the dominant mode of movement for people, goods, and services in Nigeria, accounting for the overwhelming majority of core passenger and freight transport. Consequently, the condition, security, and operational efficiency of the nation's highway

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infrastructure have significant implications for economic productivity, regional integration, and national development. Among Nigeria's strategic transport corridors, the Benin–Auchi Road in Edo State occupies a prominent position because it forms part of the arterial route connecting the South-South and South-West geopolitical zones with the North-Central and Northern regions of the country. The highway facilitates commercial activities, agricultural distribution, educational mobility, and interstate trade. Despite its strategic importance, however, the corridor has increasingly become associated with frequent road traffic accidents, kidnapping, armed robbery, vehicular breakdowns, traffic congestion, and delayed emergency response. These persistent challenges have generated substantial economic losses, threatened public safety, and reduced travelers' confidence in using the route.

overall governance predominantly aligns with the comprehensive road transport policy framework as articulated in the Federal Road Safety Corps (FRSC) policy document (Federal Republic of Nigeria, 2022). A salient commonality across these various transport sub-modes is the intrinsic presence of "risk." In the context of transportation studies, risk is defined as the element intrinsic to travel that precipitates the potential for danger leading to accidents or incidents (Ajao, 2025). The safety concerns along the Benin–Auchi Road arise from a combination of infrastructural deficiencies, human behavioural factors, institutional weaknesses, and emerging security threats. Several sections of the highway have experienced pavement deterioration, potholes, inadequate drainage systems, poor road markings, insufficient street lighting, and limited traffic control facilities. These conditions increase the likelihood of vehicle collisions, particularly during adverse weather conditions and at night. Beyond infrastructural deterioration, reckless driving, speeding, dangerous overtaking, vehicle overloading, driver fatigue, and poor compliance with traffic regulations continue to contribute significantly to road traffic crashes. These risk factors are compounded by inadequate surveillance, insufficient patrol coverage, delayed emergency medical response, and limited coordination among security agencies responsible for highway management. Research focusing on the Benin–Auchi corridor demonstrates that deteriorating pavement conditions and heavy traffic volumes are major contributors to crash occurrence and roadway safety challenges.

In recent years, criminality along major Nigerian highways has evolved beyond conventional road traffic offences to include kidnapping for ransom, armed robbery, vehicle hijacking, vandalism, and organised criminal attacks on commuters. The Benin–Auchi Road has periodically featured in reports of security incidents, particularly within isolated stretches where surveillance infrastructure and rapid-response capabilities remain inadequate. The resulting insecurity has imposed social and economic costs through increased transport fares, reduced commercial activity, travel delays, psychological trauma, and declining investor confidence. Traditional approaches to highway policing—primarily dependent on physical checkpoints and routine patrols—have produced only limited success because they are constrained by manpower shortages, inadequate equipment, delayed information sharing, and limited situational awareness.

Globally, Information and Communication Technology (ICT) has emerged as a transformative tool for improving transportation safety, traffic management, and crime prevention. Advances in Artificial Intelligence (AI), the Internet of Things (IoT), Geographic Information Systems (GIS), unmanned aerial vehicles (drones), cloud computing, big-data analytics, mobile communication technologies, and intelligent transportation systems (ITS) have significantly changed how

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governments monitor highways, detect incidents, coordinate emergency responses, and enforce traffic regulations. Rather than relying solely on manual observation, modern highway management increasingly employs interconnected digital platforms capable of collecting, analysing, and transmitting real-time information to relevant authorities. These technologies facilitate early detection of hazardous driving behaviour, predictive identification of accident-prone locations, automated traffic monitoring, and rapid deployment of emergency services. Comprehensive reviews also show that machine-learning models and connected vehicle technologies can substantially improve crash prediction and traffic safety management when integrated into transport systems.

Within the Nigerian context, the adoption of ICT in road safety management remains uneven despite increasing recognition of its potential. Although initiatives such as Automatic Number Plate Recognition (ANPR), speed enforcement cameras, digital driver licensing, and electronic traffic management have been introduced in selected urban centres, widespread implementation across federal highways remains limited. Recent assessments indicate that technology-assisted enforcement and intelligent road assessment systems can strengthen compliance with traffic regulations and improve infrastructure safety when adequately supported by institutional capacity and policy implementation.

Emerging evidence from Nigeria also supports the application of predictive analytics and IoT-enabled monitoring to highway safety. Jibunor, Odigie, and Igbape (2024) developed a Bayesian learning framework that integrates IoT technologies with predictive modelling to identify accident risks and generate timely safety warnings for highway users. Their findings demonstrate that real-time traffic data, environmental variables, and historical crash records can be combined to support proactive accident prevention rather than reactive emergency response. Although the study focused on the Benin–Onitsha Expressway, its technological framework offers valuable lessons that can be adapted to the Benin–Auchi Road because both corridors share similar traffic characteristics, infrastructure challenges, and security concerns.

