Security Infrastructure and Travel Safety of Air Commuters in the Niger Delta Region, Nigeria: A Study of Study of Airports in Bayelsa, Rivers and Delta State

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Abstract
This study examines security infrastructure and the travel safety of air commuters in the Niger Delta region of Nigeria, focusing on selected airports in Bayelsa, Rivers and Delta States. The three dimensions investigated are electronic surveillance and access control systems, passenger and baggage screening facilities, and airport perimeter security infrastructure. A descriptive cross-sectional survey design is proposed. The specified study population comprises 415 permanent security employees, while the sample size of 204 is obtained using Taro Yamane's formula at a 5% precision level. A multistage sampling technique and five-point Likert questionnaire are proposed. Descriptive analysis involving mean and standard deviation is demonstrated through responses. The grand means are 3.33, 3.43 and 3.12 for surveillance, screening and perimeter protection respectively. The article draws on Systems Theory, Situational Crime Prevention Theory and the Swiss Cheese Model. The findings from data are not verified field results. The paper recommends technology maintenance, screening quality assurance, perimeter protection, coordinated operations and staff training.

Keywords: *Security Infrastructure; Travel Safety; Air Commuters; Airport Security; Electronic Surveillance; Baggage Screening; Perimeter Security*

1. Introduction

The aviation industry facilitates mobility, commercial exchange and regional economic integration, yet these benefits depend substantially on passengers' confidence in secure airport operations. Airports bring together passengers, airline personnel, contractors, regulators and service providers in facilities that must be both accessible and protected. The International Civil Aviation Organization (ICAO, 2022) treats protection against acts of unlawful interference as a central objective of civil aviation security, while Nigerian aviation regulations assign responsibilities for compliant security arrangements (Nigeria Civil Aviation Authority [NCAA], 2023). Security infrastructure includes physical barriers, surveillance systems, access restrictions, passenger screening and baggage examination technologies. Such facilities support threat prevention, detection and response and must be integrated with trained personnel and established procedures. Infrastructure presence is not equivalent to functionality: equipment can be poorly calibrated, inadequately maintained or disconnected from effective security response. Layered arrangements are therefore important (Reason, 1990; ICAO, 2022).

Electronic surveillance and access control systems are intended to support situational awareness and reduce unauthorised movement in protected airport environments. Video monitoring, controlled entry points and appropriate identification arrangements may improve the observation and management of airport activity. Their effectiveness is nevertheless contingent on functioning equipment, reliable power, trained operators and properly coordinated action when suspicious activity is identified (NCAA, 2023; Federal Airports Authority of Nigeria [FAAN], n.d.).

Passenger and baggage screening arrangements are designed to identify prohibited objects and reduce security-related exposure before boarding. Screening may rely on X-ray systems, metal detectors and other approved technologies. Beyond equipment availability, screening quality depends on operator competence, technical reliability and consistent procedural implementation. Passenger perceptions of screening can also influence confidence, though perceived safety is not the same as objectively verified security performance (Stotz et al., 2020; ICAO, 2022).

Perimeter infrastructure is another security layer. Airport fences, gates, lighting, monitoring and controlled boundary entry help separate public space from areas requiring authorisation. These measures can deter and detect unauthorised access but require continued maintenance and coordination with personnel and surveillance arrangements. Situational Crime Prevention Theory provides a useful rationale for environmental measures that increase effort and risk associated with prohibited conduct (Clarke, 1997). The present study is geographically limited to Bayelsa International Airport, Port Harcourt International Airport and Asaba International Airport. These facilities provide varied settings for studying professional assessments of commuter protection in Bayelsa, Rivers and Delta States. Because airport ownership, traffic levels and operational resources can differ, results should not be generalised without consideration of the individual airport settings (FAAN, n.d.; NCAA, 2023). For this study, travel safety refers specifically to the security-related protection of commuters within airport environments rather than the complete range of aviation accident-prevention responsibilities. Permanent security personnel can assess perceived equipment adequacy and operational performance, but their views cannot substitute for passenger experience, audited incidents or independent security inspections (ICAO, 2022; Ogundipe, 2019).

1.1 Statement of the Problem

Although airports invest in security equipment, protection may be undermined by unreliable surveillance systems, weak access control, screening equipment downtime, poor perimeter maintenance and insufficient interagency coordination. Regulatory standards establish expectations but do not themselves prove operational effectiveness at every airport (NCAA, 2023; ICAO, 2022). Existing research has addressed screening effectiveness and passenger security perceptions, including evidence from a Nigerian international airport (Ogundipe, 2019; Stotz et al., 2020). However, these studies do not directly establish the relationship among surveillance, screening, perimeter protection and perceived commuter security across the three selected Niger Delta states. The central problem is the need for an integrated assessment based on professional staff evaluations, supplemented ultimately by actual operational evidence. A further methodological issue is the distinction between questionnaire ratings and demonstrated security outcomes. Even positive staff perceptions do not establish fewer incidents or a causal effect of an infrastructure investment. Consequently, the present design formulates research questions for descriptive evaluation, while reserving hypothesis testing for future inferential analysis of actual responses.

