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Efficacy of Closed Circuit Television in Security Management of Commercial Properties in Lagos Metropolis, Nigeria

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ABSTRACT

This study investigates the efficacy of CCTV as a crime control and management apparatus in commercial premises. Shopping malls and storage facilities with closed-circuit television systems as part of security arrangements were identified at different locations across the state. A total of 171 copies of structured questionnaires were administered, and a response rate of 77.2 percent was achieved. Data on safety and security breaches, as well as CCTV footage between 2018 and 2023, were obtained. Descriptive and inferential statistics from Excel analytics tool packs were used for the analysis. Results were presented in tables and figures, followed by a robust discussion. The study observed that CCTV has not been able to completely deter the incidence of criminal acts and that CCTV was found to be more effective in shopping malls than the warehouses, although the difference is statistically insignificant. The study further showed that power and technical issues are the top two challenges of CCTV usage in shopping malls, while personnel and power are the top two challenges at the warehouse. The study suggested an alternative power supply for the CCTV and the use of experts for acquisition, installation, and operation.

1. INTRODUCTION

The security and safety of lives and property are paramount concerns for both government and society [1]. Insecurity, in its many forms—economic, financial, political, neighborhood, property, or personal—creates a pervasive atmosphere of fear and uncertainty, which significantly impedes the growth and development of a nation. Recent studies highlight an unprecedented surge in insecurity across developing economies, with urban criminality escalating in nearly all such countries [2]. Crime varies widely in type and the pattern of its incidence has fluctuated over the years. A study drawing on data from the Nigeria Bureau of Statistics illustrated the fluctuating patterns of various crimes in Nigeria from 1993 to 2013 [3]. This study revealed an irregular increase in armed robbery, with the fewest cases occurring in 1998 and the most in 2011. Burglary incidents peaked in 1994 but fell to their lowest in 2010, only to rise sharply in 2012 and then decline again in 2013. Assault incidents peaked in 1995 and saw spikes in 2003 and 2010 after a period of steady decline.

According to the National Bureau of Statistics 2017 report, 50,975 recorded incidents of various offenses occurred. Of these, 37.1 percent were crimes against individuals, and 49.0 percent involved property-related offenses [4]. The theft was the most common property crime, accounting for 50.9 percent, followed by burglary at 4.9 percent, and store breaking and arson at 2.6 percent. Armed robbery made up about 2.0 percent of the total crimes. Assaults constituted 43.5 percent of the offenses against persons. Crime statistics from Lagos State in 2022 showed that armed robbery accounted for 13.3 percent of crimes, with other crimes making up 38.4 percent [5]. These included terrorism, murder, and kidnapping, among other offenses. Additionally, a report highlighted that the average crime rate in Nigeria has been increasing irregularly over recent decades, with crimes often involving sophisticated technology [6]. Metropolitan areas in Nigeria experience more significant crime challenges compared to rural areas.

Various strategies and devices are employed to enhance the safety and security of lives, property, and neighborhoods. These measures are designed to prevent, deter, intercept, or provide evidence of criminal acts during investigations and prosecutions. According to Radetskiy et al. [7], such measures include the utilization of trained dogs, vigilante groups, perimeter fencing, electric fences, thermal cameras, security guards, fire alarm systems, temperature spikes, flour and water sensors, closed-circuit television systems, and video recorders. Additionally, police foot and vehicle patrols play a crucial role in maintaining security [8].

Ajibade and Adediran [2] reported that the fear of crime, whether in sparsely or densely populated neighborhoods and particularly in dark areas, has led to the construction of high and extensive walls, the installation of security lights, and the addition of burglary proofs in residential buildings. The study also highlights that perimeter fences around industrial and commercial properties serve not only to prevent encroachment but also to control the movement of people and resources

entering and exiting the premises, thereby protecting both the individuals and the assets of the business.

According to Lawson et al. [9], situational crime prevention and intervention measures such as CCTV and street lighting are widely implemented as tools for deterring crime. Therefore, safety and security considerations are crucial when planning neighborhoods and designing properties.

