IMPACT OF CLOSED-CIRCUIT TELEVISION ON POLICE OPERATIONS IN NAIROBI CITY COUNTY, KENYA

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DECLARATION

Declaration by the Student

This thesis is my original work and has not been presented for a degree in any other university.

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I dedicate this thesis to my wife Gloria and children Kevin, Mitchell and Pelia for standing with me in this and many other endeavours over the years, and all police officers for putting their lives on the line every day to protect others.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

ALPR	Automatic License Plate Recognition
APA	American Psychological Association
ASP	Assistant Superintendent of Police
CAK	Communication Authority of Kenya
CBD	Central Business District
CCTV	Closed-Circuit Television
CI	Confidence Interval
COVID-19	Coronavirus Disease 2019
DCI	Directorate of Criminal Investigations
DF	Degrees of Freedom
DHS	Department of Homeland Security
FGD	Focus Group Discussion
FIPPs	Fair Information Practices Principles
GoK	Government of Kenya
HL	Hosmer and Lemeshow
IC3	Integrated Command, Control and Communication
IO	Investigating Officer
IT	Information Technology
KIF	Key Informant
KIG	Kenya Information Guide
KNBS	Kenya National Bureau of Statistics
KPS	Kenya Police Service
KUERC	Kenyatta University Ethics Review Committee
LL	Log-Likelihood

LR	Likelihood Ratio
NACOSTI	National Commission for Science, Technology and Innovation
NCBD	Nairobi Central Business District
NCO	Non-Commissioned Officer
NPS	National Police Service
NSWPF	New South Wale Police Force
NTSA	National Transport and Safety Authority
OR	Odds Ratio
PTZ	Pan-Tilt-Zoom
R^2	R Square
RAT	Routine Activity Theory
RCT	Rational Choice Theory
SCPC	Sub-County Police Commander
SE	Standard Error
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
USA	United States of America
VIF	Variance Inflation Factor
VIP	Very Important Person

OPERATIONAL DEFINITION OF TERMS AND CONCEPTS

Blind spot: An area within a CCTV camera's field of view that the camera cannot capture or monitor due to physical obstructions, poor lighting, and technical issues with the camera, such as poor positioning and malfunctions.

CCTV camera site: A location where one or more CCTV cameras are installed.

CCTV operator: A person deployed to the command-and-control centre to maintain CCTV equipment, monitor live video streams, retrieve CCTV footage, and track and report incidents or suspicious activities to police officers in the field when necessary.

CCTV system: A surveillance scheme installed to cover a given area, including equipment that captures, transmits, displays, and stores video signals, their sites, and operators.

Challenges: Problems or difficulties that hinder the successful use of CCTV in police operations.

Closed-Circuit Television: An electronic monitoring device that captures, transmits, stores, or displays visual information from a given location using several video cameras

	connected by a transmission medium to a limited set of television monitors and recorders.
Command-and-control centre:	A room with an arrangement of personnel, communication and surveillance equipment and procedures used to centrally plan, monitor, and coordinate police operations.
Field of view	The area that a CCTV camera can capture and monitor.
CCTV Footage:	Video recorded by CCTV.
Police Operations:	Duties and activities that police officers perform in the field as they serve and protect the community.
Police Operation Outcome:	The result, consequence, or impact of a specific police operation.
CCTV Policies:	Regulations, guidelines, rules and practices that govern the use of CCTV.
Public space:	A place that members of the public have unrestricted access to or can access on permission or payment, such as a road/street, sidewalk, park, playground, market, and other open spaces.
Public space CCTV:	A network of CCTV cameras installed in public areas that are monitored by a command-and-control centre.
Surveillance:	The act of obtaining information about something or someone by closely observing them.

ABSTRACT

Closed-circuit television (CCTV) is a key strategy that police services worldwide are increasingly using to improve the outcomes of their operations. However, little is known about the use and impact of the police-operated CCTV system in Nairobi City County since its implementation in mid-2015, making it difficult to say whether it is achieving its intended goals or wasting public resources. Therefore, this study aimed to assess how the CCTV system has aided police operations. The study had five specific objectives: to assess the impacts of the use of CCTV in monitoring public spaces on the outcomes of police operations, to analyse the impact of the use of CCTV to coordinate incident responses on the outcomes of police operations, to evaluate the impact of the use of CCTV in investigating crimes on the outcomes of police operations, to determine the moderating effect of CCTV policies on the relationship between CCTV use and police operations outcomes, and to examine the challenges hindering the effective use of CCTV in police operations in Nairobi County. Rational Choice Theory and Routine Activity Theory informed the study. The study used a convergent parallel mixed-methods design, integrating a cross-sectional survey design and a phenomenological design. It involved 403 police officers from police stations in Nairobi City County and those operating CCTV sampled using purposive and cluster sampling. A questionnaire, a focus group discussion guide and an interview schedule were used to collect data. Quantitative data were analysed using frequencies, percentages and binary logistic regression, while thematic analysis was used to analyse qualitative data. The findings revealed that CCTV has significantly helped police conduct their operational tasks, reduced crimes, enhanced road safety, improved the safety of police officers and reduced the cost of police operations. However, it has not significantly quickened police response to incidents. The findings also showed that CCTV policies do not significantly moderate (b = -.001, 95% CI [-.410, .408], p = .996) the relationship between the use of CCTV and police operations outcomes. The study also found that insufficient funding was the most significant challenge hindering the effective use of the CCTV system, followed by criminals evading CCTV detection and unrealistic public expectations about CCTV. Other significant challenges included CCTV vandalism, limited CCTV coverage, inadequate CCTV operators, lack of interest among police officers in using CCTV, and unavailability of footage in some areas with CCTV cameras. The study concluded that CCTV has improved police operations in the county, but several challenges need to be addressed. The study recommends the expansion of CCTV coverage, installation of lighting in areas under CCTV surveillance, the establishment of quick response squads, the sensitisation of police officers on CCTV policies and the effective ways and benefits of using CCTV, periodic meetings between police officers operating CCTV and those in the field, publicity of successes in using CCTV, adequate funding and maintenance of the CCTV system, and publication and regular review of CCTV policies.

CHAPTER ONE

INTRODUCTION

This first chapter covers the background of this study, the statement of the problem, research objectives and questions, and the study's significance, scope and limitations.

1.1 Background to the Study

Security threats have become more diverse and difficult to manage globally. Terrorism, violent crime, property crime and gang activity have all increased, especially in cities, posing a significant risk to public safety (Vanderschueren, 2013). Therefore, innovative strategies are needed to help the police fulfil their mandate. CCTV systems have proven to be an invaluable resource in this endeavour. They are increasingly used in public spaces in major cities worldwide to support police operations (Rahman, 2017).

CCTV is a surveillance technology that uses cameras and other components to capture, record, transmit, store and display video images (Willis et al., 2017). Police operations, on the other hand, are duties and activities that police officers perform in the field to serve and protect the community, such as patrols and criminal investigations (Hess et al., 2013). CCTV can be used in police operations in many ways, such as detecting crime, monitoring traffic and criminals in real-time, gathering intelligence and coordinating incident responses (Moyo, 2019). It can also provide valuable evidence to support criminal investigations, prosecution and conviction of offenders (Piza, 2018a). The use of CCTV can increase the likelihood of arrest for criminal behaviour, leading to lower crime rates, crime fear and police operation costs (Munyo & Rossi, 2019). Despite its potential benefits, the use of CCTV also raises privacy and misuse concerns and may face problems (Ways, 2018). Therefore, policies and regular evaluations are essential to ensure it is used responsibly and effectively (Shukla et al., 2020).

Research on the use of CCTV in policing has predominantly focused on jurisdictions outside of Africa and its impact on crime levels and types. Most of these studies suggest that CCTV improves police operations and significantly reduces specific crimes in some settings, mainly when proactively used by police. For example, a meta-analysis of over 80 studies from Europe and the United States of America (USA) by Piza et al. (2019) revealed that CCTV can significantly reduce property crimes when combined with police responses. This reduction mainly occurred in car parks and residential areas. Similarly, studies from the United Kingdom (UK) and Australia indicate that CCTV can greatly help police investigate crimes in rail networks (Dowling et al., 2019; Ashby, 2017). However, the impact of CCTV on police operations outcomes is inconsistent across jurisdictions. For instance, one study in South America by Munyo and Rossi (2019) found that the use of CCTV by police in Montevideo, Uruguay, resulted in lower crime levels and reduced the cost of managing crime. Conversely, a study in Asia by Lai et al. (2018) found that a police-monitored CCTV system in Taipei, Taiwan, did not significantly reduce property crimes and overall crime. These findings suggest that while CCTV can be a valuable tool in policing in specific contexts, its impact on police operations outcomes is unclear, necessitating further research.

In Africa, research on the use and impact of public space CCTV systems is scarce due to limited empirical studies and their late adoption (Noris, 2012). The existing studies have also focused on systems not operated by police or on specific aspects of CCTV. For example, Ngwenya (2012) examined the use of CCTV in investigating robberies in South Africa, while Yau (2019) focused on crime detection in Nigeria. In Kenya, Okere (2012) studied CCTV use for crime prevention but focused on no longer operational CCTV systems. Hence, more research is needed on the use and impacts of police-operated CCTV systems in Africa to help inform policy and practice in the region.

1.2 Statement of the Problem

The increased use of CCTV systems by police worldwide is expected to improve their ability to detect and respond to crime, leading to a range of positive outcomes, such as crime reduction, enhanced perceptions of safety and decreased policing costs. However, despite the substantial investment by the Kenyan government in installing and maintaining a police-operated CCTV system in Nairobi City County, information on its use and impact are scarce. Available data shows that crime rates in the county decreased in the first six months following the system's installation, but they have since increased. For example, in 2016 and 2017, they increased by 13 per cent and 50 per cent, respectively (NPS, 2019a). It is unclear whether this increase is due to improved detection or a reduction in the system's effectiveness over time. Without assessments, it is difficult to understand whether the system is achieving its intended purposes or simply draining resources. Previous studies on the use of CCTV in police operations have focused on a few outcomes, such as crime reduction and public safety. They have also largely ignored the effect of CCTV policies on the use of CCTV. Moreover, their findings are inconclusive, especially regarding the impact of CCTV on crime rates and feelings of safety (Piza et al., 2019). This study sought to fill these gaps and investigate other crucial questions about whether the police-operated CCTV system in Nairobi City County has effectively supported police operations and achieved its intended outcomes.

1.3 General Objective of the Study

The general objective of this study was to assess the impact of the use of CCTV on the outcomes of police operations in Nairobi City County, Kenya.

1.3.1 Specific Objectives of the Study

The study had five specific objectives. These were to:

1. Assess the impact of the use of CCTV in monitoring public spaces on the outcomes of police operations in Nairobi City County, Kenya.
2. Examine the impact of the use of CCTV in coordinating responses to incidents on the outcomes of police operations in Nairobi City County, Kenya.
3. Evaluate the impact of the use of CCTV in investigating crimes on the outcomes of police operations in Nairobi City County, Kenya.
4. Determine whether CCTV policies moderate the relationship between the use of CCTV and the outcomes of police operations in Nairobi City County, Kenya.
5. Establish the challenges hindering the effective use of CCTV in police operations in Nairobi City County, Kenya.

1.4 Research Questions

The study endeavoured to answer the following five questions:

1. How has the use of CCTV to monitor activities in public spaces affected police operation tasks and outcomes in Nairobi City County, Kenya?
2. To what extent has using CCTV to coordinate response to incidents impacted police operation tasks and outcomes in Nairobi City County, Kenya?
3. What is the impact of the use of CCTV to investigate crimes on police operation tasks and outcomes in Nairobi City County, Kenya?
4. Do CCTV policies moderate the relationship between the use of CCTV and the outcomes of police operations in Nairobi City County, Kenya?
5. What challenges hinder the effective use of CCTV in police operations in Nairobi City County, Kenya?

1.5 Significance of the Study

The study's findings are significant to various entities, including policing scholars, Nairobi City County residents, police managers, policymakers, the donor community, and other non-state actors in the security sector. Policing scholars can use the study's findings to enrich or advance their research on the use of CCTV systems in police operations, including developing strategies to maximise their benefits and overcome the challenges that impede their effectiveness. The study's findings may address Nairobi residents' concerns about how the police use CCTV to improve their safety and security. This can allow them to identify ways to collaborate with the police to enhance the use of CCTV in crime management. The study's findings can help police managers improve the use of CCTV in their operations, particularly in strategically deploying CCTV and maximising its effectiveness. They can also assist policymakers in making critical decisions regarding the expansion of CCTV systems for police use and the development of policies to regulate their use. The study's findings can benefit donors and other non-state actors in the security sector in identifying areas where they can support the use of CCTV in improving police operations in Nairobi County as part of their community policing partnership role.

1.6 Scope of the Study

The study focused on the police-operated CCTV system in Nairobi City County, Kenya, to examine its impact on police operations. It specifically examined how the use of CCTV to monitor public spaces, coordinate incident responses and investigate crimes has affected police operational tasks and the following outcomes: crime reduction, quick response to incidents, improved road safety, enhanced safety of police officers and drop in the costs of police operations. The study also focused on how CCTV policies moderate the relationship between CCTV use and police operations outcomes

and the challenges hindering the effective use of CCTV in police operations. The study participants included police officers stationed at the Integrated Command, Control and Communication (IC3) centre and police stations in Nairobi City County from the Kenya Police Service (KPS) and the Directorate of Criminal Investigations (DCI). The study utilised Rational Choice Theory and Routine Activity Theory.

1.7 Limitations and Delimitations of the Study

This study has three limitations. First, the findings are specific to the police-operated CCTV system in Nairobi County, so they may not directly apply to CCTV systems operated by private and other government entities in the county. Second, its findings may not be generalisable to settings outside Nairobi City County because the success of CCTV systems depends on contextual factors that vary by location. Third, the findings only reflect the views of police officers at the time of data collection. Their perspectives may change over time, and other stakeholders, such as the members of the public, may have different views.

The study focused on the police-operated CCTV system in Nairobi City County because it is the most well-developed and extensively used system in Kenya. The study did not include private citizens and other security providers because they are not very familiar with police operations. It did not include CCTV systems operated by private and other government entities because their locations and uses are not well-documented and play a minor role in routine police operations. These systems also use different technologies, which can affect their capabilities and performance. For example, while some capture footage in black and white and send analogue signals, others record in colour and transmit digital signals. Including these systems in the study would have thus made the findings less valid because the data would have been too varied.

CHAPTER TWO

LITERATURE REVIEW

This second chapter reviews past research relating to the use of CCTV in police operations. The review covers the use of CCTV to monitor public spaces, coordinate incident responses and investigate crimes. It also covers the role of policies in using CCTV in police operations and the challenges that may hinder the effective use of CCTV in police operations. The chapter also summarises the reviewed studies and discusses the study's theoretical and conceptual frameworks.

2.1 Review of Related Literature

2.1.1 Use of CCTV to Monitor Public Spaces and Police Operations Outcomes

CCTV monitoring is the act of viewing live or stored CCTV recordings (Ratcliffe, 2011). According to Piza et al. (2019), police use CCTV monitoring to detect crime and suspicious activity, track traffic and assess the need for a response. The goals of CCTV monitoring, as described by La Vigne et al. (2011a), are to reduce crime, improve police response time, increase public safety and minimise operational costs. However, research on the effectiveness of CCTV monitoring is inconclusive and sometimes contradictory (Lawson et al., 2018). The present study sought to address these gaps by focusing on the police-operated CCTV system in Nairobi County.

Research indicates that the police primarily monitor CCTV in two ways: active and passive, each with benefits and limitations. Active monitoring involves police viewing CCTV recordings in real-time to gather information and alert officers on the ground for enforcement action (Shukla et al., 2020). This type of monitoring can be relatively costly, especially regarding personnel and equipment requirements (Piza et al., 2017). However, it can significantly allow for proactive detection and immediate response to

developing and ongoing incidents (La Vigne et al., 2011b). The proactive response can, for instance, lead to disruption of ongoing crimes, on-scene arrests and recovery of stolen items or contraband. It can also enable CCTV operators to monitor the scenes before police response arrives and provide real-time information to responding officers (La Vigne et al., 2011b). However, Piza et al. (2017) observe that CCTV-initiated responses are uncommon because police organisations face resource constraints in combining active monitoring with proactive responses. This means that police mainly use active monitoring when they have sufficient resources and address incidents that could cause significant harm swiftly.

Passive monitoring, on the other hand, entails viewing recorded CCTV footage later to aid inquiries or deployments (Shukla et al., 2020). This type of monitoring can be helpful to the police in carrying out post-incident investigations and prosecutions (Agarwal et al., 2018). It is also less costly than active monitoring because it requires less staff and equipment (La Vigne et al., 2011a). However, it is ineffective for the proactive detection of crime as it cannot be used to intervene in live incidents (Donald, 2010). Owing to the inherent limitations of using active or passive monitoring alone, La Vigne et al. (2011b) recommend their integration to optimise their distinct benefits. One benefit of the integrations is that passive monitoring can significantly aid the police in detecting and managing incidents they may have missed through active monitoring alone. As neither type of monitoring is superior to the other, Gill and Spriggs (2005) recommend considering their specific goals when evaluating the impacts of CCTV systems. In general, the primary goal of active monitoring is to assist police in gaining a real-time awareness of a situation (La Vigne et al., 2011a). On the other hand, passive monitoring aims to provide a dragnet for unanticipated incidents and to aid investigations and prosecutions (Shukla et al., 2020). As such, the current study

investigated whether the use of CCTV by police to monitor public spaces in Nairobi City County, both actively and passively, had helped to improve police operations and achieve the desired outcomes.

Goold (2004) reviewed 12 published UK studies to determine the impact of CCTV monitoring on the safety of police officers. The review revealed that CCTV monitoring could have both positive and negative consequences. On the positive side, it can aid officers in identifying and responding to incidents more effectively. For example, it can assist officers in tracking suspects' movements, reducing confrontations and other operational risks. Additionally, CCTV monitoring can deter crime in high-crime or high-traffic areas, making officers safer by minimising their vulnerability to attacks. On the negative side, CCTV monitoring may make officers more visible to criminals, who may use this information to target them. It can also be used to track the movements of police officers, which may violate their privacy rights. These opposing findings imply that the effects of CCTV monitoring on police officer safety are complex and require further research in contexts other than the UK, such as Nairobi City County.

Another UK study by Levesley and Martin (2005) examined the attitudes of police officers towards CCTV. It found that most police officers (83%) were somewhat aware of CCTV cameras while on patrol, only a third (37%) felt safe in areas with CCTV cameras, and half (50%) felt that CCTV did not make them feel safe. This finding suggests that CCTV monitoring may not affect police officers' safety. However, it may not be generalisable to other jurisdictions such as Kenya. Therefore, this study investigated whether CCTV had improved police officers' perceptions of safety in Nairobi City County.

King et al. (2008) studied the effectiveness of CCTV cameras installed in 19 streets in San Francisco, California, USA. They found that property crimes decreased by 23 per cent in the monitored areas, but this decrease was not statistically significant. They also found no statistically significant change in other crimes, such as vandalism, prostitution, and violent or drug crimes. Equally, they found no evidence of crime displacement to adjacent areas and that citizens in the monitored areas were likelier to feel safer. While their findings indicate that CCTV monitoring has no overall effect on crime rates but can reduce property crimes and increase feelings of safety, they have some fundamental limitations. First, they are limited to small areas of San Francisco, so they may not apply to other neighbourhoods or cities. Second, because the study was conducted after only six months of CCTV implementation, its findings could have been different over a more extended period. Third, the study mainly focused on the impact of CCTV on crime rates and did not collect data on the use of CCTV footage by the police. The present study endeavoured to address these limitations by assessing the impact of police use of CCTV after an extended period (six years) and on a broader range of outcomes, such as police officers' safety and police operation costs.

La Vigne et al. (2011a) assessed the impact of public space CCTV systems in Baltimore, Chicago and Washington, USA, in preventing and controlling crime. Their findings revealed a significant reduction in all crimes, including robberies and assaults, in CCTV-monitored areas in Baltimore and Chicago. They also show substantial economic and societal savings from the use of CCTV in the two cities. However, they revealed no meaningful decrease in crime but increased thefts in Washington. Notably, La Vigne et al. discovered that the CCTV systems in Chicago and Baltimore were actively monitored and had many cameras. By contrast, the one in Washington had few cameras and was not always actively monitored. The findings of La Vigne et al. suggest

that active CCTV monitoring with sufficient camera density and coverage can significantly reduce crime and the cost of police operations. However, due to differences in context, their findings may not apply to other cities like Nairobi.

Piza et al. (2015) performed a randomised trial experiment in Newark, New Jersey, USA, to determine the effects of combining directed police patrols and proactive CCTV monitoring on crime. They discovered that the integration of active CCTV monitoring with directed police patrol significantly reduced violent and social disorder crimes. They also established that most of the detected incidents (56.6%) resulted in an arrest or questioning by police officers on patrol. In general, the findings of Piza et al. (2015) suggest that CCTV can significantly aid police in deterring violent and social disorder crimes, mainly when strategically installed and actively monitored. However, they are limited to violent crime and social disorder, and it is unclear whether they apply to other types of crime or the outcomes of police operations in other cities, such as Nairobi.

To build upon Piza et al.'s (2015) study, Piza et al. (2016) sought to establish the cost-effectiveness of pairing active CCTV monitoring with directed police patrols in Newark, New Jersey, USA. They measured the financial and social benefits of crime reduction against the cost of installing and operating CCTV systems. Their findings show that combining proactive CCTV monitoring and directed police patrol can significantly reduce property crimes, robberies, and assaults but has little effect on narcotics activity. This suggests that CCTV systems may effectively reduce certain crimes but not all types. Piza et al. (2016) also found that pairing active CCTV monitoring with directed patrol is highly cost-effective for police organisations with CCTV infrastructure but prohibitively expensive for those which do not have it. This means that while the initial costs of installing CCTV systems are high, the benefits of

their use outweigh the cost over time. However, Piza et al.'s (2016) study has two main limitations. First, it only considered the effect of CCTV monitoring on crime reduction. Second, it only concentrated on New Jersey, so it is unclear whether its findings apply to other cities. Therefore, this study focused on Nairobi City and explored four other outcomes of using CCTV in police operations besides crime reduction. These were faster incident response, improved road safety, increased officer safety, and cost savings for police operations.

In Sweden, Gerell (2016) assessed the effects of combining active CCTV monitoring with directed police patrols in preventing crime in hot-spot areas for assaults in Malmo's nightlife area. Gerell found that actively monitored CCTV cameras did not reduce assaults in high-risk areas. This suggests that using CCTV cameras in this manner may not be an effective crime prevention strategy. However, the study was limited to Malmo, Sweden, so it is unclear whether the findings apply to other cities, crime types and police operation outcomes. Therefore, the current study focused on Nairobi and the impact of CCTV monitoring on police operations outcomes.

In Taiwan, Lai et al. (2018) conducted a quasi-experimental study to assess the deterrent effects of police-monitored CCTV in Taipei on burglaries, theft from persons, vehicle thefts, and robberies. They found that the overall crime rate in the experimental areas dropped by 9.4 per cent, but burglaries increased by 19.2 per cent. They also discovered a 40 per cent increase in burglaries in the control areas. Accordingly, they concluded that the police-monitored CCTV system in Taipei did not perform as expected. This conclusion raised the need for the current study to assess whether the police-monitored CCTV system in Nairobi County has achieved its desired outcomes.

Eggarsasi and Sa'diyah (2018) investigated how Indonesian police interacted with drivers on the road using CCTV. They found that active CCTV monitoring helped the police detect traffic violations and warn and prosecute errant drivers. However, their findings do not show whether CCTV enhanced road safety or reduced traffic violations and the cost of traffic management. Therefore, the current study sought to determine if CCTV monitoring impacts road safety and police operation costs.