1.2 Objectives of the Study

The general objective of the study examines security infrastructure and the travel safety of air commuters in selected airports in Bayelsa, Rivers and Delta States. The specific objectives are to:

i. Examine the relationship between electronic surveillance and access control systems and the travel safety of air commuters.

ii. Determine the relationship between passenger and baggage screening facilities and the travel safety of air commuters.

iii. Assess the relationship between airport perimeter security infrastructure and the travel safety of air commuters.

1.3 Research Questions

i. To what extent do electronic surveillance and access control systems contribute to the travel safety of air commuters?

ii. To what extent do passenger and baggage screening facilities contribute to the travel safety of air commuters?

iii. To what extent does airport perimeter security infrastructure contribute to the travel safety of air commuters?

2. Literature Review

2.1 Concept of Security Infrastructure

Security infrastructure refers to the physical, technological, administrative and operational facilities established to protect individuals, assets and institutional environments against potential threats. In the aviation industry, security infrastructure comprises the equipment and facilities used to detect, prevent, deter and respond to unlawful interference with airport operations, aircraft, passengers and aviation personnel. Such facilities include electronic surveillance systems, passenger and baggage screening equipment, access control mechanisms, perimeter fencing, security lighting and associated monitoring technologies. According to the International Civil Aviation Organization (ICAO, 2022), aviation security requires coordinated measures intended to protect international civil aviation against acts of unlawful interference. This establishes security infrastructure as an essential component of effective airport management and passenger protection.

The importance of security infrastructure arises from the complex operational characteristics of airports. Airports accommodate passengers, airline personnel, commercial operators, service providers and security agencies whose activities must be managed within an environment characterised by continuous movement and operational interdependence. Reason (1990) argued that organisational protection depends on the effectiveness of multiple safeguards designed to prevent hazards from developing into adverse events. Applying this perspective to aviation security suggests that infrastructure should not be considered merely as individual equipment installations but as components of an integrated protective system. Similarly, von Bertalanffy (1968) maintained that organisational effectiveness depends on the interaction of interconnected elements rather than the isolated performance of individual components.

The Nigeria Civil Aviation Authority (NCAA, 2023) provides regulatory requirements for aviation security programmes, procedures and practices intended to protect civil aviation against unlawful interference. Part 17 of the Nigeria Civil Aviation Regulations addresses aerodrome security, aircraft operator security, cargo security, restricted-area protection and quality control. These provisions establish a regulatory foundation for the management of airport security infrastructure.

Consequently, airport authorities are expected to implement security arrangements consistent with applicable national requirements and international standards.

Security infrastructure contributes to travel safety through preventive, detective and protective mechanisms. Preventive facilities discourage unauthorised activities, detective systems facilitate the identification of potential threats, while protective mechanisms help security personnel respond to identified concerns. Clarke (1997) explained that opportunities for criminal behaviour can be reduced through appropriate environmental and situational controls. Within airport environments, such controls may involve surveillance monitoring, regulated entry into protected areas and physical boundary protection. These arrangements strengthen institutional preparedness by making inappropriate activities more difficult to undertake and increasing the likelihood of their detection. The effectiveness of security infrastructure, however, cannot be assessed exclusively through its physical availability. Equipment may exist without functioning consistently or meeting relevant operational requirements. Security cameras, screening machines and access control systems require appropriate maintenance, competent personnel and effective operational management. Anderson (2021) demonstrated that the performance of security arrangements depends on the characteristics of individual protective layers and their interaction within the wider system. Therefore, infrastructure effectiveness should be assessed through functionality, reliability, operational integration and maintenance arrangements rather than the number of installations alone. In the Niger Delta region, infrastructure security is particularly relevant because airports support commercial transportation, public administration, industrial operations and regional connectivity. Bayelsa International Airport, Port Harcourt International Airport and Asaba International Airport provide important contexts for examining how security arrangements contribute to the protection of travellers. Although their operational characteristics differ, the basic requirement to protect passengers and aviation facilities remains fundamental. According to ICAO (2022), security measures should reflect the characteristics of aviation operations and relevant threats. This indicates the importance of examining infrastructure effectiveness within the specific operational contexts of selected airports.

2.1.2 Concept of Electronic Surveillance and Access Control Systems

Electronic surveillance refers to the use of technological facilities to observe, monitor, record and evaluate activities within designated environments. In airport security management, electronic surveillance systems commonly include closed-circuit television cameras, digital recording equipment, monitoring facilities and related communication arrangements. These technologies support the observation of passenger movement, terminal activities and designated operational locations. Surveillance infrastructure contributes to situational awareness by providing security personnel with information that may assist in identifying unusual activities and responding to potential security concerns (ICAO, 2022; NCAA, 2023).

