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Informal Transportation Systems and Urban Criminal Threats in Abuja, Nigeria: A Moderating Effect of Law Enforcement Presence

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ABSTRACT

The purpose of this study is to empirically examine how informal transportation system affects urban criminal threats in Abuja, Nigeria. The research hinged on Routine Activity Theory to provide a comprehensive explanation of urban criminal threats. The study adopts a descriptive cross-sectional survey research design. Data are collected from civil servants, students, and private sector workers, residents of urban neighbourhoods, and registered traders and market women across Federal Capital Territory, using a structured questionnaire with a total sample size of 384 respondents involved in the study. The data are analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM), which is suitable for predictive analysis and theory extension in emerging research contexts. The findings revealed that for the direct relationship, law enforcement threats, operator density and route coverage have positive and significant relationship with urban criminal threats. While law enforcement presence moderates the relationship between operator density and urban criminal threats, also, law enforcement presence moderates the relationship between route coverage and urban criminal threats. Therefore, it is recommended that Nigeria Police force should focus resources on areas with high operator density, as increased law enforcement presence in these zones can effectively reduce urban criminal threats.

1. Introduction

Urban security has become a major concern in rapidly growing cities, particularly in developing countries where population growth, economic inequality, and rapid urbanization often contribute to rising criminal activities. In Abuja, these challenges have gradually emerged despite the city's original design as a well-planned capital intended to ensure administrative efficiency and security. As the city expands, various forms of urban criminal threats have developed, affecting the safety of residents and visitors.

Law enforcement presence helps control crime through patrols, checkpoints, and surveillance that increase the likelihood of detecting offenders. In Abuja, the Nigeria Police Force (NPF), supported by the Nigeria Security and Civil Defence Corps (NSCDC), carries out security operations such as intelligence gathering and community policing to enhance public safety. However, the effectiveness of these agencies varies across different districts depending on personnel availability, infrastructure, and logistics. As a result, law enforcement presence can act as a moderating factor in the relationship between urban growth and criminal threats. Strong law enforcement visibility can reduce crime opportunities, while weak presence may allow urban pressures to increase criminal activities. Therefore, understanding this moderating effect is important for developing effective urban security policies in Abuja.

According to the Numbeo Crime Index (NCI) (2026), a global crowd sourced online database operated by a Serbian company headquartered in Belgrade, comparative crime statistics indicate varying levels of urban crime across countries. The report shows that the United Kingdom recorded a crime index of 48.3% with a corresponding safety index of 51.7%, while Venezuela reported a significantly higher crime index of 80.7% and a safety index of 19.3%. Similarly, South Africa registered a crime index of 74.7% with a safety index of 25.3%, whereas Nigeria recorded a crime index of 66.6% and a safety index of 33.4%. These statistics reflect the varying perceptions and experiences of crime and safety across different national contexts.

Informal transportation systems have been closely related with rapid urbanization, population growth, and uneven spatial development. Satellite towns such as Kubwa, Nyanya, Karu, and Gwagwalada have witnessed increased reliance on informal transport due to limited availability of formal transit services. Another survey conducted by Oyesiku et al. (2023) constitutes about 65% to 75% of the intra city mobility arrangements in Nigerian Urban cities. Informal transportation systems enhance mobility by providing flexible and accessible transport services, especially in areas where formal transport services are limited or unavailable. Vehicles such as minibuses, motorcycle taxis, and tricycles often operate on flexible routes and schedules, allowing passengers to reach destinations that may not be served by formal transport networks.

Urban transportation systems play a critical role in shaping the socio-economic and security dynamics of cities, particularly in rapidly expanding metropolitan areas in developing countries. In many African cities, including Abuja, Nigeria's Federal Capital Territory, formal public transport systems remain insufficient to meet the mobility demands of the growing population. As a result, informal transportation systems such as motorcycle taxis (okada), tricycles (keke napep), informal taxis (kabukabu), and minibuses have emerged as vital alternatives that provide affordable and flexible mobility for urban residents. This study used operator density and route coverage as dimensions of informal transportation system. This is because the dimensions are aligning more closely with transport realities in developing nations.

Operator density is the number of informal transport operators within a given geographic area or along a specific transport route. It is commonly used as a proxy indicator to measure the intensity and availability of informal transportation services in urban studies. In studies of informal transportation systems, operator density reflects how many transport providers are actively operating within a particular urban space.

Route coverage is the extent or spread of transportation routes within a particular geographic area. It measures how widely transport routes are distributed and how well they connect different locations within a city or region. Route coverage could be spatial extent and distribution of transport routes that provide mobility and accessibility to different locations within an urban area.

The relationship between informal transportation system and urban criminal threats cannot be overemphasis. This is because route coverage of informal transport creates many interconnected pathways within cities, improves accessibility, it can also provide escape routes for criminals, especially in densely populated neighborhoods where monitoring is limited. Informal transportation systems also play a vital role in urban mobility in Abuja. It facilitates movement of workers, traders, and goods, which supports daily economic activities in markets, offices, and commercial areas across the city. However, despite these benefits the sector faces challenges including security risks, weak regulation, traffic congestion, and safety concerns, which require effective policy interventions and improved governance. Other comprises security concern where some criminal activities such as robbery, kidnapping, and theft have occasionally been associated with unregulated motorcycle or tricycle operators. This raises concerns about urban security and passenger safety. It is against these backdrops, the research aims to contribute to the body of knowledge by investigating the moderating effect of law enforcement presence in respect to service informal transportation systems and urban criminal threats in Abuja, Nigeria.