Munyo and Rossi (2019) studied the impact of an actively monitored police CCTV system on crime in Montevideo City, Uruguay. They found that crime levels and the cost of managing crime in areas under CCTV surveillance decreased by around 20 per cent and 830 US dollars per crime, respectively. They attributed this reduction to enhanced deterrence of offending in the streets due to arrests made by police officers on patrol after being alerted by those monitoring CCTV cameras. Their findings suggest that proactive CCTV monitoring can help police deter crime and lower the cost of managing crime. However, they may not apply to Nairobi City County because the success of CCTV systems depends on the context. In addition to crime reduction and cost savings that Munyo and Rossi studied, the current study considered three other outcomes of police operations: improved incident response time, road safety enhancement, and enhanced officer safety.

Piza et al. (2019) performed a meta-analysis on over 80 selected studies published between 2007 and 2017 from eight European countries and the USA. In the study, 54 CCTV schemes used active monitoring, while 11 used passive monitoring. Piza et al. (2019) established a significant drop in crime in schemes using active monitoring and a non-significant reduction in those employing passive monitoring. They noted that most CCTV systems employing active monitoring were in the UK, suggesting that

many CCTV schemes worldwide are not actively monitored. They also found that CCTV systems that combined active monitoring with police patrols and other strategies were more effective at reducing crime than those that used CCTV alone. Their findings demonstrate that active CCTV monitoring can help reduce crime by assisting police in detecting and managing ongoing and developing incidents. However, their findings only apply to crime levels in the USA and a few European countries. Therefore, it was necessary to determine whether they applied to Nairobi City County and other police operations outcomes.

Moyo (2019) analysed the use of CCTV systems in Johannesburg and Pretoria, South Africa, to control and prevent crime. Findings indicated that the CCTV systems in the two cities were actively monitored by private security officers and greatly aided in detecting suspicious activities and alerting the police about them. In addition, many members of the public who participated in the study reported feeling safer in areas with CCTV cameras. Fifty-six per cent and 80 per cent also felt that CCTV would speed police response to incidents and reduce crime in their neighbourhoods. However, the study also found that more than half of incidents (55%) were initiated by police communication, casting doubts on private security officers' capability to detect incidents on CCTV. For these reasons, the current study investigated whether the CCTV system in Nairobi City County, which police officers exclusively monitor, aids in detecting crime and suspicious activity.

Okere (2012) assessed the effectiveness of CCTV cameras installed in Nairobi's Central Business District (NCBD) for crime prevention in the early 2000s. The vast majority of participants (87%) in the study reported that CCTV effectively prevents crime, suggesting that CCTV can enhance police operations, particularly in crime

reduction. However, Okere's study was limited to a CCTV system that went out of service in 2013, including cameras operated by private and other government entities. Therefore, it is unclear which cameras were effective or whether the findings apply to the current CCTV system in Nairobi. Therefore, this study focused solely on the police-operated CCTV system in Nairobi County, which was installed in mid-2015 and was operational at the time of the research.

2.1.2 Use of CCTV to Coordinate Incident Responses and the Outcomes of Police Operations

Incident response is how police manage crimes or emergencies (Faggiano et al., 2012). It includes everything from securing the scene to processing evidence, pursuing and arresting suspects, and communicating with victims, witnesses and other emergency responders. The primary goal of incident response is to manage the incident, reduce its duration, severity, and cost, and prevent it from happening again (Sommer et al., 2014). Typically, police officers respond to a wide range of incidents daily, including traffic accidents, robberies, burglaries, homicides, riots and fires. These incidents can be challenging to respond to because they can happen suddenly, last for a long time, escalate, or cause significant harm (Sommer et al., 2014). Police officers also face substantial risks, such as being injured or killed by violent or unpredictable individuals, explosions, or contact with hazardous materials (Baber & McMaster, 2016). Hence, CCTV can help police respond to incidents quickly, efficiently, and safely by helping them detect and monitor developing or ongoing situations in real-time (Dean, 2009).

In their study in the UK, Levesley and Martin (2005) found that CCTV can significantly help the police manage live incidents. More than three-quarters (78%) of police officers who participated in the study said CCTV helps them clarify incidents, dispatch

personnel and other resources timeously, guide responding officers, and inform them of emerging issues and the actions to take. However, a small number (7%) of officers were concerned that the use of CCTV sometimes resulted in their deployment to low-priority incidents. Levesley and Martin attributed this to poor communication between CCTV operators and patrol officers, suggesting that strong relationships between these groups are essential for effective incident response coordination. The lack of strong relationships can lead to miscommunication and delays. Even so, there was scanty information on how CCTV has aided the police in coordinating incident responses in Nairobi County. Therefore, the current study investigated whether CCTV had improved police incident response coordination in the county.

Gill and Spriggs (2005) investigated how quickly police responded to incidents before and after the installation of CCTV in 14 CCTV schemes in the UK. They found that many respondents in the 14 schemes felt that police did not respond more quickly to incidents after the installation of CCTV. This finding suggests that CCTV may not help police respond more quickly to incidents. However, Gill and Spriggs only considered the views of members of the public and other stakeholders. Therefore, the present study addressed this gap by obtaining the perspectives of police officers in Nairobi City County on whether CCTV has improved their response to incidents.

La Vigne et al. (2011b) underscore the crucial role that CCTV can play in coordinating responses to incidents, particularly in improving responding officers' situational awareness and safety. They point out that CCTV can help responding officers understand the conditions and the possible dangers at the scene before they arrive. They also observe that CCTV operators can provide responding officers with real-time updates on the developments at the incident scene and the surrounding areas. These

developments could include the possibility of a suspect becoming violent or the presence of people attempting to harm the responding officers. Therefore, this study sought to determine whether La Vigne et al.'s observations applied to Nairobi County.

Some research suggests that CCTV can help police respond to incidents more quickly, which can help deter crime and enhance public safety (Moyo, 2019; Ratcliffe, 2011; The Scottish Government, 2009). Also, other studies suggest that prompt police response to CCTV-detected incidents can reduce their adverse effects by limiting their duration and escalation into full-fledged violence (Weisburd & Majumdar, 2018; Taylor & Gill, 2014). Based on these suggestions, the present study sought to establish whether CCTV has enabled police to respond more quickly to incidents, improved officers' safety and enhanced road safety in Nairobi City County.

Whereas CCTV can assist police in responding to incidents more swiftly, Piza et al. (2017) found that significant delays often occur in police response. This lag in response appears to be attributable to the time needed to mobilise officers and other resources. To address this delay, Piza et al. (2017) propose that police seek help from other entities, such as private security, in the CCTV-targeted area. This arrangement would allow the supporting entities to respond to incidents in their immediate vicinity before the arrival of the police response teams. One of the main reasons for installing the CCTV system in Nairobi City County was to improve the coordination among the various elements of the NPS operations in responding to incidents (NPS, 2019a). However, it was unclear how the system had achieved this goal, so this study aimed to investigate.

2.1.3 Use of CCTV in Investigating Crimes and Police Operations Outcomes

Investigating crimes or criminal investigations is considered the second core police operational activity after patrol (Novak, 2014; Hess et al., 2013). It entails gathering information and evidence of a crime to identify, apprehend and prosecute lawbreakers and recover stolen properties (Osterburg et al., 2019). The goal is to solve crimes and bring criminals to justice, which can deter crime and improve public safety (Dempsey et al., 2019). For these reasons, research has shown that police organisations mainly invest in CCTV to improve the outcomes of their investigations (Morgan & Dowling, 2019; Piza, 2018b; Hummer & Byrne, 2017).

In the UK, a vast majority (95%) of police officers who participated in a study by Levesley and Martin (2005) stated that CCTV was most helpful in their investigations. This was because CCTV helped them reduce the time they spent identifying, locating and arresting suspects and interviewing witnesses and suspects. Nearly half (49%) of the officers also reported using CCTV to obtain guilty pleas from suspects. However, many officers were dissatisfied with using CCTV footage in court, mainly because the quality was often insufficient to convict suspects. In light of these observations, the present study investigated whether IC3 footage has helped police prove cases in court.

Farrington et al. (2010) assessed the impact of the use of CCTV by police in the UK's Cheshire and Hackney areas on four criminal justice outcomes: detection, investigation, prosecution and conviction. They found that CCTV helped police detect crime on the streets and identify and eliminate suspects, particularly when the cameras clearly and wholly captured their faces. They also established that CCTV evidence was helpful in convincing juries of a defendant's guilt and corroborating evidence from other sources. The strength of Farrington et al.'s study is that it shows how CCTV may be useful for

investigations. However, it does not provide insights into whether CCTV can support suspect convictions in jurisdictions without juries like Kenya. It also does not indicate whether using CCTV in criminal investigations reduces crime and the cost of police operations or improves road safety and police officers' safety. Therefore, this study aimed to address these limitations.

Ngwenya (2012) analysed 50 robbery case files from the Middelburg police station in South Africa to determine whether CCTV assists police in investigating robberies in gas stations. The results showed that only four of the 50 case files had CCTV footage as evidence, suggesting that police least used CCTV in investigating robberies at the gas stations. In addition, 36 per cent of the 25 police detectives who participated in the study said that CCTV enhances robbery investigations, 32 per cent said it helps identify suspects, 25 per cent said it reduces crime, and 16 per cent said it saves personnel and investigative resources. However, more than half (52%) were unaware of the requirements for the admissibility of CCTV footage as evidence in court, and a nearly similar proportion (48%) had not used CCTV in their investigations. These findings suggest that CCTV can considerably improve criminal investigation outcomes when used effectively by police. However, Ngwenya's study was limited to gas station robberies and privately owned CCTV systems, and its small sample size undermines its validity. Consequently, its findings may not directly apply to other crime types, settings, or publicly operated CCTV systems like the one in Nairobi City County.

In Nigeria, Ubioworo (2015) examined the usefulness of a CCTV system in Abuja in combatting the Boko Haram insurgency. The findings revealed that the CCTV system was ineffective at detecting and deterring the insurgents' activities. This ineffectiveness was mainly due to a lack of biometric identification technology, which made it

impossible for police to identify terrorists involved in previous attacks. These limitations prompted the current study to investigate whether the CCTV system in Nairobi City County has aided police in identifying and apprehending criminals and whether its use has led to decreased crime.

Hulme et al. (2015) examined how 221 Australian local councils used CCTV footage. They found that over two-thirds of the councils (69%) received footage requests from the police to use their CCTV footage to investigate crimes, especially to identify offenders. They also found that while more than half of the councils (55%) were aware that the police used the requested CCTV footage to prosecute offenders, none were mindful of the outcome of the prosecutions. These findings indicate that police frequently use CCTV footage to aid in investigating and prosecuting crimes. However, there is little evidence that this use improves prosecution outcomes. Hulme et al.'s study has two key limitations: it only looked at CCTV systems operated by local governments and does not demonstrate whether using CCTV to investigate crime reduces crime or improves perceptions of safety or other outcomes of police operations. Therefore, the current study went a step further to determine whether using CCTV footage from police-operated CCTV systems enhances the overall performance of police operations, particularly in the context of investigations.

Ashby (2017) examined the value of CCTV footage in criminal investigations using footage of crimes collected by police in the British railway network from 2011 to 2015. The study found that CCTV footage was valuable in investigating two-thirds of the offences where it was available, and crime detection rates increased by at least 19 per cent. CCTV evidence was also helpful for investigating all crime types apart from fraud and drug and weapon offences, suggesting that it is more beneficial for visible crimes

than covert ones. The study also found that CCTV footage was more likely to be available for investigating serious crimes such as robbery, burglary and sexual offences. This was because victims were more likely to report these crimes promptly, and the police were more likely to put in more effort and time to obtain the necessary footage. CCTV footage was also most likely available if police requested it within three days after a crime occurred. This was because the images were erased or overwritten after three days to create space to store new footage. The study also found that CCTV footage was more likely available for thefts of and from vehicles but less helpful in investigating these crimes. While these findings show that CCTV footage can be a valuable tool for investigating crime, they also highlight its dependence on factors like quality, prompt access, and the nature of the crime under investigation. However, due to their focus on a railway network, further research was needed to determine the applicability of these findings to diverse settings like Nairobi City County.

Vilalta et al. (2018) conducted a study in Mexico to examine the relationship between the use of CCTV and the counts of crimes investigated by police in the Colonia Roma neighbourhood in 2013. They found a negative association between the number of police CCTV cameras and the number of non-violent crimes investigated by the police, implying that more CCTV cameras resulted in fewer nonviolent crimes investigated by police. However, they found no relationship between the number of police CCTV cameras and violent crimes. Their findings suggest that police CCTV cameras can significantly reduce non-violent crimes but not violent crimes. However, their study did not examine whether CCTV assisted police in proving or clearing the investigated crimes, which was the focus of the current study.

In Australia, Morgan and Coughlan (2018) studied how the New South Wales Police Force (NSWPF) used CCTV footage from the Sydney Trains in their operations. They found that police frequently requested footage, with 14 out of 17 requests made per day being for criminal investigations. They also found that most requests were from stations with more incidents, more cameras and lower levels of public surveillance. These findings imply that police are more likely to request CCTV footage from locations where crime or other incidents are more likely to occur. They also suggest that CCTV system design, layout and management should consider these variables. However, the findings are limited to a railway network, so it is unclear if they apply to other contexts. Additionally, the study did not look at how police used CCTV in their investigations or whether it improved the outcomes of their investigations. Accordingly, the current study focussed on Nairobi City County to address these limitations.

Another Australian study by Dowling et al. (2019) also utilised CCTV footage requests by the NSWPF from the Sydney Trains Network to assess how police use CCTV in criminal investigations. They found that CCTV footage assisted the police in achieving investigative outcomes in 62 per cent of cases studied. They also found that a substantial number (87%) of investigators had used CCTV to perform diverse investigative tasks. For example, 46 per cent had used it to trace or identify suspects, 33 per cent had used it to obtain investigative leads or intelligence, 24 per cent had used it to corroborate statements, and 16 per cent had used it to determine whether an offence had occurred. However, a small percentage of investigators (4%) had requested footage to identify or confirm the identities of victims and other third parties, suggesting they were more concerned with identifying suspects. CCTV footage was also helpful in investigating assaults, thefts and sexual offences but less useful in investigating robberies and property damage. These findings suggest that CCTV footage is valuable in

investigating specific crime types and all stages of a criminal investigation. However, they are limited to a rail context, raising concerns about their generalisability. Additionally, they do not indicate whether using CCTV in investigating crime improved officer safety or reduced crime and police operations costs, which the current study addressed.

Still in Australia, Morgan and Dowling (2019) examined whether CCTV footage assists police in solving crimes occurring on the Sydney Trains Network in New South Wales between January 2014 and September 2017. They found that police solved more cases when they requested and got CCTV footage than when they did not. They also found that clearance rates for thefts, burglaries, property damage and daytime offences increased when CCTV footage was available. However, the clearance rates for assaults and night-time crimes did not increase when CCTV footage was available. These findings suggest that CCTV footage can increase crime clearance rates, but the effect may vary depending on the type of crime and the time of day. However, the findings are limited to clearance rates and a railway environment, so it is unclear whether they apply to other contexts. The current study thus attempted to address these limitations by focussing on Nairobi City County and other outcomes of using CCTV in criminal investigations. The study sought to ascertain whether CCTV footage helped police solve crimes, improve officer safety, and reduce police operations costs.

In the USA, Jung and Wheeler (2019) conducted a quasi-experimental study in Dallas, Texas, to determine the efficacy of CCTV in increasing crime clearance rates. They found that after the installation of CCTV, clearance rates for crimes closer to CCTV cameras increased by two per cent, with thefts having the most significant increase. However, the clearance rates drastically reduced over time. These findings suggest that

using CCTV to investigate crime can have a small but significant effect on clearance rates, particularly for property crimes. However, the findings may not apply to other cities and do not consider factors that can affect clearance rates, such as the quality of CCTV footage and the effectiveness of the police response. As a result, the current study investigated the impact of these factors on the outcomes of investigations.

Other studies have also investigated how CCTV cameras with automatic license plate recognition (ALPR) technology can assist police in detecting and recovering stolen vehicles or vehicles associated with crimes (Ozer, 2016; Roberts & Casanova, 2012; Tylor et al., 2011). ALPR technology uses a high-speed camera to scan and read the alphanumeric characters on a vehicle's license plate, compare them to those in a database, and then alert the police if a vehicle of interest is spotted (Ozer, 2016). A Canadian study by Cohen and Plecas (2007) found that ALPR technology significantly aids police in recovering stolen vehicles and arresting unlicensed and prohibited drivers and persons of interest in other crimes, particularly robberies and burglaries. Similarly, Roberts and Casanova (2012) found that ALPR technology assisted 65 per cent of police agencies in recovering stolen vehicles and 55 per cent in arresting vehicle thieves in their study in the USA. This means that ALPR technology can help police identify stolen vehicles, locate wanted individuals, and detect other criminal activity. However, a randomised control experiment conducted by Tylor et al. (2011) in Arizona, USA, found no relationship between vehicle theft rates and the number of scanned vehicle license plates using ALPR. The divergence between these studies suggests that the usefulness of ALPR in combating vehicle thefts is still unclear. In addition, Ozer (2016) indicates that the application of ALPR in policing is still relatively new, with little empirical evidence of its effectiveness. Therefore, this study sought to narrow this

knowledge gap by focusing on the police CCTV system in Nairobi County, which incorporates ALPR, as there was a scarcity of information regarding its use and impact.

2.1.4 CCTV Policies and Police Operations

CCTV policies are the regulations and practices that govern how CCTV systems are used (Watt, 2021). They are mainly developed by governments and entities that own or operate CCTV systems to ensure their use is legal, ethical and effective (GoK, 2019a). CCTV policies typically address various topics, including the purpose of CCTV systems, the location and coverage of cameras, the procedures for accessing, recording and using CCTV footage, user responsibilities, the retention period and security measures for CCTV footage. As such, their scope and application significantly impact how CCTV systems achieve their desired outcomes.

Several studies have highlighted the importance of policies on the proper use of CCTV. For example, Schlosberg and Ozer (2007) argue that their absence can lead to CCTV systems being used for unintended purposes. Also, the Department of Homeland Security (DHS) (2007) states that policies can help promote fair information practices principles (FIPPs), such as transparency, integrity, accountability and security when using CCTV systems. Ntinyari and Nguyo (2017) add that abuse and misuse of CCTV systems are more likely to occur when users lack adequate policies. Moreover, Shukla et al. (2020) stress the importance of evaluating how policies are applied to identify deficiencies and make necessary revisions. However, much remains unknown about the impact of CCTV policies on police operations, which this study aimed to address by focusing on the police-operated CCTV system in Nairobi City County.

It is worth noting that Kenya, like many other countries, has no specific law on CCTV (GoK, 2019a; Ntinyari & Nguyo, 2017). In an effort to fill this void, the government drafted a national CCTV policy in 2019 through the Communication Authority of Kenya (CAK), but it has yet to be implemented. The draft policy seeks to regulate CCTV installation, operation, and management and promote the use of CCTV as a way to deter, detect and prevent crime (GoK, 2019a). The policy is expected to help police use CCTV more effectively, especially when seizing footage for evidentiary purposes. In the absence of a national policy, the use of CCTV in Kenya is regulated by various laws, such as the Data Protection Act, the Evidence Act, and the Criminal Procedure Code. Entities with CCTV, such as the NPS, also have their own regulations. However, there was little information on how these laws and regulations affected the use of CCTV in police operations. Therefore, this study aimed to fill this gap by examining the impact of CCTV policies on the use of CCTV in police operations in Nairobi County.

Schlosberg and Ozer (2007) examined the threat posed to civil liberties by public surveillance systems in California, USA. They found that many police departments did not have clear policies governing the use of CCTV. Only one-third (13 out of 37) of the departments had written CCTV policies, and most of these policies were often inadequate or legally unenforceable. For instance, some policies did not prohibit monitoring speech activities or the selection of targets based on race or gender. Others also required CCTV footage to be deleted after a short period (mostly seven days), making it difficult for community members to seek redress if they had issues with the footage or the police. These findings suggest that poor policies can lead to the abuse of CCTV systems and civil rights violations. However, they do not directly relate to Nairobi City County or show how CCTV policies might impact the outcomes of police operations, which was the focus of this study.

Jennette (2013) examined university colleges' policies in the USA. The findings showed that most CCTV policies restricted monitoring to public areas, live viewing to campus security personnel and police officers and recorded viewing of incidents only. The findings also revealed that guidelines for footage retention varied between university colleges, ranging from seven days to 120 days, after which the footage was deleted. It is worth noting that shortening CCTV data retention time helps reduce violations of privacy rights and the cost of controlling the footage. It does so by reducing the accessibility of the footage to multiple users and the cost of purchasing and maintaining ample storage (Lin, 2016). However, storing footage for a shorter time, such as less than a week, may limit its availability, mainly if its requisition is made late. In Kenya, the Data Protection Act does not specify how long data should be kept, only that it should be kept for a reasonable time unless it is still required for a legal purpose (GoK, 2019b). This means that entities with CCTV systems have discretion over how long they can keep CCTV footage, which could limit its availability for investigations, especially if deleted too soon. There was little information about how long NPS kept footage and how this affected their operations, so this study explored the same.

Hartmus (2014) compared the government guidelines for installing, operating and regulating CCTV systems in the USA, the UK, Australia and New Zealand. The findings show that the content and scope of the four countries' guidelines differed significantly, with the UK having the most comprehensive and the USA having the least. For example, UK guidelines mandated a stated purpose for CCTV systems and detailed procedures for capturing, viewing, storing and disclosing data. In contrast, the USA guidelines only emphasized adherence to constitutional standards. These findings highlight the diverse landscape of CCTV policies across nations, likely reflecting their distinct circumstances. However, the findings are limited to four countries, are based

on secondary data that may be inaccurate, and do not show the impact of the guidelines on the outcomes of police operations. These limitations necessitated this study.

A critical area addressed by CCTV policies is the use of footage as evidence in court. CCTV footage is a form of documentary evidence, so police must adhere to the rules of evidence when collecting and processing it for it to be admissible. In compliance with this legal requirement, most CCTV policies require a senior official to authorise the release of footage to outside agencies, including the police, upon request (Jennette, 2013). These measures help to prevent the inappropriate disclosure of CCTV data. However, they may impede police operations where the footage is withheld for improper reasons, such as evidence suppression. The refusal to release footage also means that the police must seek a court warrant to acquire it, lengthening the time it takes to investigate incidents. In Kenya, the police must follow a specific procedure when collecting and processing electronic evidence, such as CCTV footage. This procedure, outlined in section 106B of the Evidence Act (GoK, 2018), requires the police to keep a record of how the evidence was handled to ensure that it is not tampered with and is in its original format when presented in court. Studies show that police officers in other countries often have difficulty using CCTV footage as evidence in court. For example, Murphy (2010) and Levesley and Martin (2005) found that courts in the UK were hesitant to admit CCTV footage as evidence. This was due to concerns about manipulation, improper acquisition, and a lack of CCTV viewing equipment and technical knowledge among judges. Given Kenya's less advanced technology than the UK, the police likely face even more difficulties using CCTV footage as evidence in court. Hence, the current study investigated whether police in Nairobi County had difficulty using CCTV footage as evidence in court.

The competency of CCTV users is another critical issue addressed by CCTV policies. In Levesley and Martin's (2005) UK study, respondents identified three critical competencies for CCTV operators. These were the ability to operate CCTV equipment, know criminals and crime in the monitored area, and detect what amounts to suspicious behaviour to monitor or notify immediately. Similarly, Jennette (2013) found that policies at university colleges in the USA required CCTV operators to have the necessary skills and training, particularly in data protection legislation. While this is the case, Shukla et al. (2020) observe that many police departments assign injured officers monitoring duties so that experienced and well-trained officers can analyse the footage. According to Shukla et al., such practices can potentially breed resentment toward monitoring duties and reduce the utility of CCTV in police operations. As such, the current study sought to determine whether NPS policies ensured that competent police officers operated CCTV systems and handled CCTV data.