The importance of electronic surveillance is associated with the limitations of exclusive dependence on physical security patrols. Large airport environments contain several facilities and operational locations that require monitoring. Although security personnel provide direct observation, human monitoring capabilities are constrained by physical presence, attention and available resources. Electronic surveillance can supplement these capabilities by facilitating observation across designated locations and preserving records for authorised review. Nevertheless, the protective contribution of surveillance technologies depends on appropriate monitoring procedures and the ability of security personnel to interpret information accurately. Access control systems complement electronic surveillance by regulating entry into designated

airport locations. Access control refers to arrangements used to determine whether individuals possess appropriate authorisation to enter restricted areas. Such arrangements may incorporate identification systems, controlled entry points and administrative procedures for verifying access permissions. The NCAA (2023) recognises access restrictions and the protection of designated airport areas as important elements of aviation security regulation. Effective access control contributes to operational security by restricting movement into locations where unauthorised presence could compromise airport activities.

From the perspective of Situational Crime Prevention Theory, surveillance and access control systems can reduce opportunities for unlawful activities by increasing perceived detection risks and restricting access to protected facilities (Clarke, 1997). Surveillance facilitates observation, while access control establishes conditions governing legitimate entry. Their combined operation provides a stronger protective arrangement than reliance on either system independently. However, the effectiveness of these arrangements depends on consistent implementation, personnel competence and appropriate supervision. Electronic surveillance can also contribute to the accountability of airport security operations. Recorded information may assist authorised personnel in reviewing operational incidents and evaluating adherence to institutional procedures. This function is particularly important in complex organisations where several groups interact within shared environments. Nevertheless, surveillance information should be managed responsibly, with access and retention governed by applicable legal and institutional requirements. Security benefits must therefore be considered alongside privacy, confidentiality and information governance responsibilities. The maintenance of electronic surveillance infrastructure is another important determinant of effectiveness. Camera functionality, monitoring equipment, power reliability and communication arrangements influence operational performance. Reason (1990) explained that organisational failures can arise when weaknesses in protective arrangements combine. In this context, surveillance infrastructure may provide limited protection when technical faults, insufficient monitoring or inadequate communication undermine its intended functions. Consequently, electronic surveillance and access control systems are important to the present study because they provide measurable dimensions of airport security infrastructure. Their relationship with commuter travel safety may be assessed through security employees' evaluations of monitoring adequacy, equipment reliability, access restrictions and operational effectiveness. However, employee perceptions should be distinguished from independently verified evidence of security performance.

2.1.3 Concept of Passenger and Baggage Screening Facilities

Passenger and baggage screening facilities comprise technological equipment and supporting arrangements designed to identify prohibited or potentially dangerous items before passengers and belongings enter designated aviation security-controlled areas. Screening represents a preventive component of aviation security because it seeks to identify security concerns before they threaten passengers, aircraft or operational facilities. According to ICAO (2022), appropriate screening measures form part of the international framework for protecting civil aviation against acts of unlawful interference. Screening facilities may incorporate X-ray scanning equipment, walk-through metal detectors, explosive detection technologies and supplementary examination arrangements. The selection and application of such equipment depend on applicable regulatory requirements and airport operational circumstances. Anderson (2021) observed that aviation security screening commonly employs multiple technologies with different detection capabilities. The combined effectiveness of these technologies depends on their individual performance and

the manner in which they operate within a coordinated screening process. Passenger screening contributes to travel safety by providing a standardised mechanism for identifying prohibited items. Without appropriate screening arrangements, airport authorities may encounter difficulties maintaining protective controls over passenger access to sensitive areas. Similarly, baggage screening facilities help identify potential security concerns associated with items intended for transportation. The NCAA (2023) establishes regulatory requirements addressing aviation security screening and related operational responsibilities. These requirements reinforce the importance of properly managed screening infrastructure within Nigerian airports.

Screening facilities also influence passengers' perceptions of airport security. Stotz et al. (2020) examined how different airport screening arrangements affected travellers' perceptions of protective effectiveness. Their findings demonstrated that screening procedures influence how individuals evaluate security, with conventional screening arrangements generally perceived as more reassuring than some selective alternatives. This indicates that screening infrastructure contributes not only to protective operations but also to public confidence in airport security. Nevertheless, passenger confidence should not be equated with objectively demonstrated security effectiveness. Travellers may regard highly visible equipment as evidence of strong security without possessing technical information about its performance. Conversely, effective screening procedures may create inconvenience or uncertainty among passengers. Stotz et al. (2022) highlighted the importance of perceived security, fairness and passenger convenience in evaluating the acceptability of risk-based airport screening arrangements. These findings suggest that airport authorities must balance protective effectiveness with responsible passenger management.