1.1 Statement of the Problem

Urban areas in many developing countries depend heavily on informal transportation systems to meet the mobility needs of rapidly growing populations. In cities where formal public transport systems are limited or insufficient, informal modes such as minibuses, motorcycles, tricycles, and privately operated taxis often fill the mobility gap. These systems provide flexible, affordable, and accessible transportation services, especially for low-income residents and communities located in areas with limited formal transport coverage. Despite their importance in facilitating urban mobility and economic activities, informal transportation systems also present several regulatory, safety, and security challenges. The high mobility, anonymity of operators and passengers, and lack of formal documentation in some informal transport operations can make them difficult for security agencies to monitor effectively. As a result, criminal actors may exploit these characteristics to carry out or facilitate illegal activities within urban environments.

However, several previous studies (Afolabi & Akibo. 2020; Cervero & Golub, 2007; Pojani & Stead, 2015; Toro et al., 2023) adopted minimum sample sizes ranging from 39 to 81 respondents, while some failed to provide any clear explanation regarding their sampling procedures. Additionally, these studies were mostly confined to small geographical areas and lacked comprehensive methodological clarification, making it difficult for readers to understand how their findings were generated. This shortcoming has produced a methodological gap within the literature. To bridge this gap, the present study utilizes a more adequate sample size and adopts a quantitative research approach based on secondary data collection.

Despite the above challenges identified in this research, prior studies indicate that the relationship between informal transportation system and urban criminal threats can be negative or non-significant in settings with advance development Studies capacity (Kim & Hipp, 2021).

Empirical evidence from Adeniyi (2024), Kim and Hipp (2021), and Madoh and Ruth (2024) indicates weak or inverse relationships between the two core variables. These results point to important theoretical and practical gaps, implying that informal transportation systems alone may not directly increase urban criminal threats and that their effects may be influenced surrounding contextual dynamics. To address this gap, the present study incorporates law enforcement presence as a moderating variable to determine the circumstances under which informal transportation system positively influences urban criminal threats in Abuja.

1.2 Hypotheses

Ho_1: There is no significant relationship between law enforcement presence and urban criminal threats in Abuja, Nigeria.

Ho_2: There is no significant relationship between operator density and urban criminal threats in Abuja, Nigeria.

Ho_3: There is no significant relationship between route coverage and urban criminal threats in Abuja, Nigeria.

Ho_4: Law enforcement presence does not significantly moderate the relationship between operator density and urban criminal threats in Abuja, Nigeria.

Ho_5: Law enforcement presence does not significantly moderate the relationship between route coverage and urban criminal threats in Abuja, Nigeria.

2. Literature Review

Concept of Urban Criminal Threats

The concept of urban criminal threats is contextualized to mean crimes that affect the safety of commuters and transport services. This is often shape by both the informal transport systems and ride-hailing platforms. It is pertinent to express it succinctly that regulatory weaknesses, lack of monitoring, and unverified drivers' identity in the informal transport system, help to create room for crime such as theft, robbery, and abduction by motivated offenders (Afolabi & Asiyanbola, 2024; Blueprint Newspaper, 2025). In the same vein, ride-hailing platforms which applies digital identity checks and GPS components are still battling with the threat of identity fraud, tracking manipulation, cloned accounts and other digital associated crimes, exploited by criminals to undermine the safety of passengers and drivers (Independent Newspaper Nigeria, 2025; iTelemedia, 2025).Studies conducted revealed that these transport modalities are not merely neutral conduits of mobility but can act as crime opportunity structures, with gaps in regulation and platform safeguards heightening urban criminal threats in cities like Abuja (Medayese et al., 2025).

Law Enforcement Presence

In the context of democratic societies, policing always involved a delicate task to provide security while also maintaining liberty (Hermanto & Santiago, 2021). According to the Nigeria Police Watch (2010), crimes reported in 2008 and 2009 across major urban cities in Nigeria has shown a significant increase, where property crime is in the lead, followed by crime against local acts, persons and then a crime against lawful authority. This tends to pin point to the fact that the role performance of the Nigerian Police Force in the fight against crimes in the country, especially the urban areas, is grossly low (Nwambuko & Nnaeto, 2024). Law enforcement presence describes the agencies and employees responsible for enforcing laws, maintaining public order, and managing public safety. Some key to cover law enforcement duties may include "the investigation, apprehension, and detention of individuals suspected of criminal offenses (Rouse, 1985). For example, Community policing involves police officers working closely with communities, especially in high-crime areas, by building relationships, offering safety advice, and addressing public concerns. When crimes occur, officers gather evidence and witness statements to support criminal investigations and legal prosecution (Hermanto & Santiago, 2021).

For the purpose of this study, law enforcement presence is the visibility and active deployment of security operatives such as policemen or other security agents in a particular area to maintain order, prevent crime, and ensure public safety. It involves the physical or operational availability of law enforcement personnel within a community, public space, or strategic location. The primary purpose of law enforcement presence is to deter criminal behavior, reassure the public, maintain law and order, and enable quick intervention when crimes occur.

Informal Transportation System

Agreeably, transportation system play key roles in the socio-economic growth and development of any nation, including Nigeria; as movement of goods, people and services are often facilitated, especially via the various informal transport and ride-hailing instruments. In the Nigerian environment generally, road transportation is the most widely used and readily available means of transportation, both in the rural settings and urban cities such as the FCT. Reiterating this fact, in developing economies such as Nigeria, passengers residing at the urban cities are more accessible to the various informal modes of transportation; from large distance buses to taxis, minibuses, motorcycle, and various forms of unregulated private hire taxis. Informal Passenger Transport (IPT) providers lack licenses and their vehicles are mostly unregistered. This category of transport provider violates traffic rules and even picks up passengers in areas not designated for passengers to be picked from (CDIA, 2011).