CCTV systems are essential security tools that prevent, deter, intercept, and provide evidence of security breaches by employing proactive, active, and reactive measures for crime control. According to the study [10], CCTV was first implemented in public areas to enhance public safety, deter crime, improve detection, and ensure timely responses to crime. Malmenbratt and Brooks [11] noted that CCTV is used in both public and private settings to identify risks, deter crimes like theft and vandalism, and provide crucial evidence for criminal investigations.

In private spaces, CCTV helps monitor the movement of people and materials, manage sites, and maintain situational awareness [12, 13]. Nte et al. [14] stated that CCTV is used in various places, including offices, shops, schools, banks, resorts, and churches, to deter shoplifting, protect employees, monitor goods and people's movement, and prevent theft, damage, or unauthorized entry.

Despite its widespread utility and applicability across various settings, the effectiveness of surveillance cameras remains a subject of debate. Gill and Spriggs [15] point out that the actual impact of CCTV on achieving its intended goals is still ambiguous. Fischer et al. [16] and Smith and Brooks [17] have argued that the deterrent effect of CCTV is highly contested, as it is challenging to quantify the number of crimes it successfully prevents. Further, Gill and Spriggs [15] noted that although numerous studies have explored various facets of CCTV use in different environments, only a few have specifically addressed its effectiveness. These studies have shown that CCTV's impact can vary significantly, being effective in some contexts while failing in others. The majority of research and reports on CCTV have concentrated on the technology's technical aspects [18], regulatory mechanisms [19], corporate functions [11], challenges [14, 20], and overall impacts [15, 21].

Additionally, Okokpujie et al. [22] investigated the cost-effectiveness of CCTV, creating an affordable real-time IoT-based surveillance system for homes, offices, banks, and public spaces. Additionally, research has been conducted on using unmanned aerial vehicles (UAVs) for security surveillance in large industrial areas [23]. However, there is a lack of empirical studies on the effectiveness of CCTV in commercial settings such as shopping malls and warehouses, and it remains uncertain whether CCTV meets expectations in these environments. Furthermore, existing crime data do not provide detailed information on the types of properties most affected by criminal activities. This study aims to assess the effectiveness of surveillance cameras, specifically in commercial premises, focusing on shopping malls and warehouses.

2. LITERATURE REVIEW

2.1 Closed circuit television system

A CCTV system is fundamentally an electronic device designed to capture and transmit images for viewing and/or recording at a different location [24]. It is described as a type of situational crime prevention strategy that increases formal surveillance within a specific area [25]. The system comprises electronic monitoring tools that utilize video cameras connected through a closed (non-broadcast) circuit to capture and convey visual information about a space over time [10]. Additionally, CCTV serves as a crime prevention and security measure by collecting images and transmitting them to a monitoring or recording device for viewing, reviewing, or storage [15].

Closed circuit television is a multifaceted surveillance technology used across various domains, including public, private, social, and work environments [26]. Modern surveillance extends beyond CCTV to include satellite tracking, dataveillance, biometrics, and DNA profiling, emphasizing the comprehensive monitoring of subjects of interest [11, 27]. Moreover, CCTV systems are described as networks of video cameras linked in a closed circuit, sending images to a central monitor or storage system [28].

A typical CCTV system consists of several key components, which can vary in type, grade, size, and specification. These components generally include cameras, lenses, transmission equipment, monitors, recording or storage units, and control units [29]. The basic elements of CCTV systems have been categorized into four main parts: the camera, transmission media, recording technology, and viewing units or monitors [18]. These systems are complex, featuring a variety of functions, features, and specifications such as cameras, lenses, data distribution, power, and lighting [30].

To maximize the benefits of a CCTV system, organizations must clearly define the overall aims and objectives. This includes outlining the functional, operational, and infrastructure requirements, as well as video retention policies. Ensuring that a CCTV system possesses all these components is essential for achieving effective surveillance outcomes, whether in public or private settings.

2.2 Security effects in property environments

Properties, which exist in various designs and constructions, serve diverse purposes and are fundamental to the growth and development of human settlements. This growth is often measured by the quantity and quality of physical development. The building industry not only contributes significantly to a nation's gross domestic product but also provides substantial employment opportunities. Properties are also considered a major avenue for investment, requiring substantial capital while offering unique benefits such as durability and protection against inflation.