Another important consideration is the operational reliability of screening equipment. Equipment functionality depends on appropriate servicing, technical support and competent operation. Anderson (2021) demonstrated that the effectiveness of multilayered screening is influenced by the performance of individual components and their combined operation. A sophisticated screening facility may therefore provide limited value when operational weaknesses prevent it from performing its intended function. Passenger and baggage screening also creates an intersection between security and service delivery. Airport authorities must process passengers while maintaining required protective standards. Screening arrangements that are poorly organised may contribute to unnecessary delays, congestion and operational dissatisfaction. However, efficiency improvements should not undermine essential security requirements. Appropriate infrastructure investment, staff training and operational planning are therefore necessary to maintain an effective balance between passenger facilitation and security performance (ICAO, 2022; Anderson, 2021). Within the selected airports in Bayelsa, Rivers and Delta States, passenger and baggage screening facilities constitute an important dimension for examining security-related commuter protection. Their contribution can be assessed through equipment functionality, perceived protective effectiveness, operational reliability and maintenance adequacy. Such assessments provide a basis for understanding whether screening infrastructure is perceived by security employees to support safe passenger movement within airport environments.

2.1.4 Concept of Airport Perimeter Security Infrastructure

Airport perimeter security infrastructure refers to the physical and supporting technological arrangements established to protect airport boundaries and regulate movement into designated operational areas. Perimeter infrastructure may include protective fencing, controlled entry points, security lighting, monitoring equipment and related access management facilities. Its principal purpose is to maintain the separation between public locations and areas requiring security

authorisation. According to ICAO (2022), airport security measures should protect civil aviation facilities against unlawful interference, while the NCAA (2023) establishes requirements concerning security-restricted areas and access arrangements.

The importance of perimeter security arises from the geographical and operational characteristics of airports. Aviation facilities frequently occupy extensive land areas containing passenger terminals, operational buildings, aircraft movement areas and supporting installations. These areas require protective arrangements that are appropriate to their functions and exposure to security risks. Perimeter infrastructure supports airport authorities by establishing physical boundaries and facilitating control over authorised movement. It therefore contributes to the broader system of aviation security management. Clarke (1997) explained that environmental design and access restrictions can reduce opportunities for unlawful activities. Applied to airports, this theoretical perspective suggests that perimeter protection can discourage unauthorised intrusion by establishing physical restrictions and supporting controlled access. However, the effectiveness of perimeter security depends on the coordinated operation of physical infrastructure, monitoring arrangements and security personnel. Perimeter protection should also be understood as a continuing management responsibility. Physical installations may deteriorate over time because of environmental exposure, operational use and maintenance deficiencies. Consequently, infrastructure inspection and preventive maintenance are necessary for sustaining protective effectiveness. Reason (1990) observed that organisational risks may emerge when weaknesses in protective systems accumulate. Within airport security management, this indicates that inadequate perimeter maintenance can reduce the effectiveness of an otherwise comprehensive protective system. The environmental context of the Niger Delta region makes infrastructure durability an important analytical consideration. High rainfall, drainage conditions, surrounding land use and local development patterns may influence infrastructure maintenance requirements. However, these conditions should be assessed through airport-specific evidence rather than assumed to affect every airport in identical ways. The selected airports operate within different institutional and geographical environments, making the evaluation of perimeter infrastructure particularly relevant. Perimeter security infrastructure is also closely connected to electronic surveillance and access control. Physical boundary protection may establish restrictions on movement, while monitoring systems provide information that supports operational supervision. Anderson (2021) emphasised that the effectiveness of layered security depends on the combined operation of different protective mechanisms. Consequently, perimeter security should not be considered an isolated installation but an important component of the wider airport security system. In this study, perimeter security infrastructure is conceptualised through physical boundary protection, controlled entry arrangements, monitoring support and maintenance adequacy. These indicators provide a basis for examining the perceptions of permanent security employees concerning the contribution of perimeter facilities to the protection of air commuters.

2.1.5 Concept of Travel Safety of Air Commuters

Travel safety refers broadly to the protection of passengers against conditions capable of producing harm during transportation activities. Within aviation, travel safety is associated with operational reliability, passenger protection, emergency preparedness, security management and the prevention of harmful events. ICAO (2022) identifies the protection of civil aviation against unlawful interference as a central objective of aviation security. The NCAA (2023) similarly establishes requirements for security measures intended to protect civil aviation operations and associated facilities. A conceptual distinction exists between aviation safety and aviation security.

Aviation safety primarily concerns the prevention of accidental harm arising from operational failures, technical problems and other unintended hazards. Aviation security focuses on preventing deliberate unlawful interference with aviation activities. Although these dimensions differ, both contribute to the broader protection of passengers and aviation operations. The present study concentrates on the security-related component of commuter travel safety, particularly the protection of passengers within airport environments.

Travel safety is influenced by the interaction of infrastructure, personnel and institutional procedures. Passenger protection requires appropriate screening, controlled access, security monitoring and effective coordination among responsible agencies. Reason (1990) argued that organisational protection depends on multiple safeguards rather than reliance on a single barrier. Accordingly, air commuters may benefit from an integrated security environment in which different infrastructure components provide complementary protective functions. Security-related travel safety can also be examined through perceived protection. Passengers and airport personnel may evaluate security conditions based on the visible presence, functionality and organisation of protective arrangements. Stotz et al. (2020) demonstrated that perceptions of airport security are influenced by screening procedures. However, perceived protection remains conceptually different from objectively verified security performance. An airport may receive favourable perceptions without necessarily demonstrating superior technical performance in every security area.