Though, the sector is associated with numerous challenges, there is no doubt the informal transport sector helps to address the visible infrastructure gap created by the government in terms of urban mobility especially for the teaming low income earners who do not own private vehicles. This lack of a formal setup facilitated the interloping of IPT providers, who appear and pick up otherwise 'stranded' passengers at curves and bus stops (Nwaogbe, Ibe & Ukaegbu, 2012).

The Dimensions of Informal Transportation System

Operator Density

Lafrogne-Joussier and Rollet (2025) define operator density as the number of people in a given area at a given time. This is believed to be an important determinant of urban safety. This is because the number of personnel (operators) assigned to perform tasks within a specific area, system, or operational environment relative to the size of that area or the volume of activities being managed. In simple terms, it measures how many operators are available to monitor, control, or respond within a defined space or operation. For instance studies have opined that in the United States, an area with a core population of 386 people per square kilometre and a total population of 50,000 is defined as an 'urbanised area'. Another study stated that China with a population density of more than 10,000 people per square kilometre in 2020 with 58 districts the number of districts and counties with total populations of more than 500,000 is in excess of 1000 (Ma et al., 2025).

This study defines operator density as indication of how adequately law-enforcement personnel are distributed across urban environments to address potential criminal threats such as robbery, burglary, violence, and organized crime. A higher operator density generally enhances surveillance, improves response time, and increases the likelihood of detecting and deterring criminal activities. I there are low operator densities it may lead to insufficient monitoring delayed responses to incidents, and greater vulnerability to urban crime. Operator density is often linked to policing strategies such as proactive policing, hotspot policing, and community policing. Scholars argue that the strategic distribution of law-enforcement personnel in crime-prone areas can significantly reduce criminal opportunities and enhance urban safety.

Route Coverage

Route coverage has different meaning to different concepts depending on the industry. In logistics and transportation, it measures the geographic area or network of stops served by a fleet (Tompson et al., 2009). In software testing, it tracks which API routes or endpoints have been exercised during testing. In e-commerce, it refers to "Route" branded package protection insurance against loss, theft, or damage. However this study defines route coverage in relation to urban criminal threats. Route coverage, specifically in the context of urban transportation networks, is a critical factor influencing public safety, with transportation-related crimes surging by 34% in some major urban areas like Lagos and Abuja between 2020 and 2024 (Tang et al., 2021). Urban transportation systems including roads, bus rapid transit (BRT), and informal transit often function as high-risk environments where inadequate coverage, traffic congestion, and poor infrastructure enable criminal activities such as robbery, kidnapping for ransom, and sexual harassment (Newton, 2008).

The study operationalize route coverage as the extent to which law-enforcement or security patrols systematically monitor, traverse, and supervise streets, routes, and neighborhoods within an urban area to prevent, detect, and respond to criminal activities. The purpose of it is to deter criminal activities, increase detection, and enable rapid response around the streets, alleys, public spaces, transport hubs, and other areas susceptible to crime.

2.1 Review of Empirical Studies

The Effect of Operator Density and Urban Criminal Threats

Lafrogne-Joussier and Rollet (2025) in their study examined ambient density and urban crime: Evidence from Smartphone Data. The findings revealed that increasing the operator density in a neighbourhood raises the number of crimes reported there but lowers victimization rates. The beneficial effects of density are strongest in neighbourhoods with more social capital, and low- to medium-density levels. Finally, we show how the rise of remote work may affect crime rates across different areas of Chicago.

Ma et al. (2025) examined operator density: Urban density and the criminalization of China we found statistically significant crime-density elasticity around 0.09–0.18. The findings of this study indicate that population density has a greater impact on economic crime than other factors. This effect is particularly pronounced in medium-sized cities. The increase in the density of new businesses brings more revenue to criminals, while the improvement of the road network reduces the risk of being caught.

Jung et al. (2022) explored modeling crime density with population dynamics in space and time: An application of assault in Gangnam, South Korea. The results show that the ambient population is consistently associated with the level of assaults throughout the four time periods in a day, while residential population does not contribute much to explaining its variation. In addition, the study also find that the percentage of single-member households and the distance to the nearest subway station are constantly associated with assault density, while the proportion of non-residential use and the land price are partially associated.

The Effect of Routine Coverage and Urban Criminal Threats

Newton (2008) examined a study of bus route crime risk in urban areas: The changing environs of bus journey areas in the UK. The findings suggest that the risk of bus crime along a journey is influenced by overall levels of crime (for specific categories of crime only), that the level of risk increases in high crime areas, and that risk is raised further when there are more stops along that route. Tang et al. (2021) assessed route coverage testing for urban criminal threats via map modeling. The findings revealed that surveillance coverage, population coverage, patrol frequency coverage and response time coverage have significant relationship with urban criminal threats in Nigeria.