However, being tangible assets, properties are vulnerable to societal unrest and attacks, including arson and vandalism. They offer shelter for a wide range of human activities across private, corporate, and public spheres. At the same time, properties can shield harmful or criminal activities within their confines. The value of a property is determined by various factors, including location, accessibility, neighborhood infrastructure, social services, and the facilities within the building. Other influential factors are building condition, frontage proportion, adequate parking, convenience features, land size, and built-in amenities, which particularly enhance the value of commercial and industrial properties [31-34].

The security of a neighborhood and its properties significantly impacts property values. Consequently,

governments, communities, and property stakeholders invest heavily in security and safety measures [35]. Studies have shown an inverse relationship between property value and the perceived level of crime, with crime prevention strategies positively affecting property values [36, 37].

Furthermore, crime rates influence the demand for residential properties, with homeowners willing to invest in reducing their exposure to crime [38, 39]. Research on the security effects of CCTV has spanned various environments, with a particular focus on neighborhood and residential areas as opposed to commercial premises. For example, studies have examined the impact of CCTV in a deprived neighborhood in Sweden [40], the crime prevention effects of CCTV in public spaces [41], the security of residential estates in Nigeria [2], the influence of security on rental prices of residential properties in South Africa [8], and the effectiveness of CCTV surveillance systems for crime control and prevention in South Africa [42].

Many homeowners face the challenge of timely detection and reporting of security breaches, which highlights the need for surveillance systems capable of detecting, reporting, and transmitting real-time footage of any security breach. This capability underscores the suitability of CCTV systems for crime intervention in various settings [1].

2.3 Effectiveness of CCTV in property environment

CCTV has become an integral part of security architecture worldwide, offering the capability to provide continuous, 24-hour surveillance. According to Piza et al. [43], CCTV has evolved into a strategic crime prevention tool globally. However, the authors also recognize that the effectiveness of this technology as a crime prevention mechanism requires periodic evaluation.

The effectiveness of CCTV varies under different circumstances and environments, a topic that has been widely debated. Gill and Spriggs [15] noted that some systems are more effective than others, and the impact of CCTV differs across different settings, leading to varied results. The study further suggests that the capability of the CCTV system and the accuracy of its installation are crucial factors in determining its effectiveness. Despite these findings, the effectiveness of CCTV in achieving its intended goals remains unclear.

Smith and Brooks [17] and Pieterse 18] argued that the role of CCTV as a deterrent is contentious, as it is challenging to measure the number of potential criminal acts it has successfully prevented. According to Gill and Spriggs [15], while various studies have explored different aspects of CCTV across multiple environments, only a few have specifically addressed its effectiveness. The findings indicate that CCTV systems have been highly effective in some settings, such as car parks, but their impact is less certain in residential areas. Moreover, research on the effectiveness of CCTV in commercial premises is limited, and it remains unclear whether CCTV is beneficial in these environments.

Nte et al. [14] highlighted that the debate over the efficacy of CCTV in crime management persists amid increasing security challenges. The authors question the effectiveness and efficiency of CCTV, particularly given the rising crime rates, despite the widespread installation of these systems in strategic locations across the Federal Capital Territory.

2.4 Challenges of closed circuit television

The effectiveness of CCTV systems in achieving management or user objectives can be significantly impacted by a variety of factors. Nte et al. [14] highlighted several challenges, including cost-related issues, user attitudes, and a shortage of technically skilled staff required to manage these systems effectively.

Gill and Spriggs [15] organized the factors influencing CCTV operations into five key categories: the clarity of project goals, management quality, the density of the area under surveillance, camera coverage and positioning, and the technical characteristics and operations of the control room. The study also emphasizes that the performance of CCTV systems not only relies on the system's capability but also on the correctness of its installation.

Various studies have identified multiple factors that can hinder the effectiveness of surveillance technology [15, 20, 40, 44]. Technical issues, for instance, may include camera failure, software errors, problematic cable connections, and power outages. Cost-related challenges often involve high expenses associated with the acquisition, operation, and replacement of the systems.

Personnel-related challenges are also significant; these can include the employment of unskilled or inadequate numbers of personnel, willful damage by staff, and issues such as fatigue or distraction. Quality-related challenges might involve poor coverage, lens obstruction by external objects, weather interference, and the use of poor-quality cameras.