While some studies have identified factors that may moderate the impact of CCTV, Piza et al. (2019) note that there is less evidence on implementation issues. They suggest that future studies address these gaps. Therefore, the current study sought to determine how CCTV policies influenced the use of CCTV in police operations in Nairobi County and whether they moderated the relationship between the use of CCTV and the outcomes of police operations.

2.1.5 Challenges in Using CCTV in Police Operations

Although limited, studies conducted outside of Kenya have explored challenges that may impede the effective use of CCTV in police operations. For example, an Australian study by Isnard (2001) established that unrealistic public expectations can hinder the success of CCTV systems. Isnard found that the members of the public expect CCTV

to deter all crimes and are disappointed when it does not. Similarly, a UK study by Levesley and Martin (2005) found that the members of the public expect CCTV footage to be always available and interpret its absence as inadequate investigations by police or cover-ups. Such unrealistic expectations contribute to the public's negative perception of the police, undermining police-community relations and cooperation in crime-fighting efforts. Besides, some research suggests that unrealistic public expectations about police roles can demoralise hardworking officers by making them feel like their efforts are not appreciated, leading to lower job performance (Patil, 2019). In light of this, the current study investigated whether unrealistic public expectations about the police-operated CCTV system in Nairobi County existed and negatively influenced its use.

Some studies have identified insufficient user skills as a significant challenge in using CCTV systems. For example, Carli (2008) found that CCTV operators without technical skills may be unable to identify or repair malfunctioning CCTV components. Similarly, Al-Rawahi and Edirisinghe (2015) argue that a lack of technical skills among CCTV operators can lead to poor management of CCTV systems, making them vulnerable to hacking or manipulation by intelligent criminals. Additionally, Kerr (2009) observes that CCTV users may fail to cooperate due to differences in their understanding of CCTV. According to Kerr, the competency gaps between CCTV users stem from CCTV operators being often trained while patrol officers and CCTV managers are not. The College of Policing (2019) notes that police incompetence in using CCTV can manifest in various ways, including failing to detect or respond to significant incidents, being unable to analyse footage or identify and arrest suspects captured on CCTV, or losing cases in court due to poor footage handling. Some studies have reported these challenges. For instance, a study by Goodison et al. (2015) in the

USA found that police had a backlog in analysing CCTV footage because they lacked adequately trained analysts. Also, a study in Nigeria by Yau (2019) found that a lack of qualified operators led to poor management and operations of CCTV systems. However, these findings cannot apply to all settings. Therefore, the current study aimed to establish whether police in Nairobi County had competency gaps in using CCTV and whether such gaps affected the outcomes of police operations.

Several studies consider CCTV vandalism a significant threat to the use of CCTV in managing crime (La Vigne et al., 2011a; Keval, 2009). CCTV vandalism is the deliberate destruction or tampering with CCTV infrastructure, such as cameras, monitors, recorders, poles, mounting brackets and power or transmission systems. It can take many forms, such as pulling down, smashing or blackening cameras, altering their sight angles, cutting wires, or hacking into CCTV systems. CCTV vandalism can be motivated by various factors, such as thrill-seeking, rage, political expression, or financial gain. It has several negative consequences. For instance, it can raise maintenance and repair costs, destroy vital evidence, and reduce surveillance coverage, making it more difficult for the police to monitor and prevent crime in public spaces. Indeed, a UK study by Keval (2009) found that some CCTV cameras could not aid the police in monitoring public spaces because they had been vandalised. Vandalism is common in Kenya, particularly against road and electricity infrastructure, and has negatively affected individuals, communities and organisations (Koinange, 2017). Hence, it was critical to investigate whether CCTV vandalism was a problem in Nairobi County and whether it was affecting the effectiveness of the police CCTV system.

Cuevas et al. (2016) note that police officers' lack of interest in using CCTV can make it difficult to solve crimes. One key reason for this, as identified by Levesley and Martin

(2005), is that police officers are rarely consulted during CCTV installation. Goold (2004) found that police underutilised CCTV systems installed by the UK government without consulting them. Other reasons police officers may be reluctant to use CCTV, according to Goold (2003), are that they are unfamiliar with it or perceive it as increasing their workload. Fatih and Bekir (2015) suggest that police officers can be made more interested in using CCTV by educating them on its benefits. Even so, there was no accessible study on how police officers' interests in CCTV affect their use of CCTV in Nairobi City County. Therefore, this study was conducted to fill this gap.

Some studies consider funding constraints as a significant challenge in using CCTV. For example, Piza et al. (2016) note that the cost of installing and managing CCTV systems is relatively high for many police organisations. This is because significant resources are required to install and maintain CCTV infrastructure, pay salaries for CCTV operators, and manage more crimes that come to the attention of the police. La Vigne et al. (2011b) add that the costs can rise if large storage capacities for footage are required or when technologies such as ALPR are integrated. These reasons partly explain why some police organisations have yet to acquire CCTV systems while others are discontinuing their use (Schuck, 2015). The findings of a study carried out in Australia by Hulme et al. (2015) succinctly exemplify how inadequate funding can negatively affect the use of CCTV systems. Hulme et al. found that 61 per cent of the 221 local councils' CCTV systems they surveyed were not monitored, and 15 per cent were only monitored infrequently due to insufficient funding. In light of these findings, this study investigated whether insufficient funding negatively impacted the use of CCTV in police operations in Nairobi County, Kenya.

Another significant challenge identified by some studies is criminals evading CCTV detection. Lindegaard and Bernasco (2018), for example, observe that some offenders who are aware of CCTV cameras may alter their behaviour to remain unrecognisable. A UK study by Gill and Loveday (2003) confirmed this behaviour modification. It established that offenders could evade detection by CCTV cameras by disguising their appearance or taking steps to avoid being identified when committing crimes. Similarly, Willis et al. (2017) discovered in an interview with police detainees in Australia that they avoided CCTV detection by turning their heads or covering their faces. As criminal evasion of CCTV detection can make CCTV systems less effective, this study investigated whether it was a problem in Nairobi City County.

Some studies have also identified inadequate electricity supply as a significant challenge in using CCTV systems. For example, Yau (2019) found that insufficient power supply was the biggest challenge in using CCTV in Abuja, Nigeria, because it occasionally resulted in the loss of CCTV footage. Typically, CCTV systems require a reliable and sufficient power supply to function optimally (Keval, 2009). If power is lost or interrupted, CCTV systems may not work at all or have gaps in coverage, making it more difficult for the police to detect or respond to incidents. Given that the electrical grid in developing nations like Kenya is frequently unreliable, it was necessary to investigate whether there were issues with the electricity supply in Nairobi County and whether they hindered police use of CCTV in the county.

2.2 Summary of the Reviewed Studies and Research Gaps

The reviewed studies reveal that police can actively or passively monitor CCTV to detect crime, traffic violations and suspicious activity, track traffic flow, and gather intelligence on activities in public spaces. The studies have also focused on the impact

of CCTV monitoring on crime reduction and perceptions of safety. However, their findings are mixed and cannot be applied to all contexts. Therefore, more research is required to understand the impact of CCTV monitoring on crime rates, feelings of safety, and other outcomes of police operations, particularly in Nairobi City County, where there has been little research on the subject.

Regarding the use of CCTV to coordinate incident responses, the reviewed studies show that CCTV can help police quickly assess the nature and severity of incidents, determine the appropriate response, deploy resources, identify the quickest and safest response routes, and guide responding officers to incidents and update them on happenings at the scene. However, these studies were conducted outside of Kenya and do not show whether using CCTV to coordinate incident responses improves police operations outcomes.

The reviewed studies on the use of CCTV in investigating crime suggest that it can help police identify, trace and arrest suspects, corroborate statements from suspects and witnesses, recover stolen vehicles and obtain evidence to support prosecutions. However, most of these studies were conducted in railway environments and outside of Kenya, so it is unclear whether their findings apply to Nairobi County. Additionally, the studies did not examine the impact of CCTV on other outcomes of police operations.

Moreover, the reviewed studies highlight the significance of policies in ensuring that the use of CCTV is ethical, legal and successful. However, they do not indicate whether CCTV policies can influence the outcomes of police operations. They also reveal several challenges in using CCTV, such as inadequate funding, electricity supply,

CCTV operators and user skills. However, none of them focused on the Kenyan context. Therefore, this study aimed to fill these gaps by focusing on Nairobi County.

2.3 Theoretical Framework

Rational Choice Theory and Routine Activity Theory guided the study. The subsections below discuss the two theories in detail.

2.3.1 Rational Choice Theory

Rational Choice Theory (RCT), developed by Cornish and Clarke in 1986, focuses on how a criminal evaluates a potential crime opportunity (Tillyer, 2011). It asserts that criminals are reasoning actors who engage in criminal activity after carefully weighing the potential risks, perceived efforts and expected benefits (Cornish & Clarke, 1986). Consequently, they commit a criminal act if they believe it is less risky, requires less effort, and has a high payoff (Clarke & Cornish, 2017).

As most criminals are assumed to be rational, RCT proposes that making crime less rewarding discourages them from offending (Tillyer & Eck, 2010). As Clarke (1997) highlights, one approach to achieve this is using situational measures like CCTV. Cameras in high-crime areas create the impression of increased risk, potentially discouraging offenders due to the fear of being caught and punished (Clarke, 1997; Willis et al., 2017). However, skilled criminals may find ways to commit crimes differently, such as not looking directly at the cameras, wearing disguises, blocking the cameras, or exploiting blind spots (Lindegaard & Bernasco, 2018).

Additionally, some studies suggest that many offenders are hardly mindful or concerned about the presence of CCTV cameras (Lindegaard & Bernasco, 2018; Piza et al., 2017; Gill & Loveday, 2003). Instead, they are far more concerned if they believe

the police will respond to incidents captured on CCTV (Piza et al., 2017; Willis et al., 2017). Also, other studies show that offenders who have once been caught or convicted using CCTV evidence highly believe that CCTV increases their chances of arrest (Carli, 2008; Gill & Loveday, 2003). This implies that CCTV monitoring alone may not be sufficient to deter most potential offenders and that a prompt response by police to CCTV-detected crimes and apprehending the perpetrators is more likely to do so.

In the current study, RCT was used to help explain how the use of CCTV in police operations could deter crimes by increasing criminals' fear of detection and arrest. This deterrence effect can lead to positive outcomes, such as decreased crime rates, enhanced officers' safety, and lower police operations costs. The theory also provided a valuable lens to explore how CCTV cameras and footage affect police officers' decisions in responding to and investigating incidents, such as how urgently to respond, whether to dispatch specialized units, and whether to preserve evidence. However, RCT does not adequately explain the challenges that can hinder the effective use of CCTV in police operations and how CCTV policies may affect police operations. Therefore, the study adopted the Routine Activity Theory to fill these gaps.

2.3.2 Routine Activity Theory

Routine Activity Theory (RAT) is a derivative of RCT that shares some assumptions, such as criminals being rational (Tillyer, 2011). However, RAT differs from RCT in that it mainly focuses on situational factors that make crime more or less likely to occur rather than the offender's decision-making process (Andresen & Farrell, 2015). The theory was initially formulated in 1979 by Lawrence Cohen and Marcus Felson to explain the rise in crime rates in the USA in the 1950s, 1960s, and 1970s (Miro, 2014). It has been further expanded by Ronald Clarke, John Eck, Danielle Reynald and other

scholars to explain crime rates in different contexts and the effectiveness of crime prevention strategies such as CCTV.

According to RAT, three elements must be present at the same place and time and during people's daily activities for a crime to occur (Santos, 2015). First is a likely offender, which refers to anyone with the desire and capability to commit a crime (Reynald, 2011). The second is a suitable target, which refers to a person or an object that an offender may harm, damage or steal because they are vulnerable and will benefit them in some way (Reynald, 2019). The third element is a capable guardian, which refers to someone or something whose physical or symbolic presence or direct action can deter or discourage a potential offender from committing a crime (Hollis-Peel et al., 2011). According to Reynald (2019) and Hollis-Peel et al. (2011), CCTV cameras can act as guardians against crime in two ways. First, their mere presence can signal to offenders that they are being watched and may be caught if they commit a crime. This means that it makes it more difficult for criminals to operate undetected. Second, it can enhance the ability of other guardians, such as police officers and security guards, to manage crime by allowing them to detect and respond to criminal activity more quickly and effectively.

The element of *guardianship* has undergone significant advancements, with some criminologists proposing factors that make guardians effective. For example, Reynald (2011) emphasises the importance of guardians understanding their surroundings and knowing what to observe. Equally, Hollis-Peel and Welsh (2014) suggest that guardians can capably deter crime when visible, actively monitor targets and intervene directly or indirectly. Also, Reynald and Moir (2018) and Reynald (2010) argue that guardians are effective when they are near targets, willing to supervise them, and have clear visibility.

Reynald et al. (2018) add that guardians are effective when they can detect potential offenders and are willing to intervene when necessary. As such, guardians' characteristics play a crucial role in crime commission by either hindering or enabling offenders from reaching their targets (Reynald & Elffers, 2015). Guardians' characteristics were central to this study in shedding light on how challenges like CCTV vandalism and poor maintenance can hamper its effectiveness in police operations. Specifically, the study explored whether these challenges had weakened CCTV's guardianship function, potentially creating opportunities for crime.

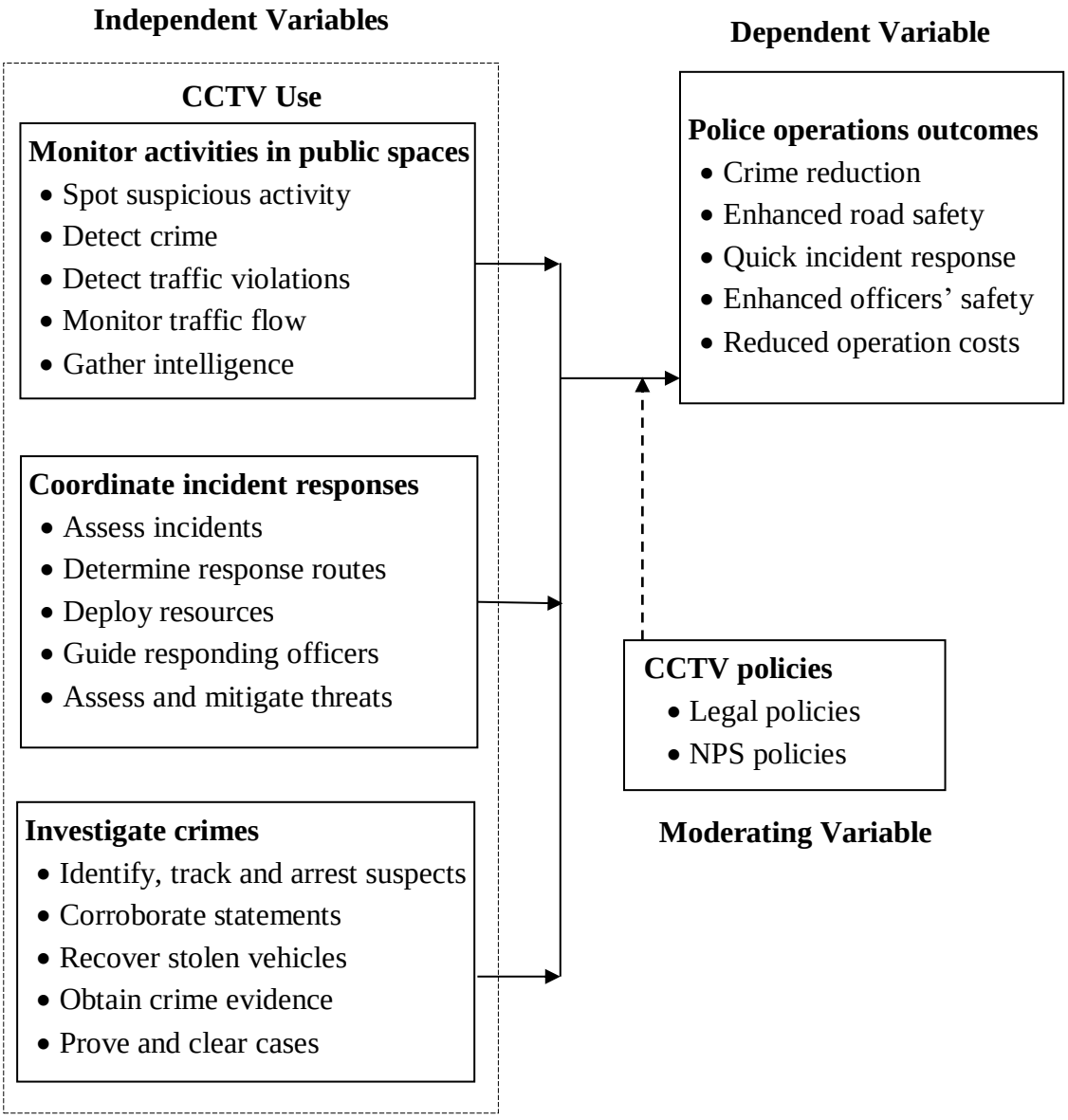
Another extension to RAT introduced by Sampson et al. (2010) that was relevant to this study was the concept of *super controllers*, which are entities that can influence crime prevention by shaping the actions of guardians. These entities include families, organisations, communities, governments, religious institutions and the media. They provide incentives through policies, training, rewards and punishments, impacting guardians' ability and willingness to protect targets (Eck, 2017). Consequently, when super controllers fail to provide adequate support, guardians may struggle to protect targets effectively (Townsley et al., 2016). The concept of super controllers was relevant to this study because it can explain how the presence and adequacy of CCTV policies influence the effective use of CCTV in police operations. Police officers, for instance, are less likely to use CCTV effectively if their organisation lacks clear and well-enforced policies, fails to provide them with the necessary resources like funding and training, or does not acknowledge their successful use of CCTV. The concept of super controllers was also relevant because it can illuminate the challenges that may hinder the successful use of CCTV in police operations, such as public opposition to CCTV or a lack of police buy-in.

2.4 Conceptual Framework

Figure 2.1 graphically depicts the conceptual framework that guided this study.

Figure 2.1

Conceptual framework showing the relationship between CCTV use, CCTV policies and police operations outcomes



Source: Author (2021)

The conceptual framework shows that the use of CCTV was the independent variable in this study, with three dimensions: monitoring activities in public spaces, coordinating incident responses, and investigating crimes. Each dimension had five indicators or measures. The measures for CCTV monitoring were spotting suspicious activity, detecting crime, detecting traffic violations, monitoring traffic flow, and gathering intelligence. The measures of the use of CCTV in coordinating incident responses were assessing the nature and severity of incidents and appropriate responses, determining the quickest and safest response routes, deploying resources, guiding responding officers, and assessing and mitigating threats. The measures for investigating crime were identifying, tracing and arresting suspects, corroborating statements, recovering stolen vehicles, obtaining evidence for crimes, and proving and clearing cases.

The conceptual framework also shows that the study's dependent variable was the outcomes of police operations, measured by five indicators: crime reduction, quick incident response, reduced traffic violations, enhanced officer safety, and reduced cost of conducting police operations. It also shows that the moderating variable in this study was CCTV policies, measured by two indicators: legal and NPS CCTV policies.

Overall, the conceptual framework illustrates that using CCTV to monitor public spaces, coordinate incident responses and investigate crimes can improve police outcomes by helping reduce crime, improve road safety, increase officer safety, and lower police operations costs. However, CCTV policies can either strengthen or weaken this impact. For example, comprehensive and well-enforced policies can help ensure ethical and effective CCTV use. In contrast, weak or poorly enforced policies can make achieving the desired outcomes difficult.

CHAPTER THREE

METHODOLOGY

This chapter discusses the research design and site and the instruments and procedures used in gathering, analysing, interpreting and reporting data. It also discusses the study's target population, sample, data sources, pilot study, and ethical considerations.

3.1 Research Design

The study used a convergent mixed methods design, integrating a cross-sectional survey design with a phenomenological design. This design gives equal importance to qualitative and quantitative data, which are collected simultaneously, analysed separately and combined during the interpretation of the results (Edmonds & Kennedy, 2017; Orodho et al., 2016). The design was chosen to allow the researcher to fully understand the impact of CCTV on police operations from both a quantitative and qualitative perspective, which is more comprehensive than using only one perspective. The combination of a cross-sectional survey design with a phenomenological design was based on Asenahabi's (2019) suggestion that research designs can be combined to help triangulate findings or gain a more holistic understanding of the research question. A cross-sectional survey design is efficient for collecting quantitative data, while a phenomenological design is appropriate for gathering qualitative data about people's experiences (Creswell, 2018; Creswell & Creswell, 2017). In this study, the survey was used to collect data on police officers' use of CCTV, and the phenomenological design was used to understand their experiences using CCTV.

3.2 Site Selection and Description

The study was conducted in Nairobi City County because it has a well-developed CCTV system that is solely operated and extensively used by the police in their

operations. The county is the third smallest and most populous of Kenya's 47 counties. It has a land area of 696.1 square kilometres and a population of over 4.3 million people (Kenya National Bureau of Statistics [KNBS], 2019). It borders three counties: Kiambu to the North, Machakos to the East and Kajiado to the South. Its headquarters is the city of Nairobi, which also serves as Kenya's capital city and the headquarters of several international organisations and firms (Kenya Information Guide [KIG], 2015).

Nairobi City County is entirely urban and generally flat, with an elevation of 1795 meters above sea level (KIG, 2015). It receives an average annual rainfall of 1500 mm and has a well-developed road network (KIG, 2015). However, traffic congestion is common, especially in the mornings and evenings. The county also has the highest crime rate in Kenya, with muggings, robberies, carjacking and burglaries prevalent in the NCBD and residential areas (NPS, 2019b). In response, the government installed a CCTV system in June 2015 to assist police in managing crime and traffic. At the time of the study, Nairobi City County had 11 police administrative areas. These were Embakasi, Njiru, Starehe, Kasarani, Mathare, Makadara, Kibra, Langata, Dagoretti, Westlands, and Kamukunji. Each administrative area was headed by a sub-county police commander (SCPC) responsible for overseeing police operations within their jurisdiction. A map of the county showing the administrative areas is in Appendix X.

3.3 Target Population

The study's target population was 5650 police officers deployed to CCTV operator and police operation duties in Nairobi City County. They included 5565 Kenya Police Service (KPS) and the Directorate of Criminal Investigations (DCI) officers stationed at police stations in the county and 85 officers stationed at the IC3. These officers were

chosen because they routinely use CCTV, especially in conducting patrols, criminal investigations, and traffic surveillance and enforcement.

3.4 Sampling Techniques

The researcher used a three-stage cluster sampling to select police officers who completed the questionnaires. According to Maxfield and Babbie (2017), this sampling technique is appropriate in survey research when collecting data from a large and dispersed population. It entails dividing the population into clusters or manageable groups based on shared characteristics or geographical proximity and randomly selecting clusters and individuals from the chosen clusters for data collection (Nafui et al., 2012). The researcher chose this sampling technique because police officers are geographically scattered. Using it allowed for a more representative and reliable sample while also saving time and money on travel during data collection.

At the first sampling stage, the target population of police officers in Nairobi City County was divided into 12 clusters based on the existing administrative boundaries, including the 11 police sub-counties and the IC3. The IC3 was considered a separate cluster because of its separate command and the technical CCTV expertise of its officers. In the second stage of sampling, one police station was randomly selected from among the 11 police administrative areas to ensure that each police station had an equal chance of being included in the sample. Finally, in the third stage of sampling, police officers from the selected 11 police stations and the IC3 were randomly chosen to participate in the study as questionnaire respondents.