From a crime prevention perspective, ICT provides opportunities to transform conventional highway security into an intelligence-driven system capable of supporting surveillance, monitoring, investigation, and rapid intervention. AI-enabled Closed-Circuit Television (CCTV) cameras can automatically detect suspicious movements, abandoned vehicles, unusual traffic behaviour, and potential criminal activities while transmitting alerts to command centres. Drone surveillance can improve monitoring of remote forested sections where conventional patrol vehicles have limited accessibility. Likewise, GIS-based crime mapping enables security agencies to identify spatial patterns of criminal incidents, optimise patrol deployment, and allocate limited security resources more efficiently. Mobile emergency reporting applications, GPS-enabled patrol vehicles, integrated communication platforms, and cloud-based incident management systems further strengthen inter-agency coordination among the Federal Road Safety Corps (FRSC), the Nigeria Police Force, emergency medical services, and other stakeholders responsible for highway safety.

Despite these technological opportunities, the implementation of ICT-based highway management in Nigeria continues to face significant obstacles. Persistent challenges include inadequate funding, unstable electricity supply, poor telecommunications coverage in rural areas, insufficient digital

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infrastructure, shortage of skilled ICT professionals, cybersecurity concerns, equipment vandalism, and fragmented institutional coordination. Without addressing these structural constraints, investments in advanced technologies may fail to achieve their intended outcomes. Consequently, technology adoption must be accompanied by supportive public policies, sustainable maintenance strategies, capacity building, and effective governance frameworks that encourage collaboration among federal, state, and private-sector stakeholders.

Against this background, this opinion paper argues that adapting ICT represents a practical and sustainable strategy for mitigating accidents, crime, and criminality along the Benin–Auchi Road in Edo State. The paper maintains that integrating intelligent transportation systems, AI-driven surveillance, IoT sensors, GIS-based spatial analysis, drone technology, digital emergency communication platforms, and predictive analytics into highway management can substantially improve road safety and security. By synthesizing recent literature and contemporary technological developments, the paper seeks to contribute to ongoing policy discussions on digital transformation in Nigeria's transport sector while proposing context-specific recommendations for enhancing safety, reducing criminal activities, and promoting sustainable mobility along one of the country's most strategic transportation corridors.

Literature Review

The application of Information and Communication Technology (ICT) to transportation safety has received considerable scholarly attention over the last decade due to its potential to reduce road traffic accidents, improve emergency response, and strengthen crime prevention. Globally, Intelligent Transportation Systems (ITS) have transformed highway management through the integration of Artificial Intelligence (AI), the Internet of Things (IoT), Geographic Information Systems (GIS), cloud computing, wireless communication, and advanced data analytics. These technologies facilitate real-time monitoring of traffic conditions, automated detection of road incidents, predictive modelling of accident hotspots, and rapid dissemination of safety information to road users and emergency responders (Jagatheesaperumal et al., 2024).

Road Traffic Accidents and Highway Safety in Nigeria

Road traffic accidents remain one of the leading public safety challenges in Nigeria. The country's heavy dependence on road transport, deteriorating highway infrastructure, weak traffic law enforcement, excessive speeding, poor vehicle maintenance, and human behavioural factors have contributed to high accident rates. Recent reviews indicate that the adoption of digital technologies in Nigeria's transport sector remains fragmented despite their demonstrated effectiveness in improving road safety. Existing initiatives—including GPS-enabled fleet management, electronic ticketing, and isolated traffic monitoring systems—have not yet evolved into integrated intelligent transportation systems capable of supporting nationwide highway management (Eruotor & Taiwo, 2024).

The Benin–Auchi Road illustrates these broader national challenges. As one of Nigeria's strategic federal highways, it experiences heavy commercial and passenger traffic while simultaneously facing deteriorating pavement conditions, congestion, and security threats. Research focusing on this corridor has identified road failures, inadequate maintenance, and increasing traffic volume as major contributors to crashes and transport inefficiency. These findings suggest that infrastructure

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rehabilitation alone is insufficient and should be complemented by digital monitoring and intelligent traffic management systems.

ICT and Intelligent Transportation Systems

Intelligent Transportation Systems represent one of the most significant innovations in contemporary transport management. ITS integrates communication technologies, sensing devices, data processing, and automation to improve traffic efficiency and public safety. According to Imam et al. (2024), ITS applications include electronic surveillance, automated traffic control, incident detection, electronic enforcement, driver information systems, and coordinated emergency management. Evidence from developed and emerging economies demonstrates that ITS reduces accident frequency, minimizes congestion, improves compliance with traffic regulations, and enhances emergency response efficiency.

Recent studies have expanded ITS capabilities through artificial intelligence and next-generation communication networks. AI algorithms now support traffic prediction, collision avoidance, abnormal behaviour detection, automated enforcement, and intelligent route optimization. Likewise, IoT-enabled sensors continuously collect information on traffic flow, road surface conditions, weather, and vehicle movement, enabling authorities to make data-driven decisions rather than relying solely on manual observation.