Additionally, user-associated challenges such as conflicts, distrust, discomfort, and concerns over privacy intrusion can also affect the operational effectiveness of CCTV systems. These multifaceted challenges underscore the complex nature of deploying and maintaining effective CCTV surveillance in various settings.

3. RESEARCH METHODS

Two groups of respondents were involved in the study, and these were the users/occupants of multi-tenanted shopping marts and warehouses or storage facilities at different locations across Lagos Metropolis. Both the shopping marts and storage facilities surveyed have surveillance cameras as part of the security and safety architecture for persons and properties. This was the basic criterion for selecting target units that constitute the study population. Since the official record of properties used as shopping centers and warehouses was not available, a cluster sampling technique was adopted to select samples from different geographical locations across the Lagos Metropolis. Lagos Metropolis comprise the Lagos (Eko) and Ikeja Administrative Division out of the Five Administrative Divisions that make up Lagos State. Cluster sampling was adjudged appropriate for the study because it eliminates the need for a complete list of all units in the population, simplifies the fieldwork, and reduces cost significantly. Consequently, a total of 96 copies of structured questionnaires were administered to tenants/users of the 32 shopping marts randomly visited across Ikeja and Lagos Business Districts, while 75 copies of the same were administered to users of 50 warehouses/storage facilities, the majority of which were single-use warehouses. In order to have a fair spread of response and opinion, three copies of questionnaires were administered at each of the shopping

malls and at the jointly used stores. Questions were framed directly from research problems and literature reviewed to address the objectives of the research. Closed-ended queries were raised in structured questionnaires to elicit responses to the incidence of criminal acts, which include burglary, armed robbery, theft, car theft, criminal damage, assault, and gang violence within the premises of the shopping centers and warehouses between 2018-2023. Within this period, the number of security and safety breaches with CCTV proof was also obtained for the purpose of determining the efficacy of surveillance cameras on the premises. Furthermore, the opinion of respondents on various challenges that hindered the optimization of CCTV technology in commercial premises was obtained and analyzed. In order to ascertain the extent to which the different aspects of the questionnaire elicit consistent responses, Cronbach's Alpha Coefficient (α), which measures the internal consistency reliability of the instrument, was used. A Chronbach's Coefficient (α) of 0.831 was obtained, indicating a high level of internal consistency of questions as well as the scale of measure of responses [45]. In addition, a robust review of studies that are recent and relevant to the research was used to obtain vital information and ensure that the instrument measures what was intended [46]. In order words, the validity, particularly the content, construct, and criterion validity of the instrument and that of findings, were anchored on a recent, relevant, and robust review of extant literature. Analysis of data was carried out with Excel analytics tool packs, and basic statistical tools engaged include mean, standard deviation, Pearson correlation, and Paired Sample T-test. The challenges were analyzed with a 5-point Likert scale, and the weighted mean was calculated and ranked accordingly. The results were presented in tables, percentages, and figures and followed with an explanation.

4. ANALYSIS AND RESULTS

4.1 Rate of response

The administration of questionnaires and retrieval is presented in Table 1.

Table 1. Questionnaire administration and rate of response

Study Group	Questionnaires Administered	No. Retrieved	Response Rate (%)
Shopping Malls	96	72	75%
Warehouse/Stores	75	60	80%
Total	171	132	77.2%

Table 1 shows that the overall response rate from the questionnaire administered to both groups of respondents is 77.2%. A response rate of 75% was achieved at the shopping malls and 80% at the warehouse. The response rate was high and sufficient for further analysis.

4.2 Security and safety breaches between 2018-2023

Responses to the questionnaires obtained the number of security and safety breaches at the shopping marts and warehouses between 2018 and 2023, which are summarily presented in Table 2.

Presented in Table 2 is the aggregate count of criminal acts that occurred in the shopping mall and warehouse between 2018 and 2023 in the study area. At the marts, a total of 2,647 incidences of different crimes were recorded over the 6-year period, and a total of 1,857 similar incidences were recorded at warehouses over the same period. The descriptive statistics of the data are presented for further discussion.