Purposive sampling was used to select five senior police commanders coordinating police operations in Nairobi County using CCTV as key informants (KIF) for the study.

This technique was chosen because it is appropriate for selecting participants with knowledge of the research topic who can provide rich and informative qualitative data, as described by Creswell and Poth (2018). The five purposively selected police commanders included the officer in charge of the command centre, the staffing officer for police operations, two SCPCs, and the officer in charge of traffic.

Purposive sampling was also used to select 24 police officers for focus group discussions (FGDs) from among those who did not complete the questionnaires. These officers were chosen based on their rank, gender, availability and deployment area to ensure that the FGDs represented a diverse range of viewpoints. They were divided into three groups of eight officers each, following Creswell's (2014) recommendation of 3-6 FGDs per study and Frey's (2018) suggestion of 6-12 participants per FGD with similar backgrounds and experiences. One focus group included patrol and traffic officers, another included DCI officers, and the third included IC3 officers.

3.5 Sample Size

Yamane's (1967) formula was used to determine the sample size of 374 police officers for the questionnaires. This formula was chosen because it is simple to apply and provides reasonable precision in the results (Blair & Blair, 2015). The sample size calculations were set at a 95 per cent level of confidence and a 0.05 level of significance. These parameters were chosen because, according to Dantzker and Hunter (2012), they are relatively easy to measure and can be used to answer various social science research questions. The sample size calculations were as follows:

$$n = \frac{N}{1 + N(e^2)}$$

Where:

n = Sample size

N = Population size

e = Margin of error (level of precision, which is + or -0.05%)

Thus, in this study:

$$n = \frac{5650}{1 + 5650\,(0.05^2)}$$

$$n = 373.554$$

$$= 374$$

As the number of officers in police stations varies, the sample size for the selected police station and the IC3 was proportionately determined using the formula below to ensure their equal representation in the sample.

$$n = \frac{\text{No. of police officers in the selected police station}}{\text{The total No. of police officers in all the selected police stations}} \times 374$$

Table 3.1 shows the sampled number of police officers who participated in the survey from each police station and the IC3. Pseudonyms were used to protect the identity of the selected police stations for security reasons.

Table 3.1

Distribution of the survey sample per the selected police stations

S/No.	Administrative Area		Selected Police Station		
	Name	**Population**	**Name**	**Population**	**Sample**
1.	Embakasi	954	A	362	68
2.	Njiru	343	B	110	21
3.	Kasarani	514	C	161	30
4.	Kamukunji	476	D	164	31
5.	Westlands	324	E	112	21
6.	Makadara	369	F	123	23
7.	Mathare	588	G	198	37
8.	Kibra	392	H	114	21
9.	Langata	423	I	119	22
10.	Starehe	765	J	315	59
11.	Dagoretti	417	K	131	25
12.	IC3	85	IC3	85	16
	Total	**5650**		**1994**	**374**

Source: NPS (2020)

3.6 Data Collection Instruments

A questionnaire, a FGD guide, and a semi-structured interview schedule were used to collect primary data, and desktop and library research were used to collect secondary data. This was done to enable the researcher to understand the research topic thoroughly, identify patterns or inconsistencies in the data, and ensure the data was accurate and reliable. Subsections 3.7.1, 3.7.2 and 3.7.3 discuss the three research instruments used in the current study to collect primary data.

3.6.1 Questionnaire

A questionnaire was used to collect data from police officers deployed to operational duties and the IC3 who responded to the survey. This group of officers was large, geographically dispersed and frequent CCTV users. Questionnaires were thus the best fit for them because they are a quick and less expensive way to collect data from a large group of people and the best way to collect quantifiable data (Creswell & Poth, 2018; Babbie, 2017). As shown in Appendix II, the questionnaire used in this study consisted mainly of close-ended questions on a five-point Likert scale, with response options ranging from 1 (*very little extent*) to 5 (*very large extent*). The closed-ended questions were selected because they provide more uniform quantitative data from respondents, which are also easier to analyse using statistical methods (Creswell & Clark, 2018). In addition to the close-ended questions, the questionnaire had a few open-ended questions. These questions were included because they allow respondents to freely answer questions from their perspectives and clarify their responses, which can aid in understanding their experiences and gathering more detailed information (Johnson & Morgan, 2016; Kombo & Tromp, 2010).

The questionnaire had seven sections, including an introduction. The introduction explained the purpose of the questionnaire, how to complete it, how long it would take, and how the data would be handled. The seven sections were numbered A to G. Section A asked questions on respondents' background information. Sections B, C, D, E and G addressed the study's first, second, third, fourth and fifth specific objectives. Section F asked about the effects of CCTV use on police operations outcomes.

3.6.2 Focus Group Discussion Guide

The FGD guide in Appendix III was used to facilitate discussions with 24 police officers engaged in police operations and their supervisors, who were purposively selected for the FGDs. The guide included five open-ended questions covering the five study's specific objectives to elicit participants' perceptions and experiences with CCTV. Each question had probing questions to help the researcher get more information or clarify unclear responses. The FGD guide was suitable for the study because it provides rich qualitative data, can help identify new issues, and can validate information from other sources (Creswell, 2018; Allen, 2017; Maina, 2017). As such, its use helped explain questionnaire data and provided insights into police officers' experiences with CCTV.

3.6.3 Interview Guide

A semi-structured interview schedule with five open-ended questions was used to conduct face-to-face interviews with five senior police commanders who were key informants for the study (see Appendix IV). The interview schedule was structured around the study's five objectives, and each question had follow-up questions to elicit more information. This structure ensured that all relevant aspects of the study were thoroughly covered and that responses from different respondents could be compared.

3.7 Pretesting of the Research Instruments

Questionnaires were pretested four weeks before conducting the main study on 38 randomly selected police officers from the IC3 and police stations in Nairobi City County. The 38 police officers were selected following Mugenda and Mugenda's (2019) suggestion that a pilot study sample should be at least 10 per cent of the actual study sample. At the same time, the key informant interview guide and the FGD guide

were pretested on one purposively chosen SCPC and eight police officers from a police station in the county. The pilot study participants did not participate in the main study.

In line with Maxfield and Babbie's (2017) observation, the pilot study's findings aided in checking the consistency and adequacy of responses and making necessary revisions to the research instruments. Some of the revisions made included rephrasing unclear items and enhancing inadequate ones. The pilot study also assisted in determining how to access and engage participants in the main study, which aided in overcoming potential challenges in its execution.

3.8 Instrument Reliability and Validity

The validity and reliability of the research instruments were determined as follows:

3.8.1 Reliability

Cronbach's alpha was used to measure the internal consistency of questionnaire items. It was used because it is a good measure of the reliability of Likert-type questions (Forero, 2014; Tavakol & Dennick, 2011), which were the main types of questions in the questionnaire. The statistical package for the social sciences (SPSS) version 27.0 was used to compute the reliability tests. Table 3.2 summarises the findings.

Table 3.2

Results of Cronbach's Alpha Test

Variable	Number of Items	Cronbach's Alpha Coefficient	Remarks
Use of CCTV to monitor public spaces	5	.809	Reliable
Use of CCTV to coordinate responses to incidents	5	.867	Reliable
Use of CCTV to investigate crime	8	.880	Reliable
CCTV policies	9	.905	Reliable
Outcomes of police operations	5	.862	Reliable
Challenges in using CCTV in police operations	11	.840	Reliable
Overall questionnaire reliability	**43**	**.941**	**Reliable**

Source: Field Data (2021)

Table 3.3 shows that the reliability coefficients for the 43 questionnaire items range from 0.809 and 0.905. These values exceed the generally accepted minimum of 0.7 for reliable measurement, as suggested by Taber (2018) and Forero (2014). This analysis confirms the reliability of the questionnaire for assessing the intended construct.

3.8.2 Validity

The study ensured content, construct, and external validity. Content validity was ensured by having multiple items for each research objective and getting input from the supervisors. Construct validity was ascertained by administering the questionnaires to different respondents during the pilot study and determining whether they gave similar answers. External validity was ensured by using a large representative sample. Additionally, as Creswell and Clark (2017) and Zheng (2015) suggest, combining data

from multiple sources, including questionnaires, FGDs and key informant interviews, enhanced the validity of the study's findings.

3.9 Data Collection Techniques and Procedures

Data were collected from February to April 2021 after the researcher had obtained the necessary approvals and notified the respondents. Questionnaires were administered to sampled respondents at their workplaces and collected at an agreed-upon time after completion. Every returned questionnaire was labelled with a code for tracking purposes. FGDs were held on different pre-arranged dates, each lasting approximately 50 to 70 minutes. The FGDs' responses were recorded in a notebook and a digital audio recorder. The two records were used concurrently to avoid missing parts of the discussions or losing information when interpreting or transcribing responses and as a backup plan in case one of the records failed or was lost. The researcher interviewed the five key informants at their workstations on scheduled dates. The interviews were recorded in a notebook and digitally and lasted about an hour each. Three trained research assistants helped collect and enter data.

3.10 Data Analysis and Presentation

The study collected both quantitative and qualitative data. The quantitative data from the closed-ended questionnaire items were first checked for completeness, then coded and entered into SPSS. After that, they were cleaned to eliminate errors and inconsistencies and analysed using descriptive and inferential statistics. Descriptive statistics comprised frequencies and percentages, while inferential statistics involved binary logistic regression. Binary logistic regression was chosen because it is easy to use and understand and can handle independent variables of any type, whether

categorical, continuous or a combination (Hilbe, 2015). The analysed quantitative data were presented in tables and figures created in Microsoft Excel 2019.

Following the suggestion of Garson (2016) that a binary regression requires the outcome variable to be either true or forced dichotomous, the five responses for the study's dependent variable (police operations outcomes) were transformed into two dummy variables for logistic regression analysis. The first dummy variable, coded 1 = *significant beneficial impact*, combined responses "great extent" and "very great extent". The second dummy variable, coded 0 = *no significant beneficial impact*, combined responses "very little extent", "little extent", and "moderate extent". This was done because the first two responses represent the most positive impact of CCTV on police operations, while the last three represent the least positive impact. They were coded as 0 and 1 following Walker and Maddan's (2019) suggestion that dummy variables can be created by converting each variable category into a number and assigning a value of 1 if the characteristic is present and 0 if it is absent. The five responses were dichotomised based on the findings of Jeong and Lee (2016), who found that doing so does not result in the loss of valuable information.

Thematic analysis was used to analyse qualitative data from FGDs, key informant interviews, and open-ended questionnaire questions. This entailed transcribing the data into a pre-formatted Microsoft Word template, coding it to identify emerging themes, organising the themes into bracket themes that explained each research question, and verbatim reporting the findings. Finally, the findings were compared to those from quantitative data and the reviewed studies.

3.10.1 Analytical models

The study used the regression model below to examine the association between the study's dependent and independent variables.

$$P(y = 1) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

y = Dependent variable (outcomes of police operations)

$P(y = 1)$ = Probability of being in any binary outcomes: 1 (the use of CCTV has a significant beneficial impact on police operations); 0 (the use of CCTV has no significant beneficial impact on police operations)

β_0 = Y-intercept (constant)

β_1 to β_3 = Regression coefficients for each independent variable

X_1 = The independent variable: use of CCTV to monitor activities in public spaces

X_2 = The independent variable: use of CCTV to coordinate responses to incidents

X_3 = The independent variable: use of CCTV to investigate crime

ε_0 = Error term

Each of the five indicators of the dependent variable (crime reduction, enhanced road safety, quick response to incidents, enhanced police officer safety, and reduced operational costs) was separately entered into the model as an outcome variable to avoid losing some information and establishing unreliable generalisations. The data for the independent variables were tested for multicollinearity using tolerance and variance inflation factors (VIF) before entering them into the regression model, as suggested by Osborne (2015). This was essential because a binary logistic regression requires the

independent and predictor variables to be uncorrelated to avoid difficulty in determining their individual effects on the dependent variable (Seneviratna & Cooray, 2019). Based on Pallant's (2011) criteria, multicollinearity was considered present if a predictor variable had a tolerance value less than 0.1 and VIF over 10. Such predictors were excluded from the regression model.

The regression model was also subjected to other diagnostic tests before it was used in making inferences. These included the likelihood ratio (LR) test, the Hosmer and Lemeshow (HL) test, and the Nagelkerke R Square (R^2) test. The LR test was used to compare the overall model (with predictors) with the null/baseline model (without predictors) to evaluate the overall model's goodness of fit. The overall model was considered significantly better than the null model if it had the same or lower chi-square (χ^2) value and *p*-value less than 0.05, as suggested by Walker and Maddan (2019). The HL test was used to assess the overall model fit. Following Hosmer et al.'s (2013) suggestion, an HL test *p*-value greater than 0.05 indicated a good model fit. The Nagelkerke R^2 was used to measure the model's explanatory power, with values ranging from 0 to 1 considered satisfactory (Harrell, 2015).

Once the model was confirmed suitable for the data, the odds ratio (OR) was used to measure the strength of the relationship between predictors and outcome variables with a 95 per cent confidence level and an alpha level of 0.05. Predictor variables were considered statistically significant if their *p*-values were less than 0.05. A significant predictor variable with an OR of 1 indicated no association with the corresponding outcome variable. An OR over 1 indicated an increased likelihood of the outcome variable, while an OR less than 1 indicated a decreased likelihood. An insignificant predictor variable (with a *p*-value greater than 0.05) indicated that there was insufficient

evidence to conclude that it had a statistically significant effect on the corresponding outcome variable. These interpretations of the ORs are based on the suggestions of Fernandes et al. (2020), Walker and Maddan (2019), and Pallant (2011).

The model below was used to test whether CCTV policies moderated the relationship between the use of CCTV and the outcomes of police operations.

$$P(y = 1) = \beta_0 + \beta_1 X1_i + \beta_2 X2_i + \beta_3 X3_i + [(\beta_1 X1_i + \beta_2 X2_i + \beta_3 X3_i)*\beta_4 M_i] + \varepsilon_0 \ldots. (2)$$

Where:

y = Dependent variable (outcomes of police operations)

$P(y = 1)$ = Probability of being in any binary outcomes: 1 (the use of CCTV has a significant beneficial impact on police operations); 0 (the use of CCTV has no significant beneficial impact on police operations)

β_0 = Y-intercept

β_1 to β_4 = Regression coefficients for each independent variable and the moderating variable.

$X1_i$ = The independent variable: use of CCTV to monitor activities in public spaces

$X2_i$ = The independent variable: use of CCTV to coordinate responses to incidents

$X3_i$ = The independent variable: use of CCTV to investigate crime

M_i = The moderating variable: CCTV policies

ε_0 = Error term

3.11 Ethical Considerations

The Kenyatta University Post Graduate School approved the study and licensed by the National Commission for Science, Technology and Innovation (NACOSTI). The

copies of the approval and license are attached to this thesis in Appendix V and VII. The researcher obtained permission from the Inspector-General of the NPS to access police officers (Appendix VIII), and relevant police commanders were notified (Appendix IX). The researcher also obtained ethical approval from the Kenyatta University Ethics Review Committee (KUERC) to conduct the study (Appendix VI). Ethical approval was necessary because the study collected sensitive security information and was conducted during the coronavirus disease (COVID-19) pandemic, both of which required consideration of ethical and legal guidelines.

Participation in this study was entirely voluntary and through informed consent. Participants were given information about the study's purpose, procedures and potential risks. They were also allowed to ask questions and choose to participate, decline, or withdraw at any time. Those who agreed to participate signed the informed consent form in Appendix I, which KUERC had approved. Protecting the privacy of those involved was paramount, so pseudonyms were used for institutions, places, and participants in data reporting, as suggested by Allen and Wiles (2016). Additionally, participants were asked not to include personally identifying information, such as their names or employment numbers, on the questionnaires.

Confidentiality and academic integrity were two other ethical considerations in the current study. Confidentiality of research data was ensured through physical and digital safeguards. All completed questionnaires, field notes, and consent forms were kept under lock and key when not in use, with only the researcher having access to them. Similarly, electronic data was processed and stored only on the researcher's password-protected laptop, with their files also being password-protected and closed when not in use. Academic integrity was upheld by properly citing and referencing all consulted

works using the American Psychological Association's (APA) seventh-edition format. This format was chosen because it is the most commonly used style for academic writing in social sciences (Beins, 2012). It is widely used because it ensures consistency and clarity in citing sources, making it easier for readers to locate and verify the information presented (Cresswell & Cresswell, 2018).

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA AND DISCUSSION

This chapter presents and analyses the study's data and interprets the findings. The chapter is divided into five sections, each of which discusses one of the five specific objectives of the study. The first section discusses the impact of CCTV monitoring on the outcomes of police operations. The second section discusses the impact of the use of CCTV in coordinating incident responses on the outcomes of police operations. The third section discusses the impact of the use of CCTV in investigating crime on the outcomes of police operations. The fourth section discusses the moderating effect of CCTV policies on the relationship between CCTV use and police operations outcomes. The fifth section discusses the challenges hindering the effective use of CCTV in police operations in Nairobi City County. The chapter begins by providing information on the questionnaire's response rate and the respondents' demographic information

4.1 Response Rate

Three hundred and fifty-eight out of the 374 questionnaires distributed to the sampled respondents were returned, yielding a 95.7 per cent response rate. This response rate exceeded the recommended minimum of 70 per cent (Mugenda & Mugenda, 2019), suggesting a representative sample for the study. The high response rate was likely due to the researcher's rapport with respondents and the study's relevance to their routine work. Sixteen questionnaires were not returned despite multiple reminders for unknown reasons. Eleven returned questionnaires were excluded from the analysis due to incompleteness (5) and inconsistencies (6), most likely caused by respondents' demanding work schedules. Therefore, 347 questionnaires were used in the analysis to ensure the correctness and dependability of the collected data.

4.2 Demographic Characteristics of Respondents

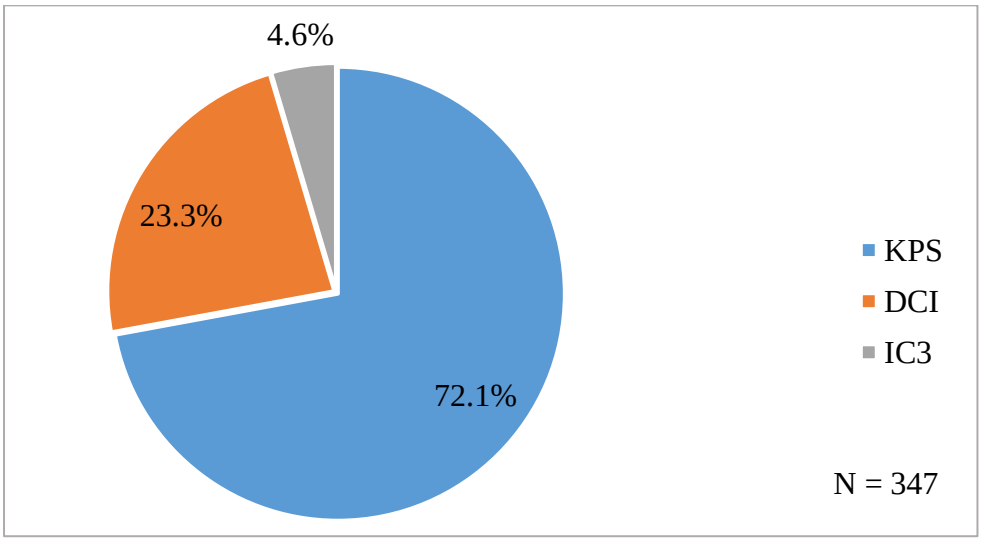
This section discusses the respondents' demographic information regarding their service or directorate, gender, age, rank, educational qualifications, and length of service in Nairobi City County.

4.2.1 Service and Directorate of Respondents

The study considered respondents' service and directorate important because police units vary in size and responsibilities, which may affect their use of CCTV. Figure 4.1 depicts the distribution of respondents per service and directorate.

Figure 4.1

Distribution of respondents per service and directorate



Source: Field Data (2021)

As shown in Figure 4.1, the majority of respondents (72.1%) were KPS officers, followed by DCI officers (23.3%) and IC3 officers (4.6%). This finding is similar to the actual distribution of police officers in Nairobi City County, where more than two-thirds are under the KPS (NPS, 2020a). The finding suggests that the study's sample is

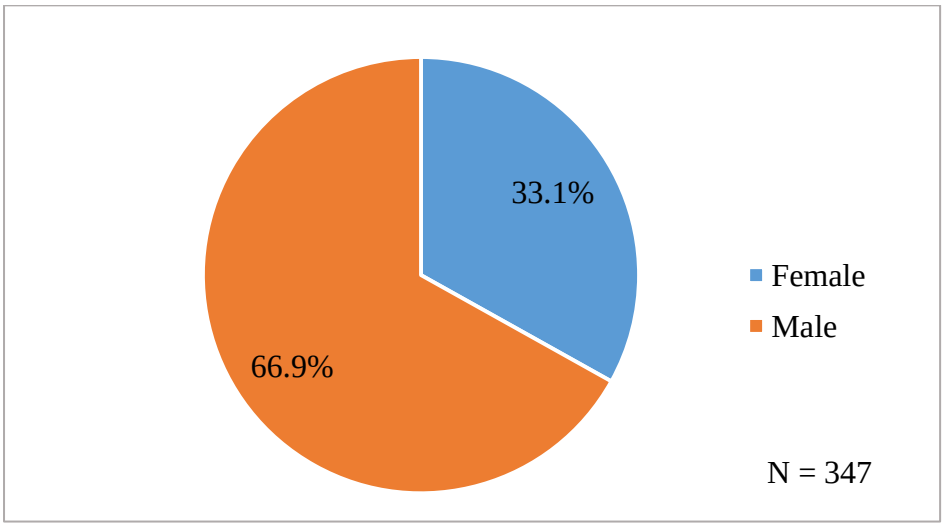
representative of police officers in Nairobi City County and that the data adequately represents their views on the impact of the use of CCTV on police operations.

4.2.2 Gender of Respondents

The study considered gender critical because police organisations are gender-imbalanced, and male and female police officers are sometimes assigned different roles based on stereotypes (Muhlhausen, 2019; Kim & Gerber, 2019). These factors can affect their experiences and perspectives on police operations, so it was essential to have gender balance in the study. Figure 4.2 depicts respondents' gender proportions.

Figure 4.2

Distribution of respondents per gender



Source: Field Data (2021)

According to Figure 4.2, the majority of respondents were male (66.9% versus 33.1% female). This distribution corresponds to the gender proportions of Kenyan police officers, where males comprise much of the service (NPS, 2020a). This suggests that the data adequately captures the perspectives of male and female officers on CCTV use in Nairobi County. This finding also supports prior policing research, indicating that

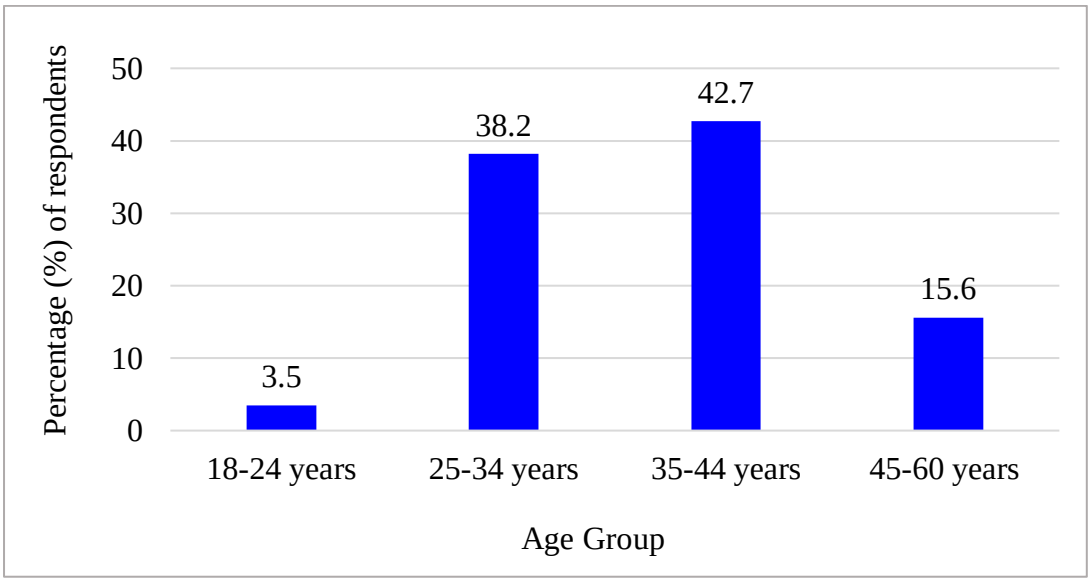
police work is generally male-dominated (Gastrell et al., 2020; Onyango & Natarajan, 2021). The finding further supports Strobol's (2020) observation that over 20 per cent of police officers in urban areas of Commonwealth countries are female. Gastrell et al. (2020) attributed this to urban areas having better infrastructure and facilities to accommodate women and many female officers preferring to serve in urban areas.