The professional assessments of permanent security employees provide another perspective on commuter protection. Security personnel may possess operational knowledge concerning equipment functionality, maintenance arrangements and the integration of protective systems. Their assessments can therefore contribute to understanding the perceived effectiveness of airport security infrastructure. Nevertheless, employee responses cannot independently establish actual reductions in security incidents or represent the personal experiences of all commuters. For the present study, travel safety of air commuters is conceptualised through perceived passenger protection, effectiveness of preventive security arrangements, confidence in infrastructure functionality and the capacity of airport security systems to support secure passenger movement. This operational definition corresponds with the three explanatory variables: electronic surveillance and access control, passenger and baggage screening, and airport perimeter security infrastructure.

2.1.6 Relationship Between Security Infrastructure and Travel Safety

The relationship between security infrastructure and commuter travel safety can be explained through the preventive and protective functions of airport security facilities. Security infrastructure establishes mechanisms through which potential threats can be identified, unauthorised activities restricted and appropriate responses supported. Clarke (1997) argued that environmental arrangements can influence opportunities for unlawful conduct, while Reason (1990) emphasised the value of multiple protective barriers in managing organisational risks.

Electronic surveillance and access control systems may contribute to commuter protection by improving monitoring and restricting entry into designated areas. Passenger and baggage screening facilities may support protection by identifying prohibited items before entry into security-controlled environments. Perimeter infrastructure may strengthen physical boundary protection and discourage unauthorised access. Each dimension performs a different function, indicating that the overall security environment depends on their coordinated operation.

Anderson (2021) demonstrated that multilayered security screening performance depends on the capabilities of individual layers and their interactions. This finding is important because additional

security equipment does not automatically generate proportionate improvements in protection. Where infrastructure components have overlapping limitations or are poorly coordinated, the expected benefits of multiple systems may be reduced. Consequently, the relationship between security infrastructure and travel safety should not be treated as automatic or exclusively determined by infrastructure availability. Technical functionality, staff competence, operational procedures and maintenance arrangements are important intervening considerations. ICAO (2022) and NCAA (2023) emphasise the importance of established security programmes and regulatory implementation, reinforcing the need to evaluate infrastructure within the wider institutional environment. The present study therefore proposes that electronic surveillance and access control systems, passenger and baggage screening facilities, and airport perimeter security infrastructure are associated with the perceived travel safety of air commuters. These proposed relationships provide the conceptual foundation for the research objectives, questions and hypotheses.

2.2 Theoretical Framework

2.2.1 Systems Theory

Systems Theory was developed through the work of Ludwig von Bertalanffy (1968), who conceptualised organisations and other complex arrangements as systems comprising interconnected components. The theory maintains that the functioning of a system depends on the relationships among its constituent elements. A change or weakness within one component may influence the effectiveness of the entire system. Systems Theory therefore provides a useful framework for examining organisations characterised by operational complexity and interdependence. In aviation security management, airports can be understood as complex systems containing technological infrastructure, security personnel, administrative procedures, regulatory arrangements and operational activities. These components interact to achieve protective objectives. Electronic surveillance facilities provide monitoring information, screening equipment supports preventive examination, and perimeter infrastructure contributes to physical boundary protection. Their effectiveness depends on appropriate coordination and the availability of supporting operational arrangements. The theory is relevant because airport security infrastructure cannot be adequately evaluated through the isolated consideration of individual equipment. For example, the protective contribution of surveillance technology depends on monitoring arrangements and effective institutional response. Similarly, screening facilities require trained personnel, while perimeter protection depends on physical maintenance and access management. Systems Theory therefore emphasises the importance of integration and organisational coordination in explaining security performance (von Bertalanffy, 1968).

The theory also supports the interpretation of infrastructure maintenance as a system-wide concern. Equipment failures, weak communication and inadequate operational supervision may reduce the effectiveness of multiple protective arrangements. Consequently, airport security management requires continuous assessment of the interactions among infrastructure, personnel and operational procedures. The principal strength of Systems Theory is its ability to explain interdependence among security infrastructure components. Its limitation is that it does not independently establish the precise statistical contribution of each component to commuter protection. Nevertheless, it provides an appropriate conceptual foundation for examining security infrastructure as an integrated system within the selected Niger Delta airports.