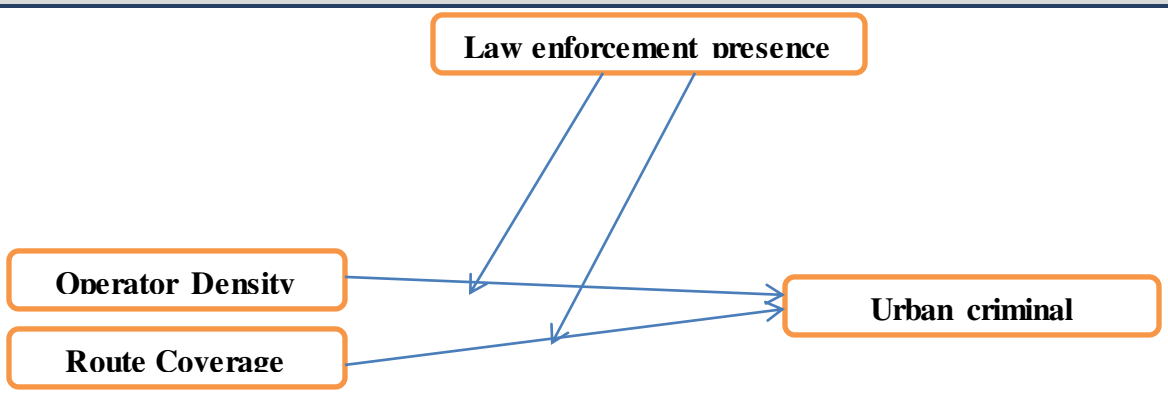
Tompson et al. (2009) investigated hot routes coverage: Developing a new technique for the spatial analysis of crime. Crime mapping. the study found that police incident reports per route, crime incident density along routes, frequency of criminal activities have positive and significant effect on spatial analysis of crime, crime mapping, while crime Type concentration and temporal crime patterns along routes have negative and non-significant effect on spatial analysis of crime.

Moderating Effect of Law Enforcement Presence

Nwambuko and Nnaeto (2024) investigated Nigerian police force and fight against urban crimes in Nigeria: Assessment of socio-economic implications with a samples size of 165 drawn from men and women of the Force Criminal Investigation Department of the Nigerian Police Force State Commands in Imo, Lagos and Abuja. The findings revealed a number of drivers of crimes in urban areas as well as the socio-economic implication of crimes in urban areas in Nigeria. Rouse (1985) in his study relationship between police presence and crime deterrence with number of police per 1,000 using 26 major cities in the United Kingdom, the findings revealed close cooperation with the community, the use of team policing, and increased night (as opposed to day) patrols. Increased police strength alone does not make a difference. Rather, many other factors must be considered if police presence is going to impact on crime rates.

2.2 Conceptual Framework

The conceptual framework of the study presents the hypothesized relationships among the study variables. Informal transportation system (ITS) is positioned as the independent variable with a direct influence on urban crime threats (UCT), the dependent variable. Law enforcement presence (LEP) is incorporated as a moderating variable that affects the strength and direction of the relationship between Informal transportation systemand urban crime threats, thus providing a comprehensive representation of the proposed relationship model.



(Source: Researcher, 2026)

Figure 1 depicts the conceptual framework for the study, highlighting the hypothesized relationships among the variables. Informal transportation system (ITS) functions as the independent construct and is represented by operator density and route coverage. Urban crime threats (UCT), is the dependent construct, while Law enforcement presence is modelled as a moderating variable.

2.3 Theoretical Framework

This study hinged on Routine Activity Theory (RAT) to lay the foundation of the study. The rational of applying it was that it explained all the variables in the study. RAT was propounded by Lawrence E. Cohen and Marcus Felson in 1979. The theory states that crime occurs when three elements converge in time and space, one motivated offender, means someone willing to commit a crime. Two suitable targets, that is a person, object, or place that is vulnerable or attractive to the offender and three Absence of capable guardian, means lack of people or mechanisms (police, security personnel. This means that it is not only the disposition of the offender that matters but also the routine activities of society that create opportunities. It is the shifts in work, leisure, travel, or urban activity patterns affect how offenders encounter targets without guardianship.

Pratt and Cullen (2005) and Farrell and Pease (1993) criticized this theory that RAT focuses heavily on situational opportunities for crime but ignores broader social, economic, and structural factors (poverty, inequality, social disorganization) that influence criminal behavior. However, in application of this theory to the study enhance that high operator density strengthens guardianship, reducing opportunities for crime and providing a visible deterrent to potential offenders, while comprehensive route coverage ensures that potential offenders are more likely to encounter capable guardians, disrupting the convergence of offender, target, and absence of guardianship. The theory also supports the showing how targeted law enforcement presence amplifies the preventive impact of patrol strategies (Miethe & Meier, 1994).

3. Methodology

The study adopted a descriptive survey design with a cross-sectional approach and employed quantitative research methods, which is suitable for collecting numerical data on the variables of interest. This approach is efficient because data are gathered at a single point in time, making it more economical and less time-consuming than longitudinal designs that require repeated measurements. The study's target population consists of 105000, civil servants, students, private sector workers, residents of urban neighbourhoods, and registered traders and market women (NBS/SMEDAN, 2025). The choice of these diverse groups for this study is that it captures multiple perspectives across different urban activities, mobility patterns, and exposure to criminal threats. The study adopted the Krejcie and Morgan (1970) sample size table, which accounts for population size, confidence level (95%), margin of error, and population proportion as previously utilized by Halake and Ombui (2022) and (Nwikiabeh et al. (2022). According to the table, a population of 75000 requires 381 respondents, while the next value 105000 requires 384, the study selected a sample size of 384 to ensure validity and consistency. This is because for populations around 75000–105,000, the sample size does not increase dramatically, so rounding to the closer value 384 maintains the validity and reliability of the study (Krejcie & Morgan, 1970). Following the recommendations of Israel (1992) and Gay (1987), a 30% increment was added to the computed minimum sample size of 384 to account for non-responses and attritions bringing the total to 499 questionnaires. From these, 403 were returned, however after removing incomplete or invalid responses, 384 valid questionnaires remained for the study analysis. This final sample falls within the acceptable range, ensuring representativeness, validity, and reliability of the study findings. Responses were measured on a five-point Likert scale, ensuring the representativeness, validity, and reliability of the data.