4.2.3 Age of Respondents

This study considered age significant because it can affect police officers' experiences, perspectives and technology use. On average, older police officers have more job experience, which allows them to understand policing issues better (Koper et al., 2015). Conversely, younger officers are more familiar and comfortable with technology because they are more likely to have grown up with it or have been trained in it (VanderKaay, 2012). Figure 4.3 shows the age distribution of respondents.

Figure 4.3

Age distribution of respondents



Source: Field Data (2021)

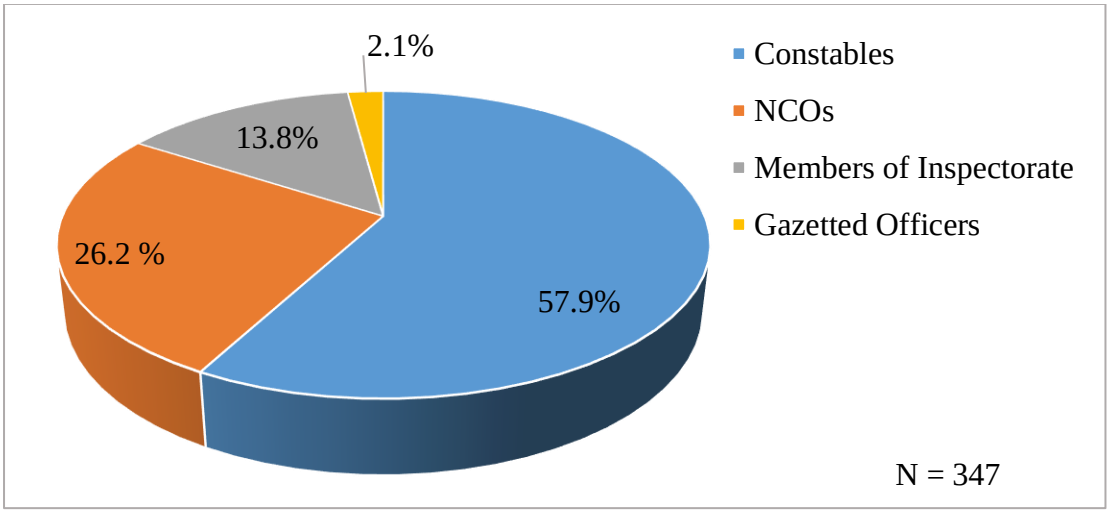
According to Figure 4.3, respondents were older, with the majority being between the ages of 25 and 44. This is not surprising because the majority of Kenyan police officers start their careers outside of Nairobi County, mainly in the country's north. The findings suggest that the study data accurately represents the perspectives of police officers in the county from all age groups on the impact of CCTV on police operations.

4.2.4 Ranks of Respondents

The study collected data on the ranks of respondents because police officers of different ranks have different responsibilities, which can affect how they interact with and perceive CCTV systems. Figure 4.4 displays the results of the survey.

Figure 4.4

Distribution of respondents per rank



Source: Field Data (2021)

Figure 4.4 shows that the majority of respondents were constables (57.9%), followed by non-commissioned officers (NCOs) (26.2%), members of the inspectorate (13.8%), and gazetted officers (2.1%). These results match the distribution of police officers in the NPS's pyramidal ranking structure, in which constables are the majority, followed

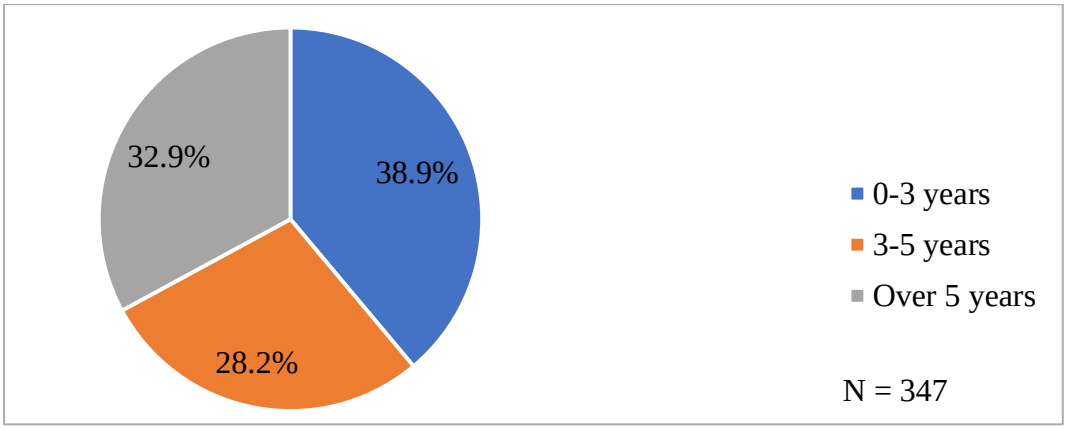
by NCOs, members of the inspectorate, and gazetted officers in decreasing order (NPS, 2020a). This suggests that the study findings accurately reflect the perspectives of police officers of all ranks in Nairobi City County on the impact of CCTV on police operations.

4.2.5 Duration Served in Nairobi County

The length of time that respondents had served in Nairobi City County was considered significant in the current study because police officers with more experience in a given area better understand crime patterns, trends and challenges in that area (Koper et al., 2015). This understanding helps them provide informed perspectives on the effectiveness of policing strategies in that area. Figure 4.5 depicts the length of time respondents had served in Nairobi City County.

Figure 4.5

Duration respondents had served in Nairobi City County



Source: Field Data (2021)

Figure 4.5 shows that respondents had served in Nairobi City County for varying lengths of time. Over one-third (39%) had served for less than three years, a third (33%) for three to five years, and nearly one-third (28%) for more than five years. The

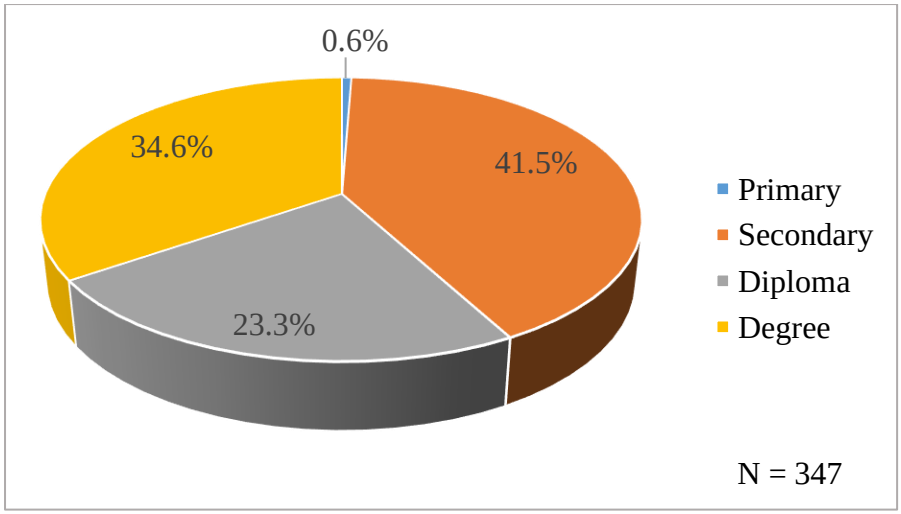
disparity in their length of service in the county is likely due to the NPS transfer policy provisions, which limit an officer's continuous service in an area to less than three years unless their transfer would interfere with operations in that area (NPS, 2017). Overall, nearly two-thirds of respondents (61%) had served in Nairobi County for more than three years, suggesting that they had a sufficient understanding of how CCTV had influenced police operations.

4.2.6 Educational Qualifications of Respondents

The study collected data on the highest level of education of the respondents because previous research has shown that police officers with higher education are more likely to understand the law and ethical principles, use technology, and communicate and articulate their thoughts effectively (Gardiner, 2017; Roberg & Bonn, 2004). This data was essential in obtaining informed perspectives on how police use CCTV, the challenges they face using it, and the impact of CCTV policies. Figure 4.6 depicts the educational qualifications of respondents.

Figure 4.6

Respondents' educational qualifications



Source: Field Data (2021)

Figure 4.6 shows that respondents had different levels of educational qualifications. The majority (41.5%) had secondary education as their highest education qualification, followed by those with university degrees (34.6%), diplomas (23%), and primary education (0.6%). These findings are consistent with the fact that most Kenyan police officers are recruited with only secondary education. Onyango's (2018) study also found that 43 per cent of Kenyan police officers had secondary education as their highest qualification. The substantial number of respondents with diplomas and university degrees is likely due to two factors. First, many police officers in Nairobi County have taken advantage of the many universities in the county to further their studies up to the university level through part-time study. Second, the study included IC3 and DCI officers, whose duties are considered technical, so more educated police officers are often deployed to perform them. The fact that all respondents were literate, with more than half (57.9%) having completed a diploma or higher, suggests that they were conversant with the research questions and adequately responded to them.

4.3 Impact of CCTV Monitoring on Outcomes of Police Operations

This section provides the results of the first specific objective of the study, which was to establish the impact of CCTV monitoring on the outcomes of police operations in Nairobi City County, Kenya. The specific objective was accomplished in two ways: assessing how CCTV monitoring had aided police in carrying out their operational tasks and how it had contributed to the desired outcomes of police operations. The results are presented in subsections 4.3.1 and 4.3.2.

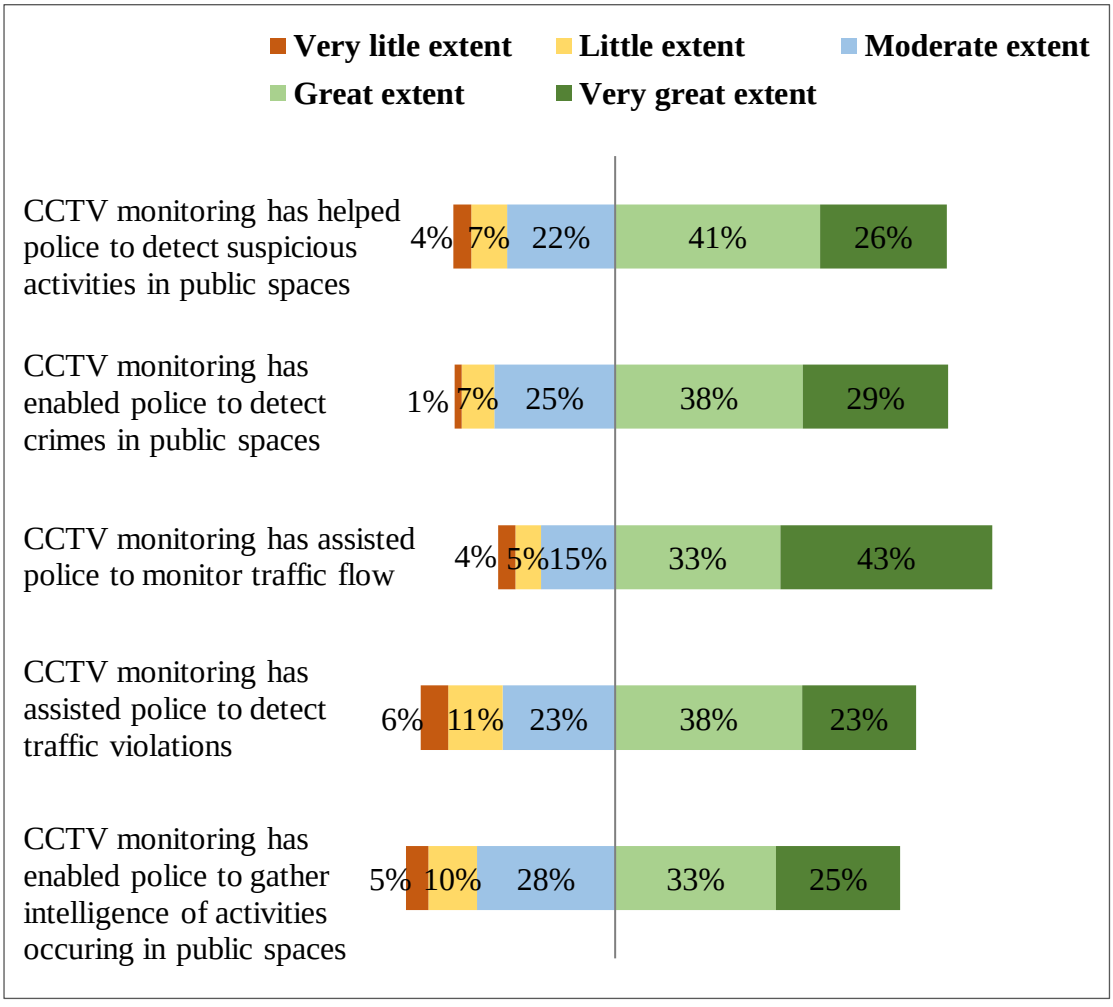
4.3.1 CCTV Monitoring and Police Operational Tasks

The effect of CCTV monitoring on police operational tasks was determined based on five surveillance tasks: detecting suspicious activities, detecting crime, monitoring

traffic flow, detecting traffic violations, and gathering intelligence. The responses were both in narratives and numerical form. The numerical responses were captured using a five-point Likert scale with responses ranging from 1 (*very little extent)* to 5 (*very great extent*). Responses 4 and 5 indicated that CCTV greatly benefits police operations, while responses 1, 2 and 3 indicated it does not. Figure 4.7 shows the results of the quantitative analysis.

Figure 4.7

Respondents' views on the extent to which CCTV monitoring has helped police perform operational tasks



Source: Field Data (2021)

Figure 4.7 shows that over two-thirds of respondents (67%) felt that CCTV monitoring has greatly helped police detect suspicious activities in public spaces. A similar proportion (67%) also said it has greatly helped police in detecting crimes, and nearly two-thirds (61%) said it has greatly helped police in detecting traffic violations. These findings suggest that CCTV is an effective tool for detecting incidents that may require police action. The findings corroborate those of other studies, such as Eggarsasi and Sa'diyah (2018) and Weisburd and Majmundar (2018). These studies found that installing CCTV in an area improves the capabilities of the police to detect crime, traffic violations, and suspicious activity.

Figure 4.7 also shows that over three-quarters (76%) of respondents felt that CCTV monitoring has greatly aided police in keeping track of traffic flow. Notably, this task received the highest rating among the five surveillance tasks, suggesting that police extensively used CCTV in traffic enforcement. The highest rating also reflected the uneven distribution of police CCTV cameras in Nairobi County. Many were on major roads, suggesting they were mainly deployed for traffic surveillance and vehicle-related crime investigations. These findings indicate that CCTV has greatly improved police traffic surveillance, resulting in more efficient traffic management. The findings corroborate prior research indicating that CCTV is significantly helpful when the camera density and coverage are high and adequate (Piza et al., 2019; Morgan & Coughlan, 2018; Ashby, 2017; Welsh & Farrington, 2009).

Figure 4.7 further shows that 58 per cent of respondents stated that CCTV has greatly aided police in gathering intelligence on activities occurring in public spaces. This suggests that CCTV has helped police intelligence gathering efforts, such as allowing them to gather intelligence around the clock, in a less obtrusive manner, and when there

are no operational officers, such as at night. These findings support Quarshie's (2014) observation that CCTV can significantly aid police in gathering criminal intelligence remotely rather than involving personnel in long-term operational surveillance. However, the lowest rating for intelligence gathering among the five surveillance tasks suggests that police rarely proactively used CCTV to manage crime and other incidents. This could be due to various factors such as discretion, resource constraints, or difficulty processing and interpreting vast amounts of CCTV data. These findings concur with those of Agarwal et al. (2018) and Piza et al. (2015), who found that police use CCTV as a reactive rather than a proactive tool in their operations.

The qualitative data agreed with the quantitative data that CCTV had greatly improved police surveillance tasks. They revealed that CCTV monitoring has helped the police detect crimes and suspicious activities as they developed by providing them with real-time information, allowing them to respond appropriately. A key informant stated:

> *The cameras have greatly improved our ability to see the actual situation on the ground. They've made it possible to monitor people's behaviour in public places and detect criminal activity that would otherwise go unnoticed. Whenever the officers at the command centre see illegal assemblies or suspicious characters and activities on CCTV, they usually radio patrol officers or the police station closest to the scene to respond immediately (KIF04, 2021).*

A FGD participant also said:

> *They've [CCTV cameras] provided a broader look at what is going on the ground on a 24/7 basis. They have assisted a lot in detecting crimes and traffic accidents by observing the unusual from the usual events. For example, when overcrowding, commotion, or smoke is detected, officers are usually dispatched to investigate and manage them promptly if they need any police action. Also, officers on the ground often call the command centre to be apprised about the occurrences in their areas (PTA01, 2021).*

These quotes show that CCTV has given the police a bird's eye view of many events in Nairobi County in real time, particularly those requiring their attention. This level of monitoring would not have been possible using other methods, such as police patrols. The quotes also show that the police have detected more crimes since the introduction of the CCTV system, some of which may have gone unknown. These findings suggest that CCTV monitoring has enabled police in Nairobi County to observe public spaces in real-time, improving their ability to identify criminal and suspicious activity. The findings are consistent with those of Piza et al. (2019), Alabi (2018) and Isnard (2001), who found that CCTV monitoring allows police and other security officers to discover more incidents than they would have otherwise.

The above quotes further reveal that CCTV monitoring has allowed the police to patrol Nairobi County virtually. This means that police officers could remotely monitor and assess happenings across the county from the command centre without being physically present. They could then respond to suspicious activity or incidents in real-time. The officers at the command centre could have successfully conducted virtual patrols because they were trained and experienced police officers. Hence, they could spot and determine suspicious persons, vehicles and activities requiring immediate police response. These findings do not mean that CCTV has replaced the need for patrol officers to investigate suspicious circumstances in CCTV-monitored areas. In fact, patrol officers were essential in investigating suspicious activities that could not be adequately discerned using CCTV, such as unusual sounds and abandoned items. The following FGD participant's remarks illustrate this point:

> *These [CCTV] cameras don't record audio. So, an officer needs to be sent to physically enquire about suspicious crowds and things spotted on the cameras that cannot be fully understood (PTA02, 2021).*

The above quote attests that CCTV monitoring has not replaced the role of patrol officers in incident detection and verification in CCTV-covered areas of Nairobi County. Instead, it has augmented their role, particularly in assessing unclear or dynamic situations. This finding suggests that CCTV monitoring has aided patrol officers in performing their duties more effectively by providing additional information and tools. Prior studies from the UK and Canada (Covoukian, 2008; Goold, 2004) have also found that CCTV cameras do not replace officers on the ground but are part of a broader strategy for supplementing traditional policing methods, such as patrols, emergency response, criminal investigations and community policing.

Regarding traffic management, the qualitative data revealed that CCTV monitoring has greatly helped the police track traffic flow, assess road conditions, and coordinate enforcement actions. This was because the cameras were strategically installed in locations prone to traffic congestion, such as road junctions, underpasses and bridges. This allowed the police to remotely monitor the situation on roads in real-time and direct officers on the ground to intervene when necessary. A FGD participant said:

> *We [police] extensively use CCTV cameras on the roads to manage traffic, especially in the evenings. I can say that they've been so beneficial as they have helped us monitor traffic flow, identify areas with congestion, overlapping, and other traffic problems, and dispatch officers to address them quickly (PTC03, 2021).*

Some studies from other countries have also found that CCTV monitoring improves traffic enforcement. For example, Grabowski and Czyewsk (2020) found in Poland that installing CCTV cameras on roads greatly assists police in identifying and managing traffic problems, such as slippery roads in different lighting and weather conditions. Similarly, Eggarsasi and Sa'diyah (2018) discovered in an Indonesian study that CCTV

monitoring can help police obtain timely and accurate information on traffic conditions, such as the flow of traffic, the number of vehicles on the road and the location of traffic accidents, which can help in the development of strategies to reduce congestion and improve traffic efficiency.

Concerning intelligence collection, qualitative data revealed that CCTV monitoring has helped the police identify crime-prone areas, understand how criminals operate, and identify habitual criminals and common crimes in specific locations and times. This has allowed the police to develop strategies to manage them. A discussant in a FGD said:

> *The [CCTV] cameras have helped us [police] detect crimes committed in specific locations and times by persons of specific genders and age brackets. They've also helped us understand the modus operandi of criminals and even physically identified some of them. This has enabled us to focus our strategies on crime hotspots and keep an eye on the known suspects (PTB03, 2021).*

The study found that police could understand recurring patterns in criminal activity and public disorder by reviewing CCTV data on a daily, weekly and monthly basis. This data comprised CCTV footage, daily reports and activity logs kept by CCTV operators during their shifts. As Kerr (2009) and Ratcliffe (2006) note, CCTV data can provide a wealth of information about people or vehicles who visited a location over a specific period. This information can include their facial features, clothing and other distinguishing features like tattoos and scars, the time and number of their visits, the nature of their activities, or the colour and license plate numbers of the vehicles they used. As exemplified in the above quote, the analysis of CCTV data has allowed the police to predict crime, public disturbances, and other incidents and devise strategies to prevent them from happening. The analysis of CCTV footage has also provided police with much information on crime and incidents, allowing them to identify and stop

criminals in their tracks and remove habitual criminals from public spaces. These findings support the observations of Ratcliffe (2011), Moyo (2019), and Ngwenya (2012) that CCTV monitoring can help police understand their jurisdiction better, strategically deploy officers, prevent crimes, and counteract criminal activity in crime hotspots. Figure 4.8 shows an example of police officers analysing CCTV footage at the command centre.

Figure 4.8

A photo of police officers analysing CCTV footage at the IC3

Source: NPS (2018)

4.3.2 CCTV Monitoring and Outcomes of Police Operations

A binary logistic regression model was used to examine the relationship between CCTV monitoring and five outcomes of police operations: crime reduction, quick response to incidents, improved road safety, enhanced safety of police officers and reduction in operational costs. The five outcomes were each entered separately as outcome variables into a multiple-binary regression model. The three independent variables in the study (use of CCTV to monitor activities in public spaces, coordinate responses to incidents,

and investigate crime) were separately combined into composite indices and used as predictors in the regression model. Following Fernandes et al.'s (2020) recommendation, the researcher used a confidence interval level of 95 per cent and an alpha level of .05 to determine the statistical significance of all tests. The data for the independent variables were checked for multicollinearity using Variance Inflation Factors (VIF) and tolerance values, as suggested by Daud (2017), before being entered into the model. Table 4.1 shows the results of the multicollinearity tests.