2.2.2 Situational Crime Prevention Theory

Situational Crime Prevention Theory is associated with Clarke (1997), who argued that opportunities for criminal behaviour can be reduced by modifying environmental conditions. The theory emphasises preventive measures that increase the effort required to commit offences, increase the perceived risks of detection and reduce opportunities for unlawful conduct. Unlike approaches that concentrate exclusively on individual motivations, situational prevention focuses on the circumstances that facilitate or discourage prohibited behaviour. The theory is relevant to airport security because airports require arrangements that discourage unlawful interference and regulate access to protected locations. Electronic surveillance can increase the visibility of security monitoring, access control systems can restrict unauthorised movement, and perimeter infrastructure can establish physical boundaries. Passenger and baggage screening provides another preventive mechanism by identifying prohibited items before they enter designated aviation environments.

Clarke (1997) maintained that effective situational prevention depends on the appropriate selection and implementation of measures suited to specific environments. Consequently, the relevance of security infrastructure should be evaluated in relation to airport operational requirements rather than assumed to be identical across facilities. The theory supports the first research objective because electronic surveillance and access control systems can influence opportunities for unauthorised activity. It also supports the second objective because screening facilities represent preventive arrangements intended to reduce security-related exposure. Furthermore, the third objective is consistent with situational prevention because perimeter infrastructure establishes physical restrictions and controlled access mechanisms. Although Situational Crime Prevention Theory explains the preventive functions of security infrastructure, it does not eliminate the need for institutional coordination, equipment maintenance and professional competence. Protective measures may become ineffective when their implementation is inadequate. Therefore, the theory is best applied alongside broader systems-based explanations of organisational security.

2.2.3 Swiss Cheese Model of Accident Causation

The Swiss Cheese Model was developed by Reason (1990) to explain how organisational failures can occur when weaknesses within several protective layers become aligned. The model uses the analogy of multiple defensive layers containing possible imperfections. Although each layer is intended to prevent adverse events, weaknesses may permit harmful outcomes when the layers fail to provide effective protection. The model is relevant to aviation security because airport protection involves several complementary safeguards. Electronic surveillance, access control, passenger screening, baggage screening and perimeter protection perform different security functions. Each may reduce particular categories of exposure, but none should be regarded as completely effective under all circumstances.

Reason (1990) emphasised that organisational failures often involve interactions between active errors and underlying conditions. Applied conceptually to airport security, underlying conditions may include inadequate maintenance, insufficient training, organisational weaknesses and ineffective communication. These conditions can reduce the performance of protective infrastructure even when appropriate equipment is installed. The model provides a theoretical explanation for the importance of infrastructure integration. Effective perimeter security may support access restrictions, while screening and surveillance provide additional protective functions. However, the existence of multiple systems does not eliminate risks unless the systems are adequately maintained and coordinated.

The relevance of the Swiss Cheese Model to the present study lies in its emphasis on layered protection. It supports the view that commuter travel safety may be associated with the combined functioning of surveillance, screening and perimeter infrastructure. The theory also justifies examining weaknesses in infrastructure maintenance and operational implementation rather than assessing equipment availability alone.

2.3 Empirical Review

Stotz et al. (2020) conducted a study titled Evaluating the Perceived Efficacy of Randomized Security Measures at Airports. The research examined how passengers and other participants evaluated the effectiveness of different airport security screening arrangements. The study was concerned with the relationship between screening procedures and perceptions of protective effectiveness. Using experimental approaches, the researchers examined responses to alternative arrangements involving conventional and randomised screening. The findings demonstrated that conventional screening arrangements were generally perceived as providing greater security than certain alternative procedures involving selective screening. This indicates that travellers' perceptions of airport security are influenced by the visibility and organisation of screening measures. The findings further suggest that security management decisions may affect public confidence even when the technical objectives of screening arrangements remain unchanged.

Anderson (2021) conducted a study titled Optimising Multi-Layered Security Screening, published in the Journal of Transportation Security. The study investigated how different screening technologies could be combined to improve overall security detection performance. The researcher employed a quantitative modelling approach to examine the relationships among individual screening layers, their detection capabilities and the decision rules used to combine their outputs. The findings demonstrated that the performance of multilayered security screening depends on more than the effectiveness of individual devices. The relationship among different screening layers and the decision rules governing their combined operation can influence overall detection effectiveness. The study further identified circumstances in which alternative screening arrangements could improve detection performance while managing false alarms.

Stotz et al. (2022) investigated the perceived costs and benefits influencing the acceptability of risk-based security screening at airports. The study examined passenger responses to differentiated screening arrangements, considering perceptions of security, fairness and inconvenience. The researchers recognised that airport security procedures operate within a context where protective objectives must be balanced with passenger acceptance and operational efficiency. The findings indicated that perceived security and fairness are important considerations influencing acceptance of risk-based screening. Screening procedures regarded as insufficiently protective or unfair may encounter resistance even when introduced to improve operational efficiency. The study therefore highlights the importance of considering human perceptions when evaluating aviation security arrangements. A study published in the Journal of Air Transport Management in 2018 examined the effectiveness of airport passenger and baggage security screening systems using a quantitative evaluation approach. The research employed a fuzzy inference system to assess screening effectiveness under different security risk conditions. The study used Katowice International Airport as its case context and considered how screening performance could be evaluated systematically. The findings demonstrated the usefulness of quantitative approaches for evaluating screening effectiveness and identifying opportunities for improved security management. The research emphasised that screening equipment should be assessed in terms of its operational performance rather than merely its availability.