4.2.1 Descriptive statistics of the security breach incidence

The analysis presented in Table 3 showed that theft has the highest record of occurrence at both the shopping malls and warehouses, with mean values of 191 and 146.17 and standard deviations of 61.90 and 53.92, respectively. This is followed by vandalism, with mean scores of 93.33 and 65.17 at shopping malls and warehouses. However, assault came 3rd in the frequency of occurrence, with a mean value of 78.83 at shopping malls, while burglary ranked third at warehouses, with a mean value of 31.67. The least occurring type of security and safety breach is car theft for both shopping malls and warehouses, with mean values of 5.67 and 1.17, respectively. A graphic representation of the incidence of various security breaches, as contained in Table 1, is displayed in Figure 1.

Figure 1. Pattern of security breach at the shopping mall and warehouses between 2018 - 2023

Table 2. Aggregate of security and safety breaches between 2018-2023

Security Breach	2018		2019		2020		2021		2022		2023	
	SM	WH	SM	WH	SM	WH	SM	WH	SM	WH	SM	WH
Burglary	23	13	47	32	69	48	41	39	19	26	15	32
Armed Robbery	9	3	13	19	19	27	11	23	7	17	5	26
Theft	105	53	187	133	289	201	211	172	151	130	203	188
Car Theft	3	-	6	1	11	3	4	-	5	2	5	1
Vandalism	45	42	83	54	116	97	119	63	87	60	110	75
Assault	39	13	87	28	151	33	73	17	56	19	55	39
Gang violence	13	7	19	21	52	30	43	24	17	19	24	27
Total	237	131	442	288	707	439	502	338	342	273	417	388

Key: SM – Shopping Mall; WH – Warehouse.
Source: Field Survey 2023/2024.

Table 3. Descriptive statistics of security breaches between 2018-2023

Variables	Mean		Standard Dev.		Kurtosis		Skewness		Sum	
	SM	WH	SM	WH	SM	WH	SM	WH	SM	WH
Burglary	35.67	31.67	20.66	11.84	-0.34	0.74	0.78	-0.35	214	190
Armed Robbery	10.67	19.17	4.97	8.82	0.74	2.37	0.87	-1.48	64	115
Theft	191	146.17	61.90	53.92	0.88	1.03	0.32	-1.07	1146	877
Car Theft	5.67	1.17	2.80	1.17	3.57	-0.45	1.73	0.67	34	7
Vandalism	93.33	65.17	28.05	18.99	0.81	0.97	-1.10	0.84	560	391
Assault	76.83	24.83	39.90	10.13	2.79	-1.64	1.58	0.31	461	149
Gang violence	28	21.33	15.77	8.07	-1.11	1.85	0.89	-1.20	168	128

Key: SM – Shopping Mall; WH – Warehouse.

4.2.2 Correlation of security breach incidence between 2018-2023

In order to understand the dynamics of the relationship among the different types of security breaches, the pattern and strength of the relationship were carried out using the Pearson Moment Correlation. The analyses for the two commercial premises are presented in Table 4 and Table 5.

Table 4 and Table 5 show that there is a positive correlation among the variables measured, albeit at varying degrees of strength for the shopping malls and warehouses. Aside from burglary, vandalism, armed robbery, and vandalism that showed a relatively weak positive correlation, other relationships posted positive correlations that can be described as above average, strong, and very strong. The implication of this is that any factor that drives or encourages any of the variables has the potential to increase the risk of incidence of others.

4.3 Average incidence of security breaches: comparing situations with and without CCTV evidence

Data on the average count of times that the surveillance camera captured and produced useful footage of various misconducts were obtained and summarily presented in Table 4 and Table 5. Likewise, the cases when the footage was either inadequate, missing or not useful were also obtained and presented. The data was further analyzed using descriptive statistics and paired sample tests to obtain the mean values, spread, and relationship between the paired scenarios.

4.3.1 Descriptive statistics and paired sample t-test

A descriptive analysis and paired sample t-test of mean values of cases of security breach with and without CCTV proof at each commercial facility was conducted and presented in Table 6.