Table 4.1

Results of multicollinearity tests

Predictor variables	**Collinearity Statistics**		**Interpretation**
	Tolerance	**VIF**	
Use of CCTV to monitor public spaces	.596	1.678	No multicollinearity
Use of CCTV to coordinate responses to incidents	.617	1.620	No multicollinearity
Use of CCTV to investigate crime	.487	2.052	No multicollinearity

Source: Field Data (2021)

Table 4.1 shows that the VIF values for all three independent variables are below 10, indicating that multicollinearity is not an issue in this study. The tolerance values are all above 0.1, which also suggests that multicollinearity is not a problem. As a result, the regression model used the three independent variables as predictors. The below subsubsections present the multiple binary regression analyses for each of the five predetermined outcomes of police operations as outcome variables.

4.3.2.1 CCTV monitoring and crime reduction

Table 4.2 summarises the results of a multiple binary logistic regression model with crime reduction as the outcome variable of interest. The predictor variables in the model are the use of CCTV to monitor activities in public spaces (CCTV_MON), coordinate responses to incidents (CCTV_RES) and investigate crime (CCTV_INV). The table shows the regression coefficients (B), the standard errors (SE), the Wald statistic (Wald), the degrees of freedom (df), the *p*-values, the odds ratio ((Exp (B)) and the associated confidence intervals (CI) for each predictor variable in the model. The table also provides model fit information from 347 cases.

Table 4.2

Regression results with crime reduction as the outcome variable

Model	Variables	B	SE	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
								Lower	Upper
1	CCTV_MON	.713*	.197	13.137	1	.000	2.040	1.387	2.999
	CCTV_RES	.256	.192	1.776	1	.183	1.292	.887	1.882
	CCTV_INV	.608*	.198	9.419	1	.002	1.837	1.246	2.709
	(Constant)	-5.561	.811	47.032	1	.000	.004		

Number of observations (N) = 347 Overall Percentage = 70.0%

Nagelkerke R^2 = .251

Omnibus Tests of Model Coefficients: χ^2 = 71.392, df = 3, Sig. = .000

Hosmer and Lemeshow Test: χ^2 = 4.887, df = 8, Sig. = .770

* $p < .01$

Source: Field Data (2021)

Table 4.2 shows that the overall logistic regression model is statistically significant (χ^2 (3, N = 347) = 71.392, p = .000), indicating that the independent variables

(CCTV_MON, CCTV_RES, and CCTV_INV) are significantly related to the dependent variable (crime reduction). The Nagelkerke R^2 of .251 indicates that independent variables explain 25 per cent of the variation in crime reduction, meaning that other variables not included in the model explain the remaining 75 per cent of the variation. The finding is plausible because other crime reduction strategies, such as lighting, private security and community policing, existed in many areas under CCTV monitoring at the time of the study. The HL test is non-significant (p =.770), indicating that the model fits the data well and is not overfitting. The model correctly predicts 70 per cent of cases, so it can be used to predict crime reduction with some accuracy.

Regarding CCTV monitoring, Table 4.2 shows a statistically significant (p =.000) and positive association with crime reduction (b = 0.713). This implies that increased use of CCTV in monitoring public spaces leads to increased crime reduction. The OR of 2.040 (95% CI, 1.387–2.999) indicates that CCTV monitoring increases the odds of crime reduction by 2.04 times, with a 95 per cent probability that the true effect is between 1.387 and 2.999 times. This is a large effect size, which suggests that CCTV monitoring is an effective crime-reduction strategy. These findings agree with a study by La Vigne et al. (2011b) in Baltimore and Chicago, which found a statistically significant link between CCTV monitoring and crime reduction. However, they differ from the findings of King et al. (2008) in San Francisco, California, USA, which found no statistically significant change in crime rates. These contrasting findings suggest that the effect of CCTV monitoring in reducing crime may vary depending on its implementation environment.

Key informants and FGD participants confirmed that crime had decreased in the CCTV-monitored areas. They believed that the increased risk of detection and arrest discouraged offenders from committing crimes. A key informant said:

> *Since their installation, the CCTVs have brought a lot of calm and peace to Nairobi County. Most criminal elements are aware that the cameras are the eyes of the police, so they avoid indulging in criminal acts in front of the cameras, as they know that police can notice their activities and apprehend them (KIF03, 2021).*

The finding that criminals avoided committing crimes in CCTV-monitored areas supports RCT's assertion that criminals are less likely to offend if they believe they are being watched or can be caught because the crime's risk outweighs its benefits. The finding also supports van Sintemaartensdijk et al.'s (2021) and RAT's claim that criminals find places with guardians less appealing for committing crimes.

Equally, the finding that crime commissions had reduced in CCTV-monitored areas is supported by the police crime data for 2019, which shows that recorded crime in Nairobi County declined by 4.1 per cent in 2018 after CCTV was implemented (NPS, 2019b). The finding also corroborates Priks's (2015) finding, which indicates that crime levels in Stockholm's subway stations declined by 25 per cent after CCTV cameras were installed in 2006. However, this study's finding contradicts those of Gill and Spriggs (2005), who established an insignificant reduction in crime in areas under CCTV surveillance in the UK. These contradictory findings may be due to contextual factors influencing how well CCTV reduces crime in different places.

4.3.2.2 CCTV monitoring and quick response to incidents

Table 4.3 displays the results of regression analysis with quick response to incidents as the outcome variable and the use of CCTV to monitor activities in public spaces (CCTV_MON), coordinate responses to incidents (CCTV_RES) and investigate crime (CCTV_INV) as the predictor variables.

Table 4.3

Regression results with response time as the outcome variable

Model	Variables	B	SE	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
								Lower	Upper
1	CCTV_MON	.901*	.210	18.402	1	.000	2.463	1.632	3.718
	CCTV_RES	.734	.210	12.223	1	.183	2.083	1.381	3.144
	CCTV_INV	.113	.209	.292	1	.589	1.120	.743	1.688
	(Constant)	-5.526	.885	47.032	1	.000	.004		

Number of observations (N) = 347 Overall percentage = 76.7%

Nagelkerke R^2 = .306

Omnibus Tests of Model Coefficients: χ^2 = 84.019, df = 3, Sig. = .000

HL Test: χ^2 = 4.425, df = 8, Sig. = .817

*Significant at $p < .01$

Source: Field Data (2021)

The regression results in Table 4.3 show that the overall regression model is statistically significant at the 0.05 level of significance (χ^2 (3, N = 347) = 84.019, p = .000). This means that the predictor variables (CCTV_MON, CCTV_RES, CCTV_INV) and the outcome variable (response time) are significantly related. The model also correctly categorised 77 per cent of cases, suggesting that it correctly predicts police response time in 77 per cent of cases. The model also explains 31 per cent (Nagelkerke R^2) of

the variation in response time, meaning that other factors not included in the model explain the remaining 69 per cent. The HL test is non-significant (p =.817), indicating that the model fits the data perfectly. CCTV monitoring is positively and statistically correlated with response time (b =.901, p =.000), implying that increased CCTV monitoring is associated with faster police response times. The OR of 2.463 (95 % CI of 1.632–3.718) means that with each increased level of CCTV monitoring, the odds of police response time increase by 2.5 if everything else remains constant. The findings suggest that CCTV monitoring can be an effective way to improve police response time.

The results from the FGDs and the key informant interviews were mixed. Some participants felt that CCTV monitoring had improved incident response time, while others did not. Those who felt that response time had improved said that CCTV monitoring has helped the police to detect, track and respond to incidents in real-time. This was because the officers at the command centre could continuously monitor public spaces and alert their colleagues in the field to incidents as soon as they were detected. A key informant said:

> *Officers at the command centre [IC3] often use the radio to communicate suspicious occurrences detected on CCTV to the nearest patrol officers or police stations. Working this way has allowed them [patrol officers and stations] to respond quickly to incidents (KIF01, 2021).*

On the other hand, participants who felt that response time to incidents had not improved reported that police rarely responded to incidents detected on CCTV. They attributed this to a strained working relationship between police officers who monitor the cameras and those on the ground. A key informant said:

> *It would be best if you asked me questions about the operations of the cameras and the CCTV system. Officers on the ground are better placed to talk about*

> *their effectiveness. They are the ones who use CCTV data and know whether it aids their operations or not (KIF02, 2021).*

Likewise, an FGD discussant performing patrols lamented:

> *The cameras are well-placed, but I think the people monitoring them are not using them correctly. I say so because sometimes, when walking in the streets of Nairobi, I have seen people committing crimes in the glare of the cameras, but no action is taken against them. This [lack of response] must be due to a communication breakdown between officers operating the cameras and those on the ground. If the cameras are well utilised, they can significantly help reduce crime (PTB01, 2021).*

A FGD participant attached to the command centre countered:

> *We [IC3 officers] can spot a wanted vehicle or criminal, but taking action requires the honesty and cooperation of the officer on the ground. We're often accused of not doing enough to detect incidents and alert officers on the ground to respond to them, but this is not true. We always contact them, but they occasionally do not respond. Not only that, even when they respond, they sometimes let go of suspects or wanted vehicles, possibly after cutting deals with them. So you can see that the successful use of the cameras depends on both the human behind them and the one on the ground. If everyone is honest and faithful to their calling, the cameras can be a superb way of curbing crime (PTA04, 2021).*

These quotes illustrate how the strained working relationship between the two groups of police officers made it difficult for them to work together and respond to incidents quickly. Neither group was interested in finding out whether the cameras aided police operations or working together. This lack of interest stemmed, in part, from their differing priorities. For instance, officers on operational duties often disregarded CCTV command centre notifications, perceiving them as micromanagement and a limitation on their discretion. As per the quotes, the strained working relationship between the two groups of police officers had created some level of mistrust, making it difficult for either group to cooperate or trust that the other would assist in the event of an incident.

This mistrust raised concerns because, if not addressed, it could lead to serious consequences, such as hindering the officers' ability to share information, coordinate their efforts, and provide services. These findings support prior research indicating that the relationship between CCTV users significantly impacts police response times and the successful management of CCTV-detected incidents (Moyo, 2019; Keval, 2009; Levesley & Martin, 2005). The findings also support RAT's claim that guardians are ineffective when unwilling to intervene when needed (Reynald et al., 2018).

Despite the poor coordination between police officers in the field and those operating CCTV, it is evident that CCTV monitoring has enabled the police to discover and respond to some incidents, even before the members of the public reported them. Undoubtedly, this would have been impossible without CCTV. Therefore, the study concludes that CCTV monitoring has enabled the police to respond quickly and proactively to some incidents in the areas under CCTV surveillance. This study's findings support Piza et al.'s (2017) and Ratcliffe's (2006) observations that CCTV monitoring can help police respond to incidents more quickly.

4.3.2.3 CCTV monitoring and road safety

Table 4.4 displays the results of a multiple binary regression model with road safety as the outcome variable. The predictor variables in the model are the use of CCTV to monitor public spaces (CCTV_MON), coordinate responses to incidents (CCTV_RES) and investigate crime (CCTV_INV).

Table 4.4

Regression results with road safety as the outcome variable

Model	Variables	B	SE	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
								Lower	Upper
1	CCTV_MON	.622*	.198	9.913	1	.002	1.862	1.265	2.743
	CCTV_RES	.528*	.197	7.225	1	.007	1.696	1.154	2.493
	CCTV_INV	.612*	.203	9.043	1	.003	1.844	1.237	2.747
	(Constant)	-6.209	.858	52.402	1	.000	.002		

Number of observations (N) = 347 Overall percentage = 69.7%

Nagelkerke R^2 = .295

Omnibus Tests of Model Coefficients: χ^2 = 83.313, df = 3, Sig. = .000

HL Test: χ^2 = 5.159, df = 8, Sig. = .740

* $p < .01$

Source: Field Data (2021)

Table 4.4 shows that the overall regression model is statistically significant (χ^2 (3, N = 347) = 83.313, p =.000) and fits the data well (HL test $p > .05$). This means that the model's predictor variables are significantly related to the outcome variable (road safety). The model accurately classifies 70 per cent of the cases, implying that it can correctly predict road safety enhancement 70 per cent of the time. The model also accounts for 30 per cent of the variation in road safety enhancement (Nagelkerke R^2 =.295), implying that the remaining 70 per cent is most likely due to other factors. The relationship between CCTV monitoring and road safety is positive and statistically significant (b = .622, p = .002), implying that CCTV-monitored areas are more likely to have better road safety. The OR for CCTV monitoring is 1.862 (95% CI 1.265-2.743), which means that CCTV monitoring increases the odds of road safety

enhancement by 86.2 per cent (1.862 - 1 = 0.862). In other words, an area with CCTV monitoring is 86.2 per cent more likely to have good road safety.

The qualitative data supported the findings of the regression analysis. They showed that CCTV monitoring has helped police to detect and manage traffic congestion and hazardous road conditions more quickly, lowering the risk of road accidents. They also showed that CCTV monitoring had helped the police to detect and respond to road accidents more quickly, which helped reduce the severity of injuries and the risk of death. Qualitative data further showed that CCTV monitoring had increased road users' adherence to traffic rules, which led to fewer accidents. A key informant said:

> *The CCTV cameras have been beneficial to us [police] in detecting and responding to road congestion, obstructions, hazards and accidents. They have also helped us identify and apprehend extreme traffic violators who used to get away with their crimes. This has made drivers and pedestrians more cautious about breaking the law, as they know the police can detect, trace and arrest them. As a result, traffic accidents have significantly decreased in areas with cameras (KIF02, 2021).*

The above quote indicates that CCTV has helped the police monitor traffic in real-time and manage various factors that may lead to road accidents, such as congestion and unsafe driving. It also suggests that the police CCTV cameras may have served as a visual reminder to road users that they were under surveillance and could be arrested for breaking traffic laws. Consequently, road users, particularly drivers, avoided violating traffic laws in CCTV-monitored areas, leading to fewer road accidents. This finding supports RCT's assertion that criminals avoid offending when the risks of doing so are high. The finding also supports prior research, which suggests that installing CCTV cameras on roads can make drivers obey speed limits, resulting in fewer road accidents, injuries and fatalities (Tang, 2017; Wilson et al., 2010; Kammerer, 2009).

Tang (2017) estimates that installing 1000 cameras on roads can reduce around 1130 road accidents and avert 330 serious injuries, saving about 190 lives per year.

4.3.2.4 CCTV monitoring and police officers' safety

Table 4.5 presents the regression results with police officers' safety as the outcome variable and the use of CCTV to monitor public spaces (CCTV_MON), coordinate incident responses (CCTV_RES) and investigate crime (CCTV_INV) as predictors.

Table 4.5

Regression results with police officers' safety as the outcome variable

Model	Variables	B	SE	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
								Lower	Upper
1	CCTV_MON	.678*	.202	11.253	1	.001	1.970	1.326	2.928
	CCTV_RES	.547*	.203	7.273	1	.007	1.728	1.161	2.570
	CCTV_INV	.575*	.208	7.605	1	.006	1.777	1.181	2.674
	(Constant)	-6.791	.876	60.160	1	.000	.001		

Number of observations (N) = 347 Overall percentage = 70.3%
Nagelkerke R^2 = .305 HL Test: χ^2 = 8.513, df = 8, Sig. = .385
Omnibus Tests of Model Coefficients: χ^2 = 90.187, df = 3, Sig. = .000

* $p < .01$
Source: Field Data (2021)

Table 4.5 shows that the overall regression model is statistically significant ($\chi^2(3, N = 347) = 90.187$, $p = .000$), meaning that the independent variables (CCTV_MON, CCTV_RES, and CCTV_INV) have a significant impact on the outcome variable (police officers' safety). The model also correctly classifies 70 per cent of cases, meaning it accurately predicts police officers' safety. The HL test is statistically non-

significant (p = .385), indicating that the model does not overfit or underfit the data. The Nagelkerke R^2 of .305 indicates that the model explains 31 per cent of the variance in police officers' safety but cannot explain the remaining 69 per cent, likely due to other factors. Such factors can include the type of crime, crime rate, time of day, resources, training, and political and social factors.

Table 4.5 also shows that CCTV monitoring is statistically significant and positively associated with police officers' safety (b = .678, p = .001), meaning that CCTV monitoring increases police officers' safety when performing operational duties. The OR of 1.970 (95% CI 1.326–2.928) indicates that CCTV monitoring increases the odds of police officers being safe by 1.97 times. This finding contradicts the results of a UK study by Gill and Spriggs (2005), which found no such association between CCTV monitoring and the general public's safety in the UK. The divergence in findings suggests that CCTV monitoring's impacts on perceived safety may differ between police officers and the members of the public. Several factors might explain this discrepancy. Police officers, attuned to the realities of crime due to their profession (Pew Research Centre, 2017), might be more likely to notice CCTV cameras and trust their effectiveness in deterring crime. This heightened awareness and trust, coupled with their firsthand experiences, could contribute to their feeling safer in CCTV-monitored areas, even if the members of the general public do not feel any safer.

Key informants and FGD participants confirmed that police officers felt safer in CCTV-monitored areas because CCTV operators could warn them about dangers in their working environment, such as suspicious activity, vehicles or persons. This warning allowed them to take the necessary precautions. A FGD participant said:

> *Controlling traffic in the city [Nairobi] is not easy and is sometimes very risky. For example, an unruly matatu crew may assault you out of a misunderstanding, or a speeding vehicle can knock you down or run you over, injuring you severely or fatally. Because of such risks, I feel safe controlling traffic in areas with cameras. The controller [at the IC3] can inform you of what is going on around your beat area so that you can exercise caution. Also, in case of any eventuality or something terrible happens to you, the CCTV recordings will allow IOs to quickly follow up on the matter (PTC01, 2021).*

A key informant also said:

> *The control [IC3] often reports suspicious characters and vehicles to the officers on the ground over the radio when captured on CCTV. Through such reports, officers on the ground become alert of potential threats and cautiously approach any vehicle or person that matches the communicated descriptions (KIF04, 2021).*

These quotes suggest that CCTV has helped police officers stay safe when performing operational duties by giving them extra ways to see what is happening around them and understand the situation. This has reduced the chances of them being caught off guard. These findings are consistent with those of Pang and Pavlou (2019), who found that police use of information technologies (IT) can significantly improve police officers' safety in the field. IT can improve officers' situational awareness by providing real-time data, predictive insights and communication capabilities, which is especially important in life-threatening situations.

The above quotes also suggest that CCTV cameras in public places have helped to protect police officers on operational duty from being harmed by criminals. They did this by signalling to criminals that their actions were being monitored and that they would be quickly apprehended if they attacked police officers. As a result, police officers on operational duty felt safer in such areas. This finding supports RAT's suggestion that criminals are less likely to harm targets if guardians are present. This is

because guardians raise the perceived risk of arrest for potential criminals (van Sintemaartensdijk et al., 2021). The finding also aligns with those of Malmenbratt and Brooks (2015) and La Vigne et al. (2011a), which show that CCTV monitoring increases perceptions of safety for police officers while carrying out their duties. The finding further echoes Goold's (2004) and Brown's (1995) findings, which suggest that using CCTV in policing can significantly reduce the number of assaults and killings of police officers in the field. However, this study's findings disagree with those of Levesley and Martin (2005), who found that CCTV does not affect police officers' feelings of safety. The contrasting findings suggest that the impact of CCTV on safety feelings may differ based on context.

4.3.2.5 CCTV monitoring and police operations costs

Table 4.6 reports the results of a regression analysis to determine whether the use of CCTV has reduced the costs of police operations in Nairobi City County, Kenya. The independent variables in the model are the use of CCTV to monitor activities in public spaces (CCTV_MON), coordinate responses to incidents (CCTV_RES), and investigate crime (CCTV_INV).

Table 4.6

Regression results with the cost of police operations as the outcome variable

Model	Variables	B	SE	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
								Lower	Upper
1	CCTV_MON	.578*	.198	8.557	1	.003	1.783	1.210	2.627
	CCTV_RES	.181	.193	.878	1	.349	1.198	.821	1.750
	CCTV_INV	.634*	.202	9.846	1	.002	1.884	1.268	2.799
	(Constant)	-5.503	.795	47.869	1	.000	.004		

Number of observations (N) = 347 Overall Percentage = 68.9%

Nagelkerke R^2 = .208

Omnibus Tests of Model Coefficients: χ^2 = 58.861, df = 3, Sig. = .000

HL Test: χ^2 = 4.500, df = 8, Sig. = .809

* $p < .01$

Source: Field Data (2021)

Table 4.6 shows that the overall regression model is statistically significant ($\chi^2(3, N = 347) = 58.861$, $p < .05$), meaning that the relationship between the three study's independent variables and the outcome variable (police operations costs) is not due to chance. The model also fits the data well (the *p*-value for the HL test is greater than .05) and correctly classifies 69 per cent of cases, meaning it can reliably predict reductions in police operation costs. However, it only explains 21 per cent (Nagelkerke R^2 = .208) of the cost variation, leaving 79 per cent unexplained. This points to other important factors, like crime rates, officer training, resources, and community policing, that likely significantly influence police operation costs.

Table 4.6 further shows that CCTV monitoring is statistically significant (p = .003) and positively associated with a reduction in police operations costs (b = .578). This implies that the more CCTV monitoring is used, the more likely police operations costs will decrease. The OR of 1.783 (95% CI 1.210 – 2.627) means that CCTV monitoring increases the odds of reducing the cost of police operations by 1.8 times. This is likely because one functional CCTV camera can provide 24-hour uninterrupted surveillance without getting tired, which would require several police officers to do. A FGD participant affirmed this by stating:

> *The cameras are another pair of eyes for the police in the county. They help know where crimes occur at a given time and deploy officers there. Also, when officers patrol roads and streets without CCTVs, the cameras help capture events on the other side (PTC05, 2021).*

Similarly, a key informant remarked:

> *I don't know how the police could have managed to secure the whole county without the CCTV cameras. There are many places to patrol and crowds to watch, yet few officers at the IC3 can keep track of everything at once. CCTV cameras are like an ever-present police officer. So long as they're serviceable, they're present around the clock and can't fail to record anything in their field of view. They've helped us [the police] accomplish much with few resources (KIF05, 2021).*

The above quotes suggest that CCTV monitoring has enabled the police to use their resources more efficiently. Instead of randomly deploying officers and other resources across the county, the police can now concentrate their efforts in areas with no cameras or high crime rates. This has allowed them to use their limited resources more effectively and reduce operational costs. These findings support the claims of Harris and Harris (2009) and Levesley and Martin (2005) that CCTV cameras can supplement police numbers while also lowering the cost of police operations.

Additionally, key informants reported that CCTV monitoring has greatly lowered the cost of supervising officers on operational duties. They explained that before the CCTV cameras were installed, police commanders relied on radio communications and physical supervision to check whether their subordinates were performing operational duties appropriately. They said that these modes of supervision were ineffective because they consumed a lot of time and fuel, put a lot of wear and tear on police vehicles, and allowed some junior officers to lie about their whereabouts. Beyond saving on supervision costs, key informants reported that CCTV monitoring has also reduced the cost of managing police misconduct. This was because police commanders could use CCTV footage to identify and reprimand subordinates who engaged in misconduct, consequently leading to a significant drop in such incidents in monitored areas. A key informant commented on this, saying:

> *The CCTV cameras have provided another means of supervising officers on the ground. Before we had them, duty officers had to move around in vehicles to see if their subordinates were in their respective places of duty. These days, they mostly go to the control centre [the IC3] to check whether their juniors are in their respective work areas. This has reduced the wear and tear of police vehicles and fuel costs. Additionally, the cameras have helped to minimise misbehaviour among police officers while on duty and case cover-ups. In fact, officers caught on camera engaging in wrongdoing have faced disciplinary action (KIF03, 2021).*

The above quote underscores CCTV monitoring's role in reducing the cost of police operations, specifically by minimising patrol expenses and addressing police misconduct. Additionally, the earlier finding that CCTV monitoring aided in crime reduction implies that police used fewer resources to manage crime in the county. These observations align with existing research demonstrating the cost-effectiveness of CCTV in police operations, particularly in crime management (Munyo & Rossi, 2020; Welsh et al., 2015; Lin & van Gulijk, 2014; Levesley & Martin, 2005). Overall, the

study findings suggest that CCTV monitoring has benefited police operations in Nairobi City County, mainly in the few CCTV-covered areas. Hence, expanding CCTV coverage to more areas could further realise these benefits.