3.1 Results

Rate of Response

Following the discussion in the previous chapter, this study distributed 499 questionnaires to , civil servants, students, private sector workers, residents of urban neighborhoods, and registered traders and market women. The study utilized Krejcie and Morgan's (1970) method, a sample size of 384 usable questionnaires was obtained after removing 96 incomplete responses, accounting for 77% of the total distributed. Details of the questionnaire distribution and retrieval are provided in Table 1.

Table 1 Response Rate of the Questionnaires

Response Rate Category	Frequency / Rate
No. of distributed questionnaires	499
Returned questionnaires	403
Usable questionnaires	384
Excluded questionnaires	19
Questionnaires not returned	96
Overall Response Rate	81%
Valid (Usable) Response Rate	77%

(Source: Researcher, 2026)

Descriptive analysis of respondent and business characteristics

This subsection presents a descriptive analysis of the respondents' demographic information; specifically focusing on age, gender, categories of persons, and educational qualification, The Table, 2 summarize of the descriptive statistics for these demograp hic variables.

Table 2 Descriptive Results of Demographic Variables

Characteristics	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Gender				
Male	239	62.2	62.2	62.2
Female	145	37.8	37.8	100.0
Total	384	100	100	
Age	Frequency	Percentage	Valid Percentage	Cumulative Percentage
18-25	48	12.5	12.5	12.5
26-35	43	11.2	11.2	23.7
36-45	116	30.2	30.2	53.9
46-55	116	30.2	30.2	84.1
56-65	61	15.9	15.9	100.0
Total	384	100	100	
Categories of Persons	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Civil servants	71	18.5	18.5	18.5
Commercial drivers/Riders	125	32.6	32.6	51.0
Market traders and business owners	108	28.1	28.1	79.2
Residents of urban Neighborhoods	80	20.8	20.8	100.0
Total	384	100	100	
Qualification	Frequency	Percent	Valid Percent	Cumulative Percentage
PhD/DBA	10	2.6	2.6	2.6
Msc/Mpil	50	13.0	13.0	15.6
First degree/HND	137	35.7	35.7	51.3
Diploma/NCE	151	39.3	39.3	90.6
O level	36	9.4	9.4	100.0
Total	384	100.0	100.0	

Source: Author's Computation (2026) using SPSS version 27

From table 2, out of 384 respondents, 239 (62.2%) were male and 145 (37.8%) were female, indicating that males formed the majority of participants. This may reflect the higher involvement of men in informal transportation and commercial activities in urban Abuja, which are closely related to urban criminal threats. Most respondents were middle-aged (36–55 years), representing 60.4% of the sample, suggesting that the data largely came from individuals actively engaged in urban economic and mobility activities. In terms of occupation, commercial drivers/riders and market traders constituted the largest group (60.7%), indicating that the study captured individuals who are frequently exposed to crime along transportation routes and market corridors. Regarding education, 75% of respondents possessed post-secondary qualifications (Diploma/NCE or First Degree/HND), implying that participants were sufficiently literate to understand the questionnaire and provide reliable responses on issue s related to law enforcement presence, route coverage, and urban criminal threats.

3.2 Internal Consistency Reliability

The measurement model's reliability was evaluated through Cronbach's alpha and composite reliability to ensure the internal consistency of the indicators used in the study. Cronbach's alpha is based on the assumption of equal indicator loadings, whereas composite reliability accounts for heterogeneous indicator loadings (Hair et al., 2014). Therefore using both measures follows established methodological guidelines and improves the credibility of the research outcomes (Hair et al., 2022). As illustrated in

Table 2, all constructs recorded values above the recommended threshold of 0.70, with Cronbach's alpha ranging from 0.982 to 0.990 (Nunnally, 1978; Hair et al., 2014). Furthermore, rho_A and rho_C values between 0.983 and 0.990, alongside composite reliability values ranging from 0.985 to 0.992, indicate strong internal consistency among the constructs (Hair et al., 2014, 2018, 2021).

Table 2 Individual Item Reliability, Internal Consistency Reliability, Convergent Validity and Discriminant Validity

	Path	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
LEP		0.982	0.983	0.985	0.904
LEP1	0.959				
LEP2	0.947				
LEP3	0.953				
LEP4	0.946				
LEP5	0.930				
LEP6	0.974				
LEP7	0.944				
OD		0.985	0.985	0.987	0.919
OD1	0.972				
OD2	0.969				
OD3	0.943				
OD4	0.968				
OD5	0.960				
OD6	0.960				
OD7	0.935				
RC		0.985	0.986	0.988	0.919
RC1	0.977				
RC2	0.959				
RC3	0.972				
RC4	0.930				
RC5	0.954				
RC6	0.964				
RC7	0.955				
UCT		0.990	0.990	0.992	0.944
UCT1	0.984				
UCT2	0.961				
UCT3	0.966				
UCT4	0.969				
UCT5	0.978				
UCT6	0.980				
UCT7	0.962				

Source: Author's Computation (2026) using Smart PLS 4.0.9.9 released 2023

The estimated PLS-SEM output results for the model specified in equation 1 are depicted in Figures1 and 2 below. The estimations were carried out using the Smart Pls statistical software