Table 4. Correlation matrix of security breach at shopping mall between 2018-2023

Variables	Burglary	Armed Robbery	Theft	Car Theft	Vandalism	Assault	Gang Violence
Burglary	1						
Armed Robbery	0.9852	1					
Theft	0.7564	0.6739	1				
Car Theft	0.7986	0.7045	0.8478	1			
Vandalism	0.3965	0.2623	0.8508	0.5	1		
Assault	0.9329	0.9120	0.8887	0.9555	0.5494	1	
Gang violence	0.7575	0.6944	0.8951	0.6781	0.7911	0.7992	1

Table 5. Correlation matrix of the security breach at the warehouse between 2018-2023

Variables	Burglary	Armed Robbery	Theft	Car Theft	Vandalism	Assault	Gang Violence
Burglary	1						
Armed Robbery	0.9045	1					
Theft	0.9161	0.9917	1				
Car Theft	0.5537	0.5012	0.5103	1			
Vandalism	0.8585	0.8311	0.8770	0.7553	1		
Assault	0.5597	0.7483	0.7300	0.5096	0.7126	1	
Gang violence	0.9288	0.9944	0.9926	0.5656	0.8796	0.7647	1

Table 6. Average count of security breaches with and without CCTV proof

Security Breach	Shopping Mall		Warehouse	
	No. with CCTV Proof	No. Without CCTV Proof	No. with CCTV Proof	No. Without CCTV Proof
Burglary	113	101	100	90
Armed Robbery	39	25	74	41
Theft	714	432	332	545
Car Theft	19	15	2	5
Vandalism	342	218	170	221
Assault	274	187	94	55
Gang violence	97	71	109	19

Source: Field Survey, 2023/2024.

Table 7. Descriptive statistics and paired sample t-tests with and without CCTV proof

Parameters	With CCTV Proof		Without CCTV Proof	
	Shopping Mall	Warehouse	Shopping Mall	Warehouse
Mean	228.29	125.86	149.86	139.43
Median	113	100	101	55
Standard deviation	245.32	103.63	146.06	192.78
Kurtosis	2.2669	2.9087	1.7547	3.9898
Skewness	1.5234	1.4155	1.3344	1.9999
Sum	1598	881	1049	976
Percentage	60.37	47.44	39.63	52.56
Pearson Correlation	0.9481		0.9422	
t-stat	1.7981		-0.3742	
P(T≤t) two-tail	0.1223		0.7211	
t Critical two-tail	2.4496		2.4469	

Sig value = 0.05.

Table 8. Likert scale analysis of the challenges of CCTV usage in commercial premises

Challenges of CCTV	Shopping Mall				Warehouse			
	Sum	Mean	RII	Rank	Sum	Mean	RII	Rank
Technical	266	3.69	0.74	2	182	3.03	0.61	3
Cost	240	3.33	0.67	3	169	2.82	0.56	4
Power	270	3.75	0.75	1	185	3.08	0.62	2
Personnel	237	3.29	0.66	4	202	3.37	0.67	1
Quality	233	3.24	0.65	5	60	1.00	0.20	5

The results presented in Table 6 show that the highest number of cases of security compromise with proof happened at the shopping mall and the highest number of cases without proof happened at the warehouse. However, while the mean value of cases of a security breach with CCTV proof has a higher spread of 245.32 at the shopping malls compared to 103.63 at the warehouses, a lower spread of cases without CCTV proof was realized at shopping malls compared to the 192.78 standard deviations achieved for cases with missing or unusable CCTV evidence at the warehouses. In each scenario, as presented in Table 7, a strong positive correlation (0.94087 and 0.942201) exists between the shopping mall and warehouse in the record of cases with and without surveillance camera evidence. Furthermore, since the Sig value denoted as *the p-value (two-tail), which is 0.12 and 0.72, are greater than 0.05 in both cases, thus implying that there is no significant difference between the mean values of cases of a* security breach at the shopping malls and warehouses with and without CCTV proof. Moreover, since the *t-stat* (1.7981 and -0.3742) is less than the *t-critical two-tail* (2.4496 and 2.4469), respectively, it implies that there is no sufficient evidence to conclude that there is a significant difference between the mean values of the number of a security breach at shopping malls and warehouse with and without CCTV proof.

4.3.2 Challenges facing the use of CCTV in commercial premises security management

Respondents who are managers/tenants of the shopping malls and warehouses were requested to provide their opinion about the significance of various challenges associated with the use of CCTV at each of the premises. Response was measured on a 5-point Likert scale of strongly disagree – 1; disagree – 2; undecided – 3; agree – 4 and strongly agree – 5. The weighted mean of response and relative importance index of each challenge were calculated and ranked. The ranking represents the opinion of respondents on the level of significance of the challenges to the effectiveness of the surveillance camera. Table 8 shows the descriptive analysis and ranking of the challenges.