4.4 Impact of the Use of CCTV to Coordinate Incident Responses on Outcomes of Police Operations

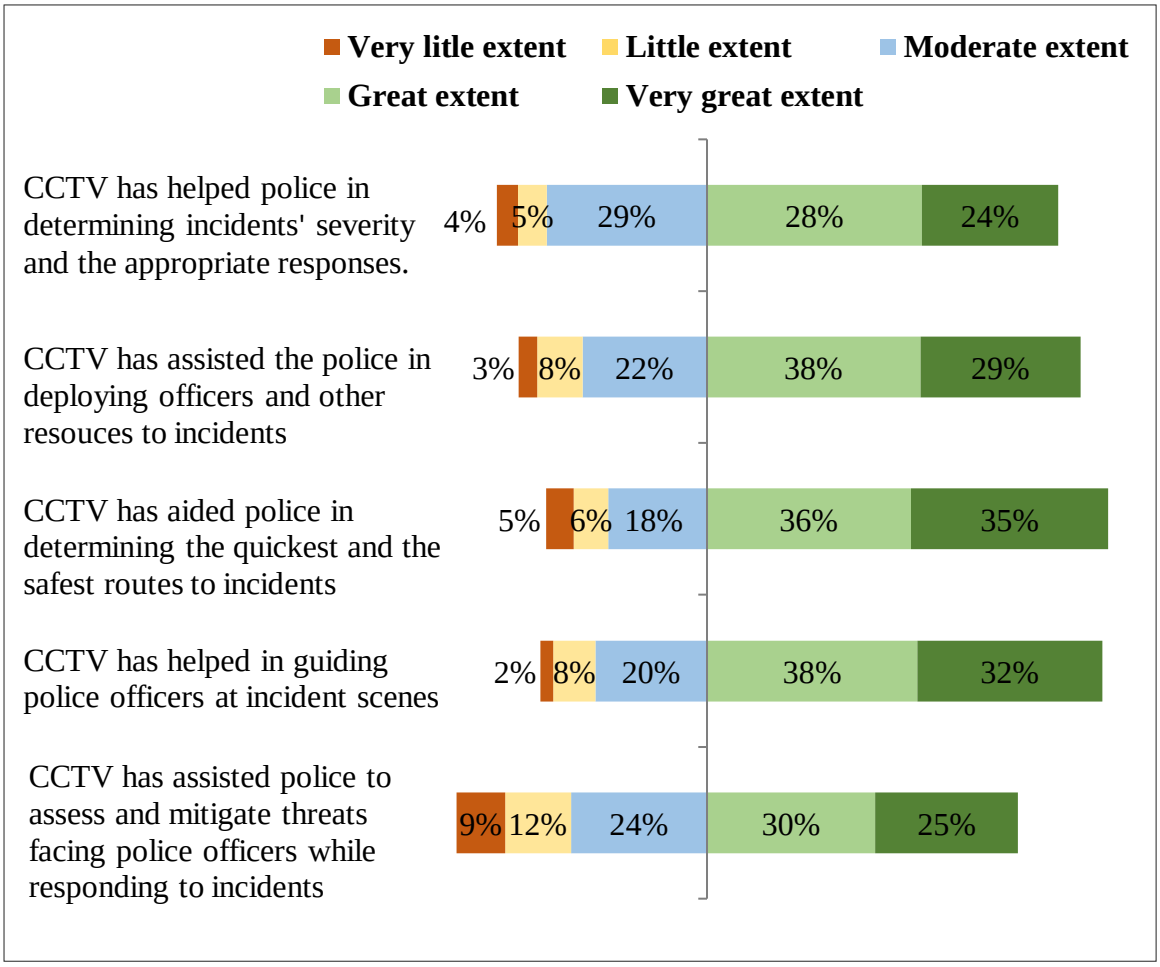
This section provides the results of the second specific objective of this study, which was to investigate the impact of the use of CCTV to coordinate responses to incidents on police operations outcomes in Nairobi City County, Kenya. The specific objective focused on establishing the extent to which CCTV has helped police coordinate incident responses and achieve the desired outcomes. The reviewed studies showed that the use of CCTV in coordinating incident responses can significantly help the police perform five incident response tasks. These included assessing incidents' severity and appropriate responses, deploying officers and other resources, determining the quickest and safest response routes, guiding responding officers at incident scenes, and assessing and mitigating threats facing them. Therefore, the study endeavoured to determine how much CCTV had assisted the police in Nairobi City County in carrying out these operational tasks and achieving the desired outcomes. The findings are presented in subsections 4.4.1 and 4.4.2 using qualitative and quantitative methodologies.

4.4.1 Use of CCTV to Coordinate Responses to Incidents

Figure 4.9 summarises respondents' views on the extent to which CCTV has helped the police coordinate responses to incidents.

Figure 4.9

Respondents' perceptions on the extent to which CCTV has helped police coordinate responses to incidents



Source*:* Field Data (2021)

Figure 4.9 shows that most respondents believe that CCTV has significantly assisted police in coordinating their responses to incidents. Over half (52%) said it has greatly aided police in determining the severity of incidents and the appropriate responses. Sixty-seven and 71 per cent also indicated that it has greatly assisted police in deploying resources to incidents and determining the quickest and safest response routes. This suggests that CCTV has been helpful to police in making better decisions about how to allocate incident response resources, such as the number of officers and equipment to

send to a scene, the mode of transportation (vehicle or foot), and the best route to take in order to arrive at an incident as quickly and safely as possible. Moreover, 70 per cent said CCTV has been greatly helpful for police in guiding responding officers when managing incidents, and 55 per cent said it has been greatly helpful in assessing and mitigating threats facing them. This means that CCTV footage has been helpful to police in directing officers at incident scenes and ensuring they resolve incidents safely and more efficiently. These findings echo prior studies suggesting that CCTV can significantly help police coordinate their responses to incidents (La Vigne et al., 2011a; Dean, 2009; Harris & Harris, 2009; Levesley & Martin, 2005).

The findings from key informant interviews and FGDs supported the quantitative data findings that CCTV has greatly aided the police in coordinating incident responses. The participants stated that CCTV has been beneficial to the police in identifying the exact location of incidents and directing responding officers to the scene. This means that responding officers were less likely to get lost or take a long time to find the scene of an incident in areas where CCTV cameras were installed. These findings support those of Piza et al. (2017) and La Vigne et al. (2011a), which suggest that CCTV can be used to direct police officers to the appropriate incidents. A FGD participant narrated that:

> *When an accident is reported or captured on CCTV, officers at the command centre [IC3] assess the situation and then advise officers on the ground on the roads or lanes to respond quickly. This has helped officers locate scenes even if they are unfamiliar with the location (PTC06, 2021).*

In addition to helping police locate incidents quickly and precisely, the study found that CCTV has been helpful in assessing incidents remotely, deploying appropriate responses, particularly resources and personnel, and keeping responding officers updated on happenings at the scenes. This finding means that CCTV has enabled police

to see what is happening at scenes without physically being present, allowing them to make quick and effective decisions on how to respond. It also means the response teams were better prepared for what they might encounter on the scene and could take the necessary precautions to ensure their safety and that of the general public. A FGD participant stated:

> *Officers on the ground are always given appropriate guidelines and measures to take when responding to incidents via CCTV and police radio. Such guidelines include information on the identities, positions and routes taken by the targets they are pursuing (PTA05, 2021).*

Equally, a key informant said:

> *These CCTVs have been used several times to assess scenes that require police action. They've been used to determine the seriousness of situations like riots and robberies and the number of officers needed to deal with them. The cameras help commanders understand what is happening at the scenes and send reinforcements if things aren't going well (KIF02, 2021).*

These quotes show that CCTV has helped the police to respond to incidents more quickly, safely and efficiently. This is because officers on operational duties could receive real-time updates and assistance from their colleagues at the command centre, which gave them a better understanding of the situation and allowed them to make better decisions. This has improved police officers' situational awareness and safety when managing incidents. These findings support the police's claim in 2019 that CCTV has helped coordinate various police teams to respond to incidents in Nairobi City County (NPS, 2019a). The findings also support prior studies from Ghana, the UK and the USA that show that CCTV can help police respond to incidents in a more informed, measured and safe manner (Ansong & Ofori-Dwumfuo, 2015; La Vigne et al., 2011b; Levesley & Martin, 2005).

4.4.2 Use of CCTV to Coordinate Responses to Incidents and Outcomes of Police Operations

This subsection provides results of regression analyses and qualitative data findings on how the use of CCTV to coordinate incident responses has affected police operations outcomes. The regression results are shown in Tables 4.2, 4.3, 4.4, 4.5, and 4.6.

4.4.2.1 Use of CCTV to coordinate incident responses and crime reduction

The regression results in Table 4.2 show that the use of CCTV to coordinate responses to incidents (CCTV RES) has a positive (b =.256) relationship with crime reduction. This means that using CCTV in coordinating incident responses is associated with a decrease in crime. However, the relationship is not strong enough to conclude that using CCTV in this way causes crime reduction. The qualitative data supported this finding. They revealed that the police-operated CCTV system has minimally assisted the police in coordinating responses to incidents across the county due to its limited coverage. As a result, crime commissions in areas without CCTV cameras remained high, raising the overall crime rate in the county. Additionally, qualitative data revealed that some criminals committed crimes in areas with CCTV cameras and then fled to areas without CCTV cameras, thereby limiting their chances of being apprehended as police would have difficulty tracking them down. This finding suggests that areas without CCTV cameras were safe havens for some criminals. This finding is well articulated by the below FGD participant:

> *Some criminal elements, especially those on motorcycles, commit crimes in areas with CCTV cameras and vanish to areas without cameras. This makes it difficult for us [police] to track and arrest them because cameras cannot capture their movements in areas without cameras (PTC06, 2021).*

The preceding quotes suggest that the use of CCTV by police to coordinate incident responses has caused some criminals in Nairobi City County to alter their criminal tactics, which is a form of tactical displacement. This finding suggests that criminals are aware of the limitations of the police CCTV cameras and are exploiting them to avoid capture. Andresen (2010) defines tactical displacement as a form of crime displacement that occurs when criminals change their methods of committing crimes in response to a crime prevention initiative. Criminals primarily alter their tactics to circumvent measures that hinder their objectives. This is consistent with the RCT's assertion that criminals plan their crimes to minimise their risk of detection and arrest.

Furthermore, the study found that the use of CCTV by police in coordinating responses to incidents has not led to a decrease in some crimes, particularly pickpocketing and stealing from motor vehicles. This was because the perpetrators of such crimes could conceal their activity from CCTV cameras and flee quickly after the fact. The following statements by a FGD participant illustrate this observation:

> *It's difficult to monitor and identify people with bad intentions, especially pickpockets, in a city with many people and vehicles. Pickpockets can easily blend with the crowd and prey on unsuspecting victims. Also, mobile phone snatchers hide between vehicles during traffic jams, snatch phones from their unsuspecting victims, and quickly vanish into the crowds (PTA07, 2021).*

The above quote suggests that pickpockets and phone thieves believed that they could commit crimes in crowded areas with CCTV cameras because they would be less likely to be identified and arrested. They also knew that crowds and traffic jams would obscure their activities from CCTV cameras or make it difficult for police to respond. Consequently, they committed crimes in CCTV-monitored areas without any apprehension of being caught. These findings corroborate the research by Lv et al.

(2014) and Isnard (2001), which found that CCTV has minimal impact in reducing pickpocketing and other forms of theft in crowded areas or with multiple escape routes. This is because criminals believe their crimes are least detectable in these areas and can quickly flee if discovered or pursued. The findings also support RCT's assertion that criminals are more likely to offend when they perceive a low chance of detection and arrest. The findings further align with RAT's assertion that guardians, like CCTV, have limited effectiveness when they cannot clearly observe targets. Moreover, the findings substantiate Gill and Spriggs's (2005) observation that CCTV is unlikely to deter crimes that can be committed quickly, as criminals believe they have sufficient time to avoid the cameras and flee after the fact.

On the contrary, this study's findings contradict NPS's claim that CCTV has reduced petty crimes in Nairobi County, particularly in crowded areas (NPS, 2019a). They also contradict Piza et al.'s (2019) view that CCTV can effectively reduce crime when combined with police patrols and other interventions. They are further inconsistent with the findings of Priks (2015), who found that pickpocketing decreased by 20 per cent in Stockholm's CBD, Sweden, due to the installation of CCTV cameras in its subway stations in 2006. The inconsistent findings support Basimanyane and Gandhi's (2019) claim that CCTV may not always be effective in all settings or against all types of crime.

Although the use of CCTV by police in coordinating incident responses had not decreased pickpocketing and stealing from motor vehicles, the study found that it had reduced bank robberies, vehicle thefts and carjacking. This was because police could use the cameras on the roads to track, pursue and seize vehicles linked to such crimes as they drove away from crime scenes. A key informant quipped:

> *The coordination between the officers at the command centre and those on the ground has made it difficult for suspects to escape using vehicles after committing crimes. This is because the police can track the movements of vehicles using CCTV cameras, intelligence and other technology. As a result, only a reckless criminal would think they could steal a car or rob a bank in Nairobi and run away with it. How many carjackings and bank robberies have you heard of in Nairobi [County] lately? (KIF04, 2021).*

Similarly, a FGD participant stated:

> *The CCTV cameras have been of much help in coordinating our responses, especially in arresting fleeing suspects and intercepting wanted vehicles. When officers at the command centre detect such incidents on CCTV, they contact officers on the ground to respond swiftly. Also, officers at the IC3 often circulate details of reported stolen vehicles over the radio, enabling officers on the ground to seize them when detected by cameras on the roads. Consequently, reported incidences of vehicle theft are becoming increasingly infrequent these days (PTA02, 2021).*

The above quotes suggest that carjacking and bank robberies in Nairobi County had decreased because criminals avoided stealing or using vehicles to commit crimes because they knew they could not get away with them quickly. These findings support the view of RCT that criminals avoid committing crimes that they perceive as too risky. They also affirm NPS's (2020b) claim that carjacking and bank robberies incidents have decreased significantly in the county since the introduction of CCTV in 2015. They are further consistent with police crime data for 2020 and 2021, which show that reported robbery cases in Nairobi City County decreased from 430 cases in 2019 to 360 cases in 2020, a decrease of 16.3 per cent, and to 352 cases in 2021, a decrease of 2.2 per cent (NPS, 2020, 2021). The study's findings also agree with those of other studies that have found that CCTV can reduce crime. For example, Priks (2015) found that robberies in Stockholm's subway stations decreased by 60 per cent after CCTV was installed in 2006. Likewise, Gill and Spriggs (2005) found that vehicle thefts in areas under CCTV surveillance in the UK decreased by 7 per cent to 75 per cent.

Despite the decrease in bank robberies and vehicle thefts, the study found that the police were not publicising successes in using CCTV to coordinate incident responses to help deter crime. A FGD participant attached to traffic duties stated:

> *These CCTVs are dependable and have provided the quickest way to learn about what is happening on the ground and respond to incidents. For example, when an accident occurs on a road not covered by traffic officers, IC3 officers will zoom in on the cameras, establish what is going on, and immediately notify the nearest officers to respond. Unfortunately, many people are unaware of these cameras' benefits because the service [NPS] doesn't make the incidents they've successfully resolved known (PTC03, 2021).*

This quote reveals a worrying lack of awareness among Nairobi City County residents about how CCTV aids police in coordinating incident responses. This missed opportunity for public trust-building could hinder cooperation in reporting crimes and identifying criminals captured on CCTV. Overall, the study's findings suggest that the use of CCTV to coordinate responses to incidents has significantly reduced robberies, vehicle thefts and carjacking in Nairobi County. However, it has not meaningfully reduced overall crime. This conclusion is consistent with the research of Basimanyane and Gandhi (2019) and Gogov (2017), who argue that CCTV can effectively reduce specific crimes but sometimes fails to lower overall crime rates in a given area.

4.4.2.2 Use of CCTV to coordinate incident responses and quick response

According to Table 4.3, the relationship between the use of CCTV in coordinating incident responses and quick response time is positive (b = .734) and statistically insignificant (p > .05). This means that, while there is a positive correlation between the two variables, it is insufficient to conclude that the use of CCTV in coordinating incident responses reduces police response time. The finding affirms Gill and Spriggs's (2005) views that police are less likely to respond more quickly to incidents after CCTV

cameras are installed in an area. This is due, in part, to the fact that mobilising police officers and other resources to respond to an incident takes time, even with CCTV in place (Piza et al., 2017).

FGD participants and key informants differed on whether the use of CCTV in coordinating responses to incidents has improved police response time. Some felt that incident response time had improved because CCTV had helped police locate crimes and emergencies in real-time, assess their severity, and mobilise adequate and quick responses. They added that CCTV operators often provided information about incidents and criminals captured on CCTV to police officers on operational duties and guided them to the precise locations of the incidents or criminals. They also said that police officers monitoring CCTV cameras at the IC3 often apprised responding officers of the developments at incident scenes and the actions to take. According to them, such coordination had allowed police to respond more quickly to incidents. A key informant remarked:

> *The officers at the command centre [IC3] assist commanders in locating the nearest traffic or patrol officers to respond to spotted or reported incidents as quickly as possible. They also assist them [commanders] in directing responding police officers on the most direct routes to the scene and keeping them updated on what is happening. In fact, the cameras have been critical in responding quickly to many incidents, saving lives and reducing massive property destruction (KIF02, 2021).*

Similarly, a FGD participant said:

> *We [police] have been able to detect and respond quickly to riots and illegal gatherings thanks to the CCTV system. Also, in places like the AGX13 market, where there are frequent fire incidents, the cameras have greatly helped police officers and firefighters respond quickly, and this has reduced the damage caused by fires (PTC07, 2021).*

The above quotes show that the use of CCTV in coordinating incident responses has allowed for the prompt deployment of police officers and other emergency responders, reducing the risk of incidents escalating and minimising their impacts. These findings suggest that the police CCTV system served as a common visual reference for multiple agencies during an emergency, providing them with a shared view of an incident and allowing them to work more effectively together to respond to the emergency. These findings corroborate La Vigne et al.'s (2011b) observations that CCTV can promote cross-agency collaboration during emergencies. They also support the findings of Weisburd and Majmundar (2018), Piza et al. (2017), and Ratcliffe (2011), who found that CCTV can help police and other emergency responders respond to incidents more quickly, reducing incident duration, escalation and level of harm.

On the other hand, participants who felt police response time had not improved said that the police only used CCTV to coordinate responses to a few incidents, such as major incidents, road clearances for dignitaries, and evening traffic jams. A FGD participant said:

> *The CCTV cameras are rarely used to respond to incidents unless they are serious or initiated by commanders. Instead, they are mainly used to facilitate easy passage of very important persons (VIPs) or responses to robberies, fires, riots and terrorist-related incidents (PTC04, 2021).*

These sentiments suggest that the police used CCTV selectively to coordinate responses to specific incidents based on their unique circumstances and complexities. For instance, they could have mainly used CCTV in coordinating responses to terrorist acts, riots, fires and robberies because these events often result in many lives and property loss. Similarly, traffic jams can adversely affect the economy and quality of life, and mishaps or attacks on VIPs embarrass a country by making it look incompetent or

insecure. These findings suggest that police prioritise responses to specific incidents detected on CCTV in order to handle them effectively, manage resources efficiently and focus on critical situations requiring immediate intervention to ensure public safety. This is consistent with RCT's premise that individuals choose the activity that provides the most significant net benefit, considering each option's potential benefits and costs.

Studies conducted outside Kenya have also found that police discretionally respond to CCTV-detected incidents. For example, in the UK, Dunnett et al. (2019) found that police responded more quickly to emergencies than to other incidents because of their severity. Equally, a study in Chicago, USA, by La Vigne et al. (2011b) found that police prioritised their responses to serious crimes despite recording lesser crimes such as littering, begging and public drunkenness more often on CCTV. There are two primary reasons why police prioritise their responses to serious incidents. These are their significant negative impacts on individuals or society (Ashby, 2017) and the fact that the police have limited resources to respond to all incidents captured on CCTV (La Vigne et al., 2011b).

As previously revealed in the CCTV monitoring section, the study also found that strained relationships between police officers at the IC3 and those in the field impeded their ability to coordinate faster responses to CCTV-detected incidents. This was worsened by the stringent CCTV guidelines requiring CCTV operators to respond only to requests made over the police radio. As a result, police officers performing operational duties could not request assistance from their colleagues at the IC3 via their mobile phones to manage live incidents. This finding is concerning because it implies that officers in the field may be unable to respond to incidents detected on CCTV if they do not have radiophones or if they malfunction. It also means that prompt police

response to CCTV-detected incidents is not guaranteed, which may endanger public and police officers' safety. A FGD participant remarked:

> *It is not that easy to get assistance from the IC3. The procedures in place are cumbersome. For example, there's a requirement to raise the control using the police radio only. So, what if an emergency occurs and mobile phone calls are not entertained? Besides that, some CCTV operators are unwilling to cooperate. All these issues limit the coordination of officers and responses to incidents. Who knows, maybe the blatant cases of thefts and muggings in the presence of these cameras are evidence of criminals taking advantage of the lack of coordination among officers (PTC01, 2021).*

The above quote shows that CCTV procedures and the strained working relationship between police officers monitoring CCTV cameras and those in the field hampered their responses to incidents. These findings concur in part with past studies indicating that the level of cooperation between patrol officers and CCTV operators significantly impacts how they coordinate incident responses (La Vigne et al., 2011a; Keval, 2009; Scottish Government, 2009). The findings underscore the importance of improving collaboration and communication between police officers monitoring CCTV cameras and those performing operational duties and the need for clear procedures to facilitate efficient incident response. Moreover, it is evident from the above quotes that the poor coordination between two groups of police officers had given some criminals a sense of impunity to commit crimes in front of CCTV cameras because they were confident that police responses to CCTV-detected crimes were unlikely. This is a serious issue because it implies that police CCTV cameras are not as effective as expected at deterring crime. This study's findings validate Piza et al.'s (2017) assertion that criminals do not fear committing crimes in the presence of CCTV cameras when they know the police take long or rarely respond to incidents captured on CCTV. The findings also affirm RCT's claim that criminals are undeterred from committing crimes

when they believe their chances of being caught are minimal. Overall, the study's findings suggest that the use of CCTV in coordinating incident responses has not significantly improved police response time. This conclusion is based on the fact that CCTV has aided the police in mobilising responses to a few incidents, and only in areas where CCTV coverage is available.

4.4.2.3 Use of CCTV to coordinate responses to incidents and road safety

The multiple regression results in Table 4.4 show a positive and statistically significant relationship between the use of CCTV to coordinate incident responses (CCTV_RES) and road safety (b = .528, p = .007). This implies that increased CCTV_RES increases road safety. The OR of 1.696 (95% CI 1.154–2.493) shows that an increase in the use of CCTV to coordinate response to incidents would increase the odds of road safety by 69.9 per cent. The findings from the qualitative data substantiated that CCTV_RES has improved road safety. This was because police could coordinate swift responses to clear road hazards and manage traffic accidents, thereby reducing accidents, fatalities and injuries. A FGD participant said:

> *When a road accident is reported or captured on CCTV, officers at the command centre immediately contact the nearest police station and emergency responders. They then direct responding officers to the proper roads and lanes in order to avoid obstructions and traffic jams. Such use has greatly aided in saving lives and the quick clearance of roadways to avoid further accidents (PTC07, 2021).*

A key informant also commented:

> *CCTV cameras have helped us a lot clear roads quickly, especially during rush hours, major public gatherings, and road accidents. As a result of their use, road accidents and traffic jams, which are mainly caused by overlapping and restlessness among drivers, have decreased (KIF02, 2021).*

The above quotes show that CCTV has significantly aided police in mobilising responses to clear traffic congestion and road hazards, lowering the risk of road accidents. This finding supports Retallack and Ostendorf's (2019) findings that clearing road congestion reduces the risk factors for road collisions, particularly stress and frustrations among drivers. The quotes also show that CCTV has enabled police and other emergency responders to attend to road accidents quickly, saving lives and reducing the likelihood of secondary accidents. These findings align with Grabowski and Czyżewsk's (2020) claim that CCTV can provide emergency responders with up-to-date information about incidents, allowing them to manage incidents quickly and effectively.