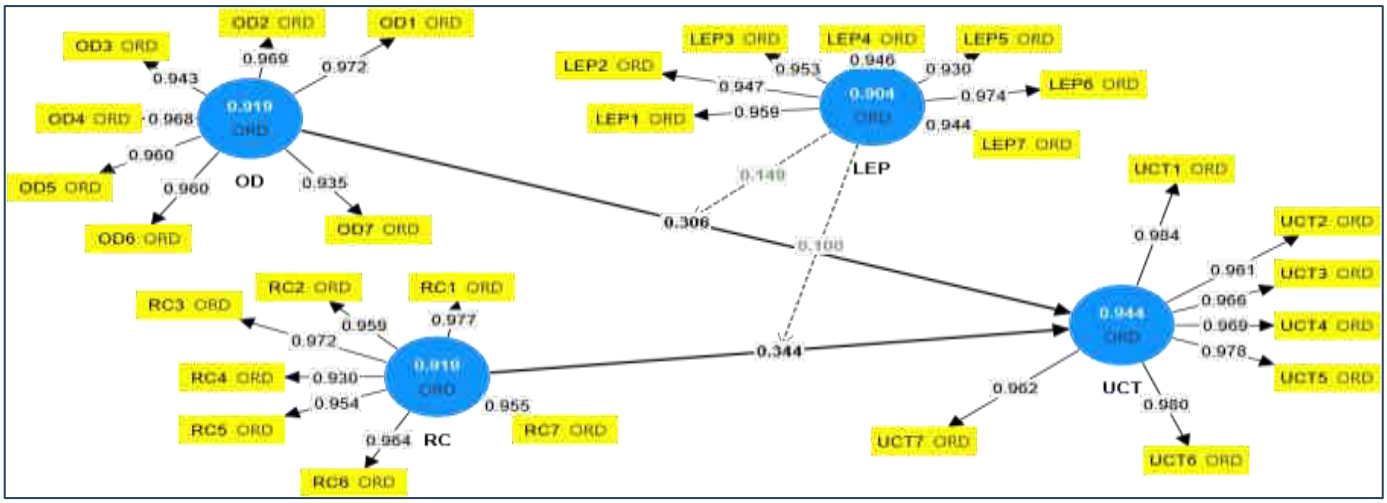


Figure 2: Path Diagram of Measurement (Outer) Model

3.3 Convergent Validity

Convergent validity indicates the extent to which indicators associated with a latent construct collectively measure the same conceptual domain (Hair et al., 2022; Fornell & Larcker, 1981). This study assessed convergent validity using the Average Variance Extracted (AVE), which reflects the proportion of variance captured by a construct relative to the variance attributed to measurement error. Hair et al. (2014) suggest that AVE values of 0.50 or higher demonstrate adequate convergent validity. The results shown in Table 3 reveal that all constructs obtained AVE values ranging from 0.904 to 0.944, indicating that approximately 93.1% of the variance in the observed indicators was explained by their respective constructs, thereby meeting the recommended convergent validity threshold.

3.4 Discriminant Validity

The assessment of discriminant validity focuses on determining whether latent constructs are empirically distinct and free from excessive conceptual overlap. In this study, discriminant validity was examined using the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT), as recommended in the PLS-SEM literatures (Hair et al., 2014). Prior research suggests that discriminant validity is achieved when indicators load more strongly on their assigned constructs than on alternative constructs (Hair et al., 2022; Henseler et al., 2015). Additionally, the Fornell–Larcker criterion requires that the square root of each construct's AVE surpasses its correlations with all other constructs in the model.

Table 3 Depicting Discriminant Validity- Fornell-Lacker Criterion

	LEP	OD	RC	UCT
LEP	0.951			
OD	0.566	0.958		
RC	0.496	0.448	0.959	
UCT	0.560	0.588	0.586	0.971

Source: Author's Computation (2026) using Smart PLS 4.0.9.9 released 2023

Table 3 shows that the Fornell–Larcker criterion confirms satisfactory discriminant validity. The square root of AVE values for Law Enforcement Presence (0.951), Operator Density (0.958), Route Coverage (0.959), and Urban Criminal Threats (0.971) are all higher than the correlations among the constructs. This indicates that each construct shares more variance with its own indicators than with other constructs, confirming that the variables are empirically distinct and supporting the validity of the measurement model.

Table 4 Discriminant Validity- Heterotrait-Monotrait Ratio (HTMT)

	LEP	OD	RC	UCT
LEP				
OD	0.575			
RC	0.504	0.455		
UCT	0.567	0.595	0.593	

Source: Author's Computation (2026) using Smart PLS 4.0.9.9 released 2023

Similarly, operator density demonstrates positive associations with route coverage and urban criminal threats, while route coverage also shows a moderate positive relationship with urban criminal threats. With correlation values ranging from 0.455 to 0.595, the results indicate moderate relationships among the constructs and confirm that multicollinearity is not a problem, allowing for further structural model analysis.

4. Structural (Or Inner) Model

Following the establishment of measurement model reliability and validity in Section 4, the structural model was evaluated to examine the effects of job embeddedness dimensions psychological attachment, social connection, and career alignment on employee performance. Bootstrapping with 5,000 resamples was conducted using data from 380 respondents, in line with methodological recommendations by Hair et al. (2011, 2012, 2014, 2017) and Henseler et al. (2012). The structural model was assessed using path coefficients (β), t-values, p-values, R^2, Q^2, and f^2 to determine explanatory power and predictive relevance