As presented in Table 8, it is observed that the power problem ranked 1st with the shopping mall with weighted mean and relative importance index of 3.75 and 0.75. This is closely followed by technical, cost, and personnel challenges, ranking 2nd, 3rd, and 4th respectively in order of significance. The challenge that is considered least important is the quality of footage or recordings of the surveillance cameras at the shopping malls. At the warehouses, however, personnel ranked first in order of importance with a mean score of 3.37 and a relative importance index of 0.67. This was closely followed by the challenges associated with power, technical, and cost, which ranked 2nd, 3rd, and 4th respectively in order of significance. Incidentally, the challenge considered least important is the quality of footage and outputs of the CCTV.

5. DISCUSSION OF RESULTS

As evident from the data presented in Table 2, the incidence of various criminal acts within and around commercial premises peaked in 2020 and spiked again in 2023. Theft has the highest count, approximately 45.4 percent of all incidences, followed by vandalism, 21.4 percent, and assault, which was approximately 13.7 percent of total incidences during the period. Car theft recorded the lowest count of occurrence similar to armed robbery attacks on shopping malls and warehouses, contributing approximately 1 and 4 percent, respectively. Moreover, the analysis of the mean scores of criminal acts, as presented in Table 3, showed that theft was the highest occurring security breach at both the shopping malls and warehouses, followed by vandalism and assault. Although the scope of crime statistics is wider than the categories of criminal acts covered in this research, findings showed that the rate of occurrence of crime such as theft, burglary, vandalism, and armed robbery resonate with the proportion of their respective occurrence on a wider scale as shown in the record [4, 5, 47] in which stealing (theft) was recorded as having the highest number of incidences between 2017-2019.

Table 4 presented the relationship among the security breaches that occurred at shopping centres over the period of the study. The analysis showed a positive correlation, albeit at varying degrees of strength. The matrix showed that burglary, armed robbery, theft, and gang violence have a very strong positive correlation with each other, whereas the correlation between vandalism and assault is relatively strong and positive, while there exists a fairly strong positive correlation between vandalism, burglary, and armed robbery incidences at the malls. Furthermore, a similar pattern was observed in the relationship among criminal act incidents at warehouses in the study area. Table 4 and Table 5 show that there exists a very strong positive correlation among burglary, armed robbery, theft, vandalism, and gang violence, whereas there is an average positive correlation among burglary, armed robbery, theft, car theft, and assault. All these relationships are significant at 0.05 level of significance *(p = .05)*, implying that change in one can be used to explain or interpret the change in another variable. These results are corroborated in the study of Atanu [6], who in his analysis of Nigeria crime data, observed a strong positive correlation among armed robbery, theft, rape, house breaking-in, murder, assault, grievous harm, and wound.

Despite the absence of a year without a security breach at the commercial premises investigated, the effectiveness of CCTV in providing evidence of such incidents was scrutinized by analyzing the number of cases with and without CCTV proof from 2018 to 2023. Table 7 reveals that the highest number of criminal activities with sufficient CCTV evidence was recorded at shopping malls, with a mean value of 228.29, accounting for about 60.37% of the incidents. In contrast, cases of security breaches without adequate CCTV proof were more prevalent at warehouses than at shopping malls. The mean value of incidents lacking sufficient CCTV evidence at these storage facilities was 139.43, constituting about 52.56%, compared to those with CCTV proof, which had a mean value of 125.86 and accounted for 47.44% of incidents at warehouses. This suggests that surveillance cameras are more effective at shopping malls than at warehouses, supporting the findings [14, 15].

Moreover, when comparing the number of criminal acts with CCTV proof in the two commercial premises to the number of cases without CCTV proof in both locations, it is observed that incidents with useful surveillance footage are above average compared to those without adequate footage. This observation aligns with the study of Malmenbratt and Brooks [11], which posits that CCTV is more effective in reducing crimes in controlled environments.