Artificial Intelligence, IoT and Predictive Analytics

Artificial Intelligence has become central to modern road safety management because of its ability to analyse large datasets rapidly and identify emerging risks. Machine-learning algorithms can predict accident-prone locations by integrating historical crash records, traffic density, driver behaviour, environmental variables, and infrastructure characteristics. AI-powered surveillance systems also recognize speeding, dangerous overtaking, abandoned vehicles, and suspicious activities in real time, allowing immediate intervention by relevant authorities.

Similarly, IoT technologies have expanded the scope of intelligent transportation through interconnected sensors, smart cameras, vehicle-to-infrastructure communication, and cloud-based monitoring platforms. Recent reviews conclude that IoT-enabled transportation systems improve situational awareness, facilitate predictive maintenance, and support automated incident reporting, thereby enhancing both safety and operational efficiency (IoT-Driven Intelligent Transportation System in the Era of 6G and AI, 2026).

Within Nigeria, Jibunor et al. (2024) proposed a Bayesian learning framework powered by IoT for the Benin–Onitsha Expressway. Their study demonstrated that combining IoT sensors with predictive analytics improves accident forecasting and enables proactive highway safety management. Although conducted on a different corridor, the framework provides practical insights applicable to the Benin–Auchi Road because of similarities in traffic patterns, infrastructure challenges, and security concerns.

ICT and Crime Prevention

Beyond accident prevention, ICT has become an important instrument for combating crime on transportation corridors. AI-enabled Closed-Circuit Television (CCTV), Automatic Number Plate Recognition (ANPR), drones, GPS tracking, and GIS-based crime mapping have strengthened

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surveillance capabilities in many countries. These technologies enable security agencies to detect suspicious activities, monitor remote highway sections, identify stolen vehicles, and coordinate rapid responses through integrated command centres. Contemporary literature suggests that combining AI, geospatial intelligence, and real-time communication significantly improves situational awareness and resource deployment in transport security operations (Jagatheesaperumal et al., 2024).

For the Benin–Auchi Road, where kidnapping and highway robbery remain recurring security concerns, technology-assisted surveillance offers considerable promise. Drone patrols, smart cameras, and integrated emergency communication platforms could supplement conventional policing by extending surveillance coverage and improving response times.

Knowledge Gap

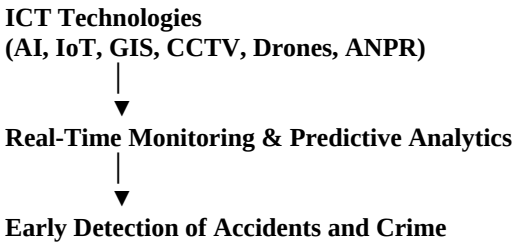
Although the literature extensively examines intelligent transportation technologies, most studies focus on urban traffic management, developed economies, or general highway safety. Comparatively fewer studies integrate accident prevention and crime mitigation within a single ICT framework for Nigerian federal highways, particularly the Benin–Auchi Road. Existing Nigerian studies also concentrate largely on infrastructure deficiencies or isolated technological interventions without proposing an integrated digital highway management strategy. This gap justifies the present opinion paper, which argues for a comprehensive ICT-based approach combining AI, IoT, GIS, drones, predictive analytics, and inter-agency information systems to simultaneously reduce accidents, crime, and criminality along the Benin–Auchi Road in Edo State.

Table 1

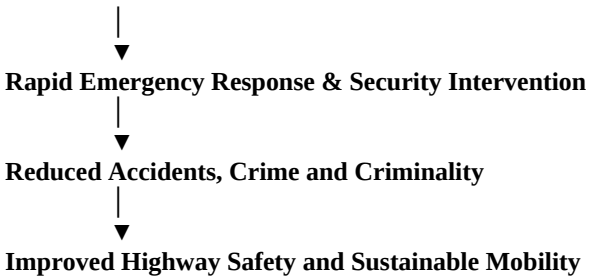
Summary of Selected Literature (2020–2026)

Author(s)	Year	Focus	Key Contribution
Eruotor & Taiwo	2024	ITS in Nigeria	Reviews AI, IoT, and ITS adoption challenges.
Imam et al.	2024	Road safety	Demonstrates the effectiveness of ITS in reducing crashes.
Jibunor et al.	2024	Benin–Onitsha Expressway	Develops an IoT-based predictive accident model.
Guo & Xu	2024	Smart highways	Explains IoT-enabled highway management systems.
Ojo et al.	2025	AI in transportation	Reviews AI applications and barriers in Nigeria.
IoT-Driven Intelligent Transportation System Review	2026	Future ITS	Highlights integration of AI, IoT, and 6G for safer transport.

Figure 1. Conceptual Relationship Between ICT and Highway Safety



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