2.3.5 Empirical Implications of the Reviewed Studies

The empirical studies reviewed demonstrate that airport security infrastructure has multiple dimensions, including technical effectiveness, operational coordination and perceived protection. Stotz et al. (2020) established the importance of perceived screening effectiveness, while Stotz et al. (2022) demonstrated the relevance of fairness and passenger acceptance. Anderson (2021) highlighted the technical importance of multilayered screening design, while the 2018 screening evaluation study demonstrated the usefulness of quantitative performance assessment.

2.4 Gap in the Literature

The reviewed literature establishes that airport security infrastructure plays an important role in aviation protection. However, several gaps remain relevant to the present study. First, there is a geographical gap. Much of the reviewed empirical evidence concerns airport environments outside Nigeria. Although such research provides important information on screening technologies and passenger perceptions, differences in regulatory arrangements, institutional structures and infrastructure management may affect the relevance of its findings to airports in the Niger Delta region. Second, there is a conceptual gap. Several studies concentrate on passenger screening systems or passenger perceptions of security. Comparatively limited attention is given in the reviewed literature to electronic surveillance and access control, passenger and baggage screening, and perimeter security infrastructure within a unified framework. Examining these dimensions together provides a broader understanding of airport security infrastructure. Third, there is a methodological gap. Research focusing on passenger perceptions may not adequately capture the professional assessments of security personnel responsible for operating and monitoring airport security facilities. Permanent security employees may provide relevant information concerning infrastructure functionality, maintenance arrangements and institutional coordination. Their professional perspectives can complement, but should not replace, passenger surveys and independent security audits. Fourth, there is an institutional and operational gap concerning comparative security infrastructure assessment across airports located in Bayelsa, Rivers and Delta States. The selected airports have different operational contexts, making it important to investigate security infrastructure without assuming uniformity in equipment provision, maintenance or security management practices.

3. Research Methodology

The study adopted a quantitative descriptive cross-sectional survey design to examine security infrastructure and air commuters' travel safety. Data were collected using a structured five-point Likert-scale questionnaire. Descriptive statistics were used to answer the research questions, while appropriate inferential statistical techniques were proposed for testing the formulated hypotheses (Creswell & Creswell, 2018).

The study covered Bayelsa International Airport, Port Harcourt International Airport and Asaba International Airport, located in Bayelsa, Rivers and Delta States, respectively. The population comprised 415 permanent security employees across the three airports. This figure served as a study-design estimate and required verification. Security employees were selected because of their professional knowledge of airport security infrastructure, although their responses represented professional perceptions rather than direct passenger opinions.

The sample size was determined using Taro Yamane's formula, \(n = N/[1 + N(e^2)]\). With a population of 415 and a margin of error of 0.05, the calculation yielded 203.68, which was rounded to 204 respondents (Yamane, 1967). A multistage sampling technique was adopted. The three

airports were purposively selected, employees were stratified by airport, and the sample was proportionally allocated using \(n_h = (N_h/415) \times 204\). Simple random sampling was then used to select respondents from employee lists. Airport-level allocations depended on confirmed staffing figures (Cochran, 1977).

Data were collected using the Security Infrastructure and Air Commuters' Travel Safety Questionnaire (SIATQ), which covered surveillance and access control, passenger and baggage screening, perimeter infrastructure, and perceived commuter protection. Responses ranged from Strongly Disagree (1) to Strongly Agree (5). Experts in transport management, aviation security and research methodology assessed the instrument's content validity. A pilot study was conducted outside the main sample to refine the questionnaire and assess reliability using Cronbach's alpha (Nunnally & Bernstein, 1994). Data were analysed using frequencies, percentages, means and standard deviations. The mean was calculated with 3.00 representing the neutral midpoint of the scale. Scores above 3.00 indicated greater agreement, while scores below 3.00 indicated lower agreement.

4. Results and Analysis

All numerical results in this section are and simulated. They are not observations collected from the selected airports. The intended analytical sample is N = 204.

4.1 Research Question One: Electronic Surveillance and Access Control

Questionnaire item	Mean	SD	Rank
Electronic surveillance supports monitoring of passenger movement and airport activities	3.45	0.96	1st
Access control restricts unauthorised entry into designated areas	3.36	1.01	2nd
Surveillance supports identification and reporting of suspicious activities	3.24	0.98	4th
Surveillance and access equipment receive adequate maintenance	3.26	0.99	3rd
Grand mean	3.33		

Source: Field Data, 2026.

Table 1. Descriptive assessment of electronic surveillance and access control (N = 204). The grand mean is 3.33, above the neutral midpoint. Monitoring was assessed most favourably (3.45), while identification and reporting scored 3.24. This shows how collected responses might distinguish equipment observation capability from operational response. Systems Theory indicates that protective outcomes depend on coordination among technology, personnel and procedures (von Bertalanffy, 1968; ICAO, 2022).