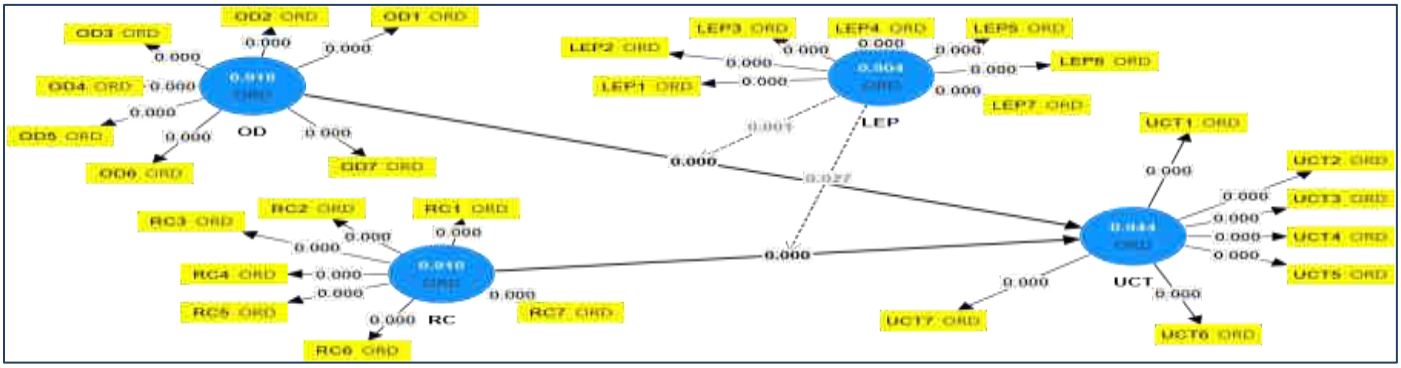


Figure 3: Path Diagram of Structural (Inner) Model

4.1 Hypothesis Testing For Direct Relationship

This section focuses on the assessment of the direct effects linking the exogenous construct of informal transportation system to the endogenous construct of urban criminal threats. As specified in the research hypotheses, Table 5 summarizes the estimated path coefficients, t-values, and significance levels for these direct associations. The null hypothesis (H_0) assumes that the effects of operator density and route coverage as represented by the path coefficients (β), are not statistically significant.

Table 5 Path Coefficients for Direct Effects in the Inner Model

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
LEP -> UCT	0.218	0.218	0.048	4.565	0.000	Rejected
OD -> UCT	0.306	0.305	0.047	6.443	0.000	Rejected
RC -> UCT	0.344	0.345	0.043	8.005	0.000	Rejected

Source: Author's Computation (2026) using Smart PLS 4.0.9.9 released 2023

The research hypothesized (H1) that the informal transportation system, proxied by operator density and route coverage, would significantly and positively affect urban criminal threats, thus rejecting the null hypothesis (H0). However, the empirical evidence reported in Table 5 shows that H01: Law enforcement presence has a positive and statistically significant effect on urban criminal threats with a path coefficient (β = 0.218, t= 4.565, p < .001). Since the p-value is less than 0.05 and the t-statistic exceeds the critical value of 1.96, the relationship is statistically significant. Therefore the null hypothesis was rejected, indicating that there is statistically significant relationship between law enforcement presence and urban criminal threats in Abuja. The positive beta coefficient implies that as law enforcement presence increases, urban criminal threats by 0.218.

H02; from table 5 path coefficients for direct effects result, operator density exerts a positive and significant influence on urban criminal threats with a path coefficient (β = 0.306, t = 6.443, p < .001). For the fact that p-value is below 0.05, and the t-value is well above 1.96, indicating that the effect is statistically significant. Meaning that the null hypothesis was rejected, indicating that there is statistically significant relationship between operator density and urban criminal threats in Abuja. The positive beta coefficient implies that as operator density increases, there is correspondence of 0.306 on urban criminal threats.

H03: The analysis also reveals that route coverage has a positive and statistically significant effect on urban criminal threats with a path coefficient (β = 0.344, t= 8.005, p < .001). This represents the strongest relationship among the predictors in the model. Since the p-value is less than 0.05 and the t-statistic is greater than 1.96, the effect is statistically significant. Thus, the null hypothesis (H03) which states that route coverage has no significant influence on urban criminal threats is rejected.

4.2 Hypotheses Testing For the Moderating Relationship

Table 6 shows the model specification analysing the moderating effect as hypothesized as follows:

Table 6 Path Coefficients for moderating Effects in the Inner Model

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
LEP x OD -> UCT	0.149	0.148	0.046	3.212	0.001	Rejected
LEP x RC -> UCT	0.100	0.100	0.045	2.218	0.027	Rejected

Source: Author's Computation (2026) using Smart PLS 4.0.9.9 released 2023

H04: From the results of the statistical analysis in table 6, the structural model shows that law enforcement presence significantly moderate the relationship between operator density and urban criminal threats with (β = 0.149, t = 3.212, p < .001). The null hypothesis is rejected, indicating that law enforcement presence significantly moderates the relationship between operator density and urban criminal threats. The positive interaction coefficient (β = 0.149) suggests that the effect of operator density on urban criminal threats (β = 0.149) strengthens as law enforcement presence increases.

.H05: Law enforcement presence significantly moderate the relationship between route coverage and urban criminal threats with (β = 0.100, t = 2.218, p < .001). The null hypothesis is rejected, indicating Law enforcement presence significantly moderates the relationship between route coverage and urban criminal threats. The positive statistics suggests that as between route coverage increases, the urban criminal threats also increase by 0.100 with law enforcement presence strengthens.

4.3 Coefficient of Determination: R-Squared

The coefficient of determination, known as R^2, measures the explanatory capability of a regression model by showing how much variation in the dependent variable is explained by the independent variable(s). An R^2 of 0.00 implies no explained variation, whereas an R^2 of 1.00 indicates full explanation. Hair et al. (2022) suggest that R^2 values of about 0.75 are substantial, 0.50 are moderate, and 0.25 are weak.