Furthermore, the results from the Paired Sample T-test analysis, aimed at determining the statistical significance of the relationship between the mean values of the paired scenarios, indicated that since the significance value (p-value, two-tail) is 0.12 and 0.72, both greater than 0.05, there is no significant difference between the mean values of security breaches at the shopping malls and warehouses with and without CCTV proof. Additionally, the t-statistics (1.7981 and -0.3742) being less than the critical two-tail values (2.4496 and 2.4469), respectively, suggest insufficient evidence to conclude a significant difference between the mean values of security breaches at the shopping malls and warehouses with and without sufficient CCTV evidence. This casts doubt on the overall effectiveness of CCTV at each of the premises surveyed, consistent with findings from previous studies [11, 14, 15, 40, 44].

According to Gill and Spriggs [15], the impact of CCTV varies across different environments and can be positive, negative, or neutral. The study also noted that CCTV is more effective in certain contexts and against certain types of crimes than others. Malmenbratt and Brooks [11] highlighted the difficulty in determining the number of criminal acts actually deterred by CCTV, thus questioning the effectiveness of the technology. Nte et al. [14] reported that while 66.6% perceived the impact of CCTV as positive, 24.0% were unsure, and 9.0% felt the impact on crime control was negative. Additionally, while 50.7% believed that CCTV cameras have aided in crime prevention and control, 48.4% disagreed. Gerell [40] acknowledged the widespread use of CCTV for security purposes but noted that its effect is relatively small. Dowling et al. [44] observed that investigators value CCTV footage depending on its usefulness to the investigation. The differences in mean values and distribution of incidents at the shopping malls and warehouses corroborate the observations [15], while the t-statistics being less than the critical values for both premises support the findings [11], suggesting that there is no significant evidence to infer differences in the mean values of incidents at the shopping malls and warehouses. The conclusions [14, 40, 44] reinforce the notion that the effectiveness of CCTV and the usefulness of the footage vary according to the crime and context of an application.

Finally, the challenges that affect the optimization of CCTV as a crime control and management device in commercial premises were determined by computing the weighted mean and ranked according to the relative impact index. Based on the analysis, the lack of sustainable power supply ranked 1st and constituted the most challenging threat to the optimization of CCTV at the shopping malls. Technical and cost challenges ranked 2nd and 3rd, respectively, while personnel and quality of CCTV footage ranked 4th and 5th, respectively, in order of significance for the shopping malls. At the warehouse, personnel issues and power supply ranked 1st and 2nd, while technical and cost ranked 3rd and 4th, respectively. Incidentally, the quality of CCTV output also ranked 5th in order of significance for the warehouse. Nte et al. [14] have also highlighted these challenges and attributed significance that reflects the circumstances and purposes of the deployment of the technology.

6. CONCLUSION

This study examined the efficacy and challenges of surveillance camera technology on security and safety breaches in premises used for commercial activities, with a particular focus on shopping malls and warehouses in the study area. Tenants, users, and owners of businesses in the facilities were approached during the data collection. As much as there are different dimensions to measuring the effectiveness of a piece of technology, the number and quality of output of surveillance cameras were engaged in the study. Despite the record of criminal breaches and cases with and without CCTV evidence, analysis has revealed, amongst others, that the use of surveillance cameras in commercial facilities has not been able to totally prevent the criminal intention of perpetrators as there was no year without an incidence of a security compromise at either the shopping centers and the warehouses. Further, the analysis also showed that CCTV is more effective in shopping marts than the warehouses, as the facilities produced more useful footage

than the storage facilities. Nevertheless, further analysis, particularly the statistics of the paired sample tests, revealed that there is no sufficient evidence to establish any significant difference in the occurrence of criminal acts at both facilities with or without sufficient CCTV proof. By implication, the incidence and effective management or otherwise of criminal acts at the two facilities could have been at the instance of other measures or strategies of security and safety control deployed. The study subsequently analyzed and ranked challenges of surveillance camera usage in shopping malls and warehouses in order of impact on effectiveness. Analysis showed that users of commercial premises need to find an alternative power supply for continuous and efficient coverage. Technical and personnel problems such as camera failure, software error, cable connection, and data loss, as well as untrained personnel, inadequate personnel, distraction, and high camera-to-screen ratio, are critical factors hindering the optimization of CCTV in both premises. There is, therefore, the need to engage technically qualified personnel in the acquisition and installation process as well as retain qualified hands to operate the system after installation.

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