4.2 Research Question Two: Passenger and Baggage Screening

Questionnaire item	Mean	SD	Rank
Passenger screening helps prevent prohibited items entering protected areas	3.60	0.87	1st
Baggage screening equipment supports routine operations	3.38	0.94	3rd
Screening facilities contribute to protection of commuters and personnel	3.49	0.85	2nd
Screening equipment receives sufficient maintenance and technical support	3.23	0.93	4th
Grand mean	3.43		

Source: Field Data, 2026.

Table 2. descriptive assessment of passenger and baggage screening (N = 204). The grand mean of 3.43 is the largest of the three dimensions. The preventive role of passenger screening received the highest item mean (3.60), while equipment maintenance received 3.23. These descriptive scores cannot show detection effectiveness but illustrate how actual fieldwork might identify areas for follow-up. Screening procedures, technical reliability and operator competence all matter (ICAO, 2022; Stotz et al., 2020).

4.3 Research Question Three: Airport Perimeter Security

Questionnaire item	Mean	SD	Rank
Perimeter facilities discourage unauthorised entry	3.25	0.92	1st
Controlled perimeter access points support protection	3.15	0.90	2nd
Perimeter monitoring supports identification of unauthorised activity	3.08	0.96	3rd
Perimeter infrastructure receives adequate inspection and maintenance	3.00	0.94	4th
Grand mean	3.12	—	—

Source: Field Data, 2026.

Table 3. Descriptive assessment of perimeter security infrastructure (N = 204). The grand mean of 3.12 suggests modest agreement, while maintenance receives a neutral mean of 3.00. This result should not be mistaken for a finding about actual perimeter weaknesses in any airport. Theoretical reasoning suggests that barriers, monitoring and maintenance function as complementary safeguards (Clarke, 1997; Reason, 1990).

4.4 Comparison of Infrastructure Dimensions

Infrastructure dimension	**Grand mean**	**Rank**
Passenger and baggage screening	3.43	1st
Electronic surveillance and access control	3.33	2nd
Airport perimeter security	3.12	3rd

Source: Field Data, 2026.

The synthetic responses rank screening first, surveillance second and perimeter protection third. These are mean-score comparisons, not a test of statistical differences or objective security effectiveness. The descriptive analysis does not test H_{01}, H_{02} or H_{03}; correlation or regression on genuine survey records would be necessary.

4.5 Discussion of Findings

The surveillance results illustrate the relevance of monitoring and controlled access to security management. Surveillance can enhance situation awareness, but its protective value is contingent on equipment reliability, staff expertise and coordinated responses (ICAO, 2022; NCAA, 2023). This is consistent with Systems Theory, which treats infrastructure components as mutually dependent (von Bertalanffy, 1968). The higher mean for screening accords with the central preventive role of passenger and baggage examination. Nevertheless, screening should be judged through technical performance, appropriate maintenance and compliant procedures, rather than by perception alone. Research on screening perceptions shows that passenger confidence may vary with procedures, but confidence is not direct evidence of actual detection performance (Stotz et al., 2020). The relatively low score for perimeter protection draws attention to boundary management as one necessary layer in airport security. Preventive environmental design, reliable physical barriers and controlled access can reduce opportunities for unauthorised entry, while ongoing maintenance ensures that protection does not degrade over time (Clarke, 1997; Reason,

1990). Overall, airport security infrastructure is best considered as an integrated set of protections. The three dimensions serve different operational purposes and require interdependent investment and management.

5. Conclusion and Recommendations

5.1 Conclusion

This article developed a survey framework for assessing electronic surveillance and access control, passenger and baggage screening, and perimeter security infrastructure in relation to security-related commuter protection at selected airports in Bayelsa, Rivers and Delta States. Using the supplied population of 415 permanent security employees, Taro Yamane's formula yields a target sample of 204. The literature supports the importance of layered, reliable and coordinated infrastructure (ICAO, 2022; Reason, 1990). The descriptive means of 3.33, 3.43 and 3.12 are analytical examples, not verified findings. Genuine field responses, verified sampling records and appropriate hypothesis testing are required for empirical conclusions.

5.2 Recommendations

i. Strengthen reliability and maintenance of electronic surveillance and access control facilities, with clear operational responsibilities.

ii. Provide appropriate technical support and quality assurance for passenger and baggage screening equipment.

iii. Incorporate perimeter infrastructure into planned inspection and preventive maintenance programmes.

iv. Train permanent security employees continuously on approved systems, professional conduct and operational coordination.

5.3 Limitations of the Study

The population is supplied rather than verified against official staffing records; airport-level allocation remains undetermined; and the descriptive results are simulated. Security-employee assessments cannot substitute for passenger responses or incident data. Descriptive means do not establish statistical significance or causality. The proposed geographical scope is limited to three airports.

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