Table 7 Coefficient of Determination: R-Squared

	R-square	R-square adjusted
UCT	0.543	0.537

Source: Author's Computation (2025) using Smart PLS 4.0.9.9 released 2023

The results show that urban criminal threats has an R^2 value of 0.543 and an adjusted R^2 of 0.537, indicating that 54.3% of the variation in urban criminal threats is explained by law enforcement presence, operator density, and route coverage, while 45.7% is explained by other factors not included in the model. The small difference between R^2 and adjusted R^2 suggests that the model is stable and not over fitted.

4.4 F-Square Effect Size

The f-square (f^2) statistic was employed to assess the relative contribution of each exogenous construct to the explained variance in customer retention by examining the change in explanatory power when a predictor is included in the model.

Table 8 Depicting the Effect size- f-square

Relationship	f-square	Size
LEP -> UCT	0.063	Small
OD -> UCT	0.131	Small
RC -> UCT	0.185	Medium

Source: Author's Computation (2026) using Smart PLS 4.0.9.9 released 2023

From table 8 the effect size results show that law enforcement presence ($f^2 = 0.063$) and operator density ($f^2 = 0.131$) have small effects on urban criminal threats, while route coverage ($f^2 = 0.185$) demonstrates a medium effect, indicating that route coverage contributes more strongly to explaining variations in urban criminal threats.

4.5 Discussion of the Findings

The aim of this study was to explore whether law enforcement presence moderates the relationship between informal transportation system and urban criminal threats in Abuja Nigeria. Informal transportation system was measured through its dimensions: operator density (OD),), and route coverage (RC). Using hypothesis testing and the moderation theory by Hair et al. (2014), the study assessed the direct effects of these dimensions on urban criminal threats through the moderator, law enforcement presence.

Law enforcement presence has a positive and statistically significant effect on urban criminal threats with a path coefficient. The result highlights the importance of strategic and proactive policing; suggesting that law enforcement alone may not reduce crime unless combined with preventive strategies, environmental design, and community engagement, especially in areas with high operator density and route coverage. These study findings are in line with deterrence and crime detection theory which argued increased reporting and detection. This study aligned with previous studies (Nwambuko & Nnaeto, 2024) who revealed that law enforcement presence is important in area of urban criminal threats.

Operator density has a positive and statistically significant influence on urban criminal threats. This finding suggests that areas with higher concentrations of informal transport operators or traffic flow experience greater urban criminal threats in Abuja. The study corroborate with routine activity theory (RAT) where it was argued that crime occurs when a motivated offender, a suitable target, and the absence of capable guardians converge in space and time while dense operators, such as bus terminals, motor parks, and busy streets, naturally attract offenders due to the concentration of valuables and commuters. The current study is in consistent with prior studies (Jung et al., 022; Lafrogne-Joussier & Rollet, 2025; Ma et al., 2025) who found that operator density has positive effect on urban criminal threats.

The positive and statistically significant effect of route coverage on urban criminal threats on urban criminal threats indicates that higher route coverage correlates with an increase in monitoring or intervention opportunities, which theoretically can reduce criminal threats by increasing police visibility and deterrence. The finding supports crime prevention through environmental design theory, asserted that environmental and spatial strategies can influence crime patterns. This mean that comprehensive route coverage ensures that public spaces and transit routes are regularly monitored, which discourages criminal behaviour. The current study aligns with previous findings (Newton, 2008; Tang et al., 2021) who stated that route coverage is positive with urban criminal threats.

Law enforcement presence significantly moderates the relationship between operator density and urban criminal threats. This implies that the strength and/or direction of the relationship between operator density and urban criminal threats depend on the level of law enforcement presence in the urban environment. The study supports the situational crime prevention theory. The presence of law enforcement officers in high density operator areas may serve as a situational control mechanism, altering offender behaviour through surveillance, patrolling, and rapid response. This study is in consistent with previous studies (Nwambuko & Nnaeto, 2024)) who found moderating effect on the variables

The moderating effect of law enforcement present in the relationship between route coverage and urban criminal threats is positive and significant. This implies that law enforcement presence increases, the beneficial effect of route coverage on urban crime reduction becomes more pronounced. High route coverage, such as patrolling major streets, transport corridors, and public routes, may not be sufficient alone to deter criminal activity. However, when law enforcement presence is strong, the risk perception among potential offenders increases, enhancing the effectiveness of route coverage in controlling crime.

5. Conclusion

The study concludes that law enforcement presence, operator density and route coverage positively and significantly influence urban criminal threats in Abuja. This implies that urban criminal threats in Abuja are influenced not only by structural and environmental factors (like operator density and route coverage) but also by law enforcement strategies. Effective crime management, therefore, requires coordinated planning. In light of these results, the following recommendations are suggested.

6. Recommendation

a. The management of Nigeria Police force in Abuja should joint task force and patrols with preventive measures, such as community watch programs, public awareness campaigns, and intelligence-led policing, to proactively reduce criminal opportunities.
b. The authorities should implement registration, licensing, and structured operation systems for informal transport operators to reduce disorder and create accountability, which can deter criminal activities.
c. The management of Abuja transport system should deploy effective CCTV cameras, traffic sensors, and real-time reporting tools along high-coverage routes to support rapid response and increase the deterrent effect of route coverage.
d. Nigeria Police force should focus resources on areas with high operator density, as increased law enforcement presence in these zones can effectively reduce urban criminal threats.

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