4.4.2.4 Use of CCTV to coordinate incident responses and police officers' safety

The regression results in Table 4.5 show that the use of CCTV to coordinate responses to incidents is positively and statistically significantly associated with police officer safety (b =.547, p = .007). These results imply that the enhanced use of CCTV in coordinating responses to incidents improves the safety of police officers when performing operational duties. The OR of 1.728 (95% CI 1.161–2.570) implies that the use of CCTV in coordinating incident responses is associated with a 72.8 per cent increase in police officers' safety while on operational duties. In other words, police officers on operational duties are 72.8 per cent more likely to be safe when working in areas with CCTV cameras than in areas without. The qualitative data confirmed the regression results. They revealed that police commanders often used CCTV to assess incidents remotely instead of dispatching officers to investigate potentially dangerous situations. This could have been for various reasons, such as protecting officers from harm or gaining a better understanding of the situation before deciding how to respond.

The qualitative data also revealed that CCTV has immensely aided police commanders in assessing incidents and deploying appropriate responses, including reinforcements when needed. This was most likely because CCTV can provide real-time information about the situation, allowing commanders to make better decisions about how to respond. These findings imply that the use of CCTV in coordinating incident responses has reduced police officers' exposure to dangers when managing incidents, such as being overpowered by demonstrators or armed criminals. The findings are consistent with the observations of Ways and Pearson (2018) and Carli (2008), who argue that CCTV is an effective safety tool that can help police manage risky situations safely. A key informant said:

> *The cameras have made it easier and safer to identify and classify incidents. Commanders use them to assess scenes remotely rather than dispatching officers to do so physically. They [commanders] also use them to understand what is happening at incident scenes and make real-time decisions, such as sending reinforcements and specialised equipment (KIF03, 2021).*

It also emerged from the qualitative data that CCTV had enhanced the safety of police officers on operation duties when managing incidents and when in danger. This was because they could receive real-time updates from their colleagues at the IC3 on the incident location, happenings at scenes, the movements and descriptions of criminals they were pursuing, and the potential threats. This information allowed them to make informed decisions on managing the incidents safely. Moreover, their IC3 colleagues could locate them when in danger and coordinate rescue efforts. One key informant remarked:

> *The cameras are handy when tracking criminals, especially dangerous and armed ones. For example, during hot pursuits, officers at the IC3 track criminals' movements and notify the officers pursuing them whether they're hiding, have dropped weapons or changed clothes (KIF02, 2021).*

Similarly, a FGD participant said:

> *These cameras are incredible! If not for them, I don't know what could have befallen a female traffic officer who had been abducted and quickly driven to an unknown destination by a matatu crew (PTC03, 2021).*

The above excerpts indicate that the use of CCTV in coordinating incident responses enabled police officers on operational duties to understand the situations they were managing better, including the description (such as number and physical appearance) and movement of criminals they were pursuing. These findings imply that the use of CCTV in coordinating incident responses has enhanced the safety of responding officers by increasing their situational awareness and lowering their occupational risk, especially when dealing with potentially dangerous situations. The excerpts also indicate that police officers performing operational duties could get support, including backup from their IC3 colleagues, if the situation worsened or they were in danger, implying that CCTV had provided them with a sense of safety. These findings corroborate those of Pang and Pavlou (2019), who found that using IT in policing allows police to coordinate criminal pursuits and arrests more effectively, reducing the risk of harm to responding officers. The findings further reinforce the observations of La Vigne et al. (2011a) that responding officers feel safer when someone is monitoring live feeds and apprising them of the situation on the ground.

4.4.2.5 Use of CCTV to coordinate incident responses and police operations costs

Table 4.6 indicates that the relationship between the use of CCTV to coordinate incident responses and the cost of police operations is statistically insignificant ($p > .05$). This means that using CCTV to coordinate incident responses does not significantly reduce police operations costs. However, key informant interviews and FGDs revealed that the

CCTV system had enabled the police to better target their response to incidents, thereby reducing wasted efforts, responses and overall costs. A key informant said:

> *It is uncommon to receive false, exaggerated, or incomplete reports about incidents in our work. Therefore, the CCTV system has aided in confirming whether reported incidents exist if they're in an area covered by CCTV cameras. If they exist, it [the system] aids in locating their exact location, persons or vehicles involved, and other essential details. This allows commanders to dispatch adequate or nearby officers to a scene, which saves money on personnel, fuel, and time (KIF04, 2021).*

Similarly, a FGD participant stated:

> *The CCTV cameras have greatly aided in locating incidents and rapidly dispatching the nearest officers or response teams to deal with them. Working this way saves time. It's unlike directing officers to a larger area where they will spend much time looking for the scene (PTB03, 2021).*

According to the quotes above, the use of CCTV in coordinating incident responses has enabled police to locate and verify incidents accurately, thereby reducing responses to low-priority or non-existent but notified incidents. This means that such use has helped save police resources by ensuring they are only deployed where they are genuinely or most needed. The quotes also show that the use of CCTV in incident response coordination has enabled the police to notify and deploy the most appropriate and nearest officers to incident scenes. This implies that the use of CCTV has resulted in a more efficient use of police resources by ensuring that the right resources are deployed to manage an incident at the right time and in the right amount. These findings support Isnard's (2001) observation that CCTV can improve the management of police resources and the deployment of police officers. They also support the findings of Lawson et al. (2018) and Piza et al. (2016), who established that CCTV is cost-effective when used proactively to target police responses, especially in high-crime areas. In sum,

the current study's findings show that CCTV has assisted police in coordinating responses to a few incidents, and only in the few areas covered by CCTV. As a result, the study concludes that using CCTV to coordinate incident responses has not significantly reduced the cost of police operations in Nairobi City County.

4.5 Impact of the Use of CCTV in Investigating Crimes on Outcomes of Police Operations

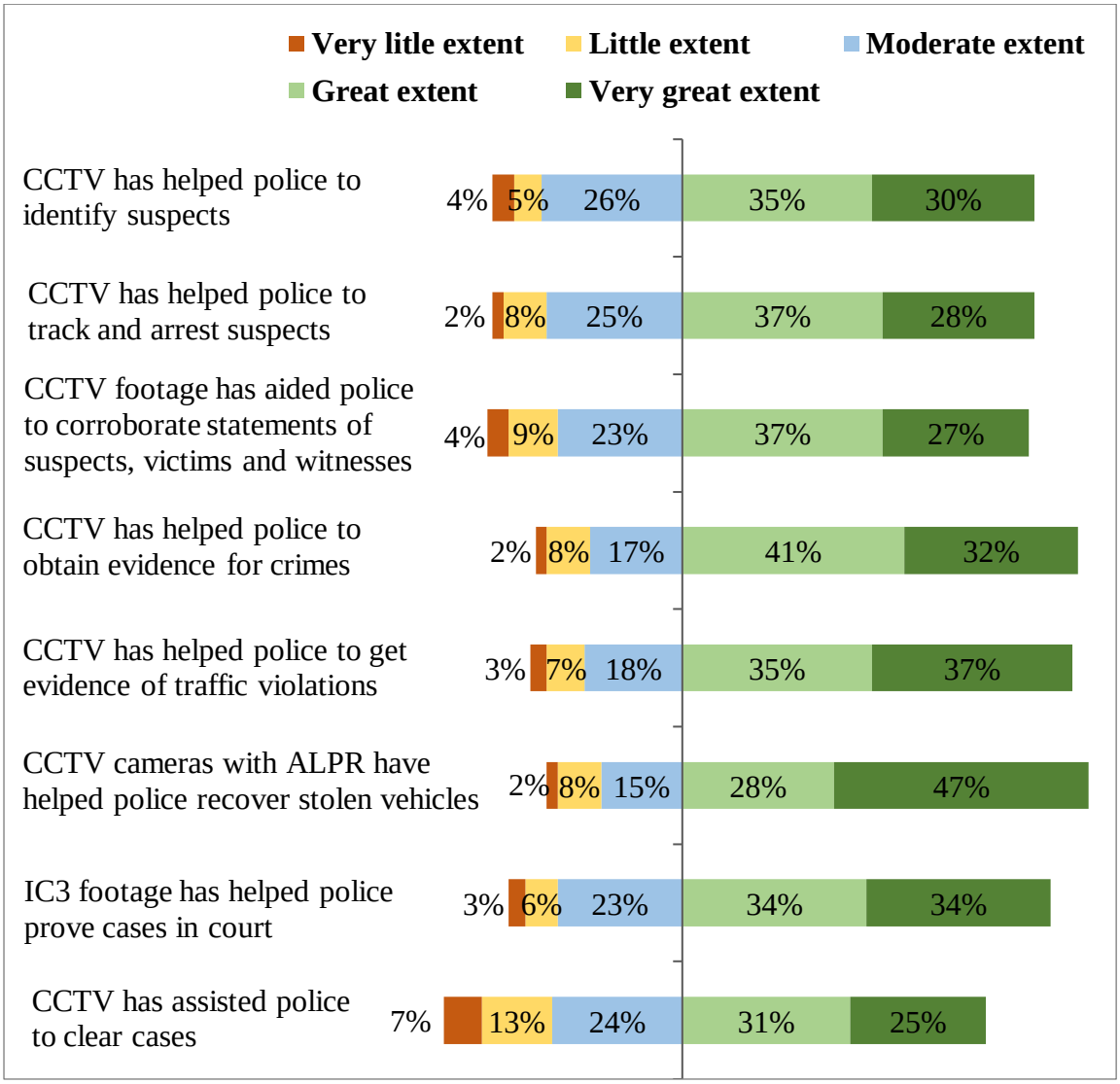
This section presents the findings of the third specific objective of the study, which examined the impact of the use of CCTV in investigating crimes on police operations outcomes in Nairobi City County. The results are provided in two subsections. The first part discusses how CCTV has aided police in carrying out eight investigative tasks. These tasks include identifying suspects, tracking and arresting them, and corroborating suspects' and witnesses' statements. Other tasks include obtaining evidence for crimes, getting evidence for traffic violations, recovering stolen vehicles, proving cases, and clearing cases. On the other hand, the second subsection examines how the use of CCTV to investigate crime has affected police operation outcomes.

4.5.1 Effect of CCTV on Criminal Investigation Tasks

Figure 4.10 summarises respondents' responses on how the use of CCTV to investigate crimes has assisted police in carrying out criminal investigation tasks.

Figure 4.10

Respondents' responses on how CCTV has helped police investigate crime



Source: Field Data (2021)

Figure 4.10 shows that three-quarters of respondents (75%) stated that the use of CCTV cameras with ALPR has greatly aided police in recovering stolen vehicles. The highest rating for ALPR uses among the eight investigative tasks suggests that CCTV has mostly benefitted the police in recovering stolen vehicles. It also implies that police use CCTV extensively to detect, track, and recover stolen vehicles. One reason that may have contributed to ALPR's high rating is its accuracy in detecting vehicles of interest. Ozer (2016) argues that ALPR systems can quickly and accurately scan license plates,

identify vehicles of interest, and automatically alert the police when they come into the cameras' view. This allows the police to determine the vehicle's or its occupants' movements in real-time or retroactively and respond accordingly. However, this is only possible if the registration number of the vehicle of interest is in the ALPR database and the cameras are functioning properly.

Figure 4.10 also shows that nearly three-quarters of respondents (73%) indicated that CCTV has greatly aided police in obtaining evidence of crimes. A similar number (72%) also stated that CCTV has greatly assisted police in getting evidence for traffic violations. Also, more than two-thirds (68%) said it has greatly helped police prove court cases. Similarly, two-thirds (65%) said it has greatly aided police in identifying suspects, and a similar proportion (65%) also said it had assisted police in tracing and apprehending suspects. Moreover, 64 per cent and 56 per cent stated that it has greatly helped police corroborate statements and clear cases, respectively. These results indicate that CCTV has significantly enhanced police investigative tasks. The findings are consistent with those of Dowling et al. (2019) and Ashby (2017), who found that CCTV immensely aids criminal investigations.

Qualitative data confirmed that CCTV has greatly aided police in investigating crimes. They revealed that IC3 footage has been beneficial to police in cracking cases, particularly those involving multiple suspects and with no witnesses. A FGD participant said:

> *The CCTV video clips from the IC3 have greatly assisted IOs [investigating officers] in solving crimes, especially in cases involving more than one suspect. Once they view the footage, the IO is better positioned to isolate suspects and identify the real perpetrators, which shortens the investigation process (PTB04, 2021).*

Similarly, a key informant stated:

> *When IOs are assigned cases, they always first check to see if the crime occurred in an area covered by CCTV cameras. If so, they will immediately seek the necessary documentation to obtain video clips from IC3. The IC3 footage has greatly aided IOs in their investigations, particularly in identifying crime perpetrators who would otherwise have gone unnoticed because of a lack of eyewitnesses. However, there have been instances where IOs have been let down because the cameras in the areas where they investigate crimes are not operational (KIF02, 2021).*

Another key informant also stated:

> *IOs from all over Nairobi County often visit the command centre [IC3] to obtain playbacks for the cases they are handling. The playbacks mainly act as a starting point for their investigations. They provide clues on how, where, who, what and when offences happened. The footage also helps IOs establish the movement and trajectory of victims' or suspects' motor vehicles (KIF02, 2021).*

According to the above quotes, police officers in Nairobi County regularly requested IC3 footage to aid their investigation processes, demonstrating that they have embraced and integrated CCTV into their investigations. This finding is consistent with Morgan and Coughlan (2018), Piza (2018b), and Hulme et al. (2015), who found that police frequently request CCTV footage to aid their investigations. The above quotes also show that IC3 footage has immensely helped police understand the circumstances surrounding crimes and the identities and roles of the involved parties. It has also greatly assisted police in determining the exact locations of crime scenes, the sequence of events, criminals' modus operandi, and other investigative leads. These findings indicate that IC3 footage has significantly assisted the police in investigating crimes in areas under CCTV surveillance in Nairobi County. The findings accord with those of Ashby (2017), who discovered that CCTV footage significantly helps police in their investigations, particularly in confirming suspects' identities and roles in committing

crimes. The findings also corroborate Dowling et al.'s (2019) and Morgan and Dowling's (2019) findings that CCTV footage increases police chances of correctly identifying suspects, determining whether a crime occurred, and solving it.

Although IC3 footage had greatly aided police in investigating crimes, the study found it was not consistently helpful. This was because it was sometimes of poor quality, incomplete or unavailable. FGD participants cited several work-related and personal experiences to demonstrate this, as shown below.

> *I investigated a case involving a lorry hijacked by armed men while transporting cargo. The footage I obtained from the IC3 showed images of three persons in the lorry's cabin. However, their faces and the lorry's license plate were unrecognisable (PTB05, 2021).*

Another FGD participant also stated:

> *I was involved in a hit-and-run road accident in the LY123 underpass… the cameras didn't capture my car's license plate, and the other vehicle's plate was barely visible. As a result, the investigations did not progress much (PTA07, 2021)*

These excerpts show that IC3 footage had minimally aided criminal investigations when it was of poor quality and only partially captured incidents. The reason was that the details of people or objects, including their activities, were grainy or incomplete in such footage. These findings correspond with those of prior studies conducted in Australia by Gibson (2017), the USA by La Vigne et al. (2011b) and the UK by Farrington et al. (2010). Gibson (2017) found that CCTV footage is less helpful in investigating crimes when it is low-quality. La Vigne et al. (2011b) established that CCTV footage was not consistently helpful in criminal investigations because it was sometimes of poor quality and failed to record incidents entirely. Farrington et al.

(2010) discovered that CCTV footage is least helpful in criminal investigations when it is incomplete or fails to capture targets' features and surrounding circumstances well.

The preceding quotes also suggest that the incomplete and low-quality footage came from cameras in locations with low light and blind spots. CCTV footage recorded in poorly lit areas is often choppy and grainy because most CCTV cameras record and stream images at low frame rates in low-light environments (Ratcliffe, 2006). Also, the features of the targets in such footage are often hazy, making identification difficult. On the other hand, blind spots could have resulted from camera defects, poor configurations or obstructions. Footage from these areas is fragmented because it cannot transit from one camera to another. Therefore, cameras with such flaws leave their intended areas uncovered. These findings are consistent with La Vigne et al.'s (2011b) and Keval and Sasse's (2008) views, who argue that insufficient lighting and blind spots reduce the quality and usefulness of CCTV footage in investigating crimes.

The incomplete or low-quality footage from the IC3 does not imply that it was of little value in investigating crimes. In fact, Morgan and Dowling (2019) and Ashby (2017) argue that having CCTV footage in partial or low-quality form is better than having none. This is because partial or poor-quality footage can still help the police understand some aspects of a crime of interest, such as the time and place of occurrence. Additionally, the police can piece together the information from the incomplete footage with those from other sources, such as eyewitnesses and forensic examinations, to successfully investigate a case (La Vigne et al., 2011b). Moreover, prior studies have demonstrated that people can correctly identify familiar individuals on low-quality CCTV footage (Ritchie et al., 2018; Hodgetts et al., 2017). This is due to the fact that people can identify suspects, albeit with varying degrees of accuracy, based on context

clues such as their clothing, gait, and mannerisms. Other studies have also shown that incomplete footage is sometimes the only evidence that helps police link a suspect to a crime (Morgan & Dowling, 2019; La Vigne et al., 2011b). For these reasons, the low-quality or incomplete IC3 footage may not have been worthless, as it may have aided police in some way or some extent in their investigations.

The study also found that the footage from the IC3 has greatly aided police in pursuing, locating and arresting suspects. This was because police often used it to track the movements of wanted criminals, particularly the locations they visited and the people they contacted. Even so, IC3 footage was most useful when combined with data from other technologies, such as mobile phones and vehicle tracking services. A key informant said:

> *As part of a high-profile murder case investigation, we obtained CCTV records from the IC3. The records were crucial in assisting us in tracing the movements of the victim's vehicle and establishing who was behind the wheel when it was behind the wheel. Another plus was that the car had a tracker, and the mobile phone data records of the key suspects were available. The mobile signals allowed us to zero in on the prime suspect as the person who drove and dumped the victim's vehicle. They also led us to arrest another suspect in his hideout (KIF04, 2021).*

The above quote exemplifies how combining IC3 footage with mobile phone and vehicle tracking data has been crucial in providing police with massive amounts of information that has helped them successfully resolve cases. Such integration has greatly aided police in identifying suspects, potential witnesses and vehicles associated with crimes, establishing their connections and relationships, and tracing their movements, actions and the locations they visited before, during and after committing crimes. These findings support the assertion made by La Vigne et al. (2011a) that CCTV evidence alone may not be sufficient to investigate and solve a crime

successfully. They also support previous research that suggests combining CCTV with other technologies, such as facial recognition software and ALPR, is far more beneficial in criminal investigations (Gogov, 2017; Taylor & Gill, 2014; Ratcliffe, 2011).

The study established a few instances where CCTV had assisted police in arresting suspects while committing crimes or immediately after the fact. However, most arrests were for traffic and theft-related offences. The high number of traffic arrests could be due to evidence for traffic offences being readily available from the recordings of the numerous CCTV cameras installed on major roads. On the other hand, the many arrests for theft-related offences could be because thefts are the most common crime in public places, with the majority being overt and planned (Jung & Wheeler, 2019; Weisburd & Majumdar, 2018). As such, police could have easily detected the activities of thieves on CCTV before, during and after they committed thefts and arrested them accordingly. Participants provided several notable examples of how CCTV had assisted police in quickly arresting lawbreakers. For instance, a FGD participant said:

> *While monitoring the cameras one day, I spotted a vehicle hitting a child. The driver fled the scene, leaving the child unconscious on the road. I immediately captured the car's details and raised the nearest officers on a patrol car to pursue it. I continued monitoring the vehicle's movements and kept the pursuing officers updated. The officers got up with the driver in a garage, trying to repair a dent caused by the accident's impact. The mechanics were astounded by how quickly the police discovered the accident and caught up with the driver (PTB02, 2021).*

The above sentiments demonstrate that CCTV has aided police in detecting and arresting criminals while committing crimes or immediately afterwards, raising the risk of criminal behaviour in areas with CCTV cameras. These findings validate Jung and Wheeler's (2019) and La Vigne et al.'s (2011b) observations that proactive CCTV use can allow the police to disrupt ongoing crimes and record vital details that they can use

to investigate the crime and prosecute suspects. The findings are also consistent with those of past studies suggesting that CCTV can enable police to respond faster to incidents and increase their chances of arresting offenders immediately after the fact or at the crime scene (Piza et al., 2015; Wells et al., 2006). Piza et al. (2015) established that police made arrests for more than half of the crimes detected on CCTV.

Regarding statement corroboration, the qualitative data revealed that the use of IC3 footage in investigating crimes has greatly aided police in verifying the authenticity of the statements of suspects and witnesses. They also revealed that IC3 footage has immensely helped police absolve suspects from false accusations and get facts where there were conflicting testimonies. A FGD participant said:

> *Traffic offences are sometimes problematic because drivers in this country hardly admit liability. So, when there are disputes, or the errant party is unclear, IOs often obtain footage from the IC3 to determine who is telling the truth and who is at fault (PTC06, 2021).*

Congruently, a key informant commented:

> *The clips from IC3 have helped investigators verify if the recorded statements are factual and get evidence to prove crimes in court. They have also used them to challenge or corroborate suspects' alibi and exonerate suspects who are falsely accused or wrongly arrested (KIF05, 2021).*

The views of the above participants show that IC3 footage has greatly helped police determine the credibility of witnesses' and suspects' statements and how to proceed with criminal and traffic cases. These findings imply that IC3 footage enabled police to uncover the truth about crimes and obtain probative evidence to prove cases in court. These findings support Ashby's (2017) view that CCTV footage can help police determine whether a person has made a false statement and dispel doubts in

circumstances of disagreements. They also affirm the findings of La Vigne et al. (2011b) and Levesley and Martin (2005), which indicate that CCTV footage considerably helps police confirm the accuracy of a suspect's alibi.

Additionally, qualitative data revealed that the IC3 footage has helped police obtain evidence not provided by witnesses and corroborate or disprove evidence obtained from other sources. According to participants, this was because IOs frequently requested the footage to verify witness testimony and obtain additional details about crimes. These findings affirm La Vigne et al. (2011a) and Conche and Tight (2006) that CCTV footage can help police determine how crimes occurred and get evidence to prove or exonerate a suspect from alleged criminal involvement. A FGD participant said:

> *The recordings of police CCTV cameras are silent witnesses to crimes and help IOs get evidence for cases with few facts, such as when the victim is dead or can't entirely remember what transpired. Therefore, they've been of great help in cases where the complainant fails to produce or doesn't have a witness, like in hit-and-run accidents (PTA08, 2021).*

Based on the above sentiments, it is evident that IC3 footage had provided police with substantial evidence to prove crime commissions, especially when other evidence was lacking or conflicting. Indeed, unlike eyewitness testimony, which must be evaluated for credibility, reliability and accuracy, legally acquired CCTV footage can alone provide objective and sufficient evidence to prove a crime. Hence, it is helpful when other collaborative evidence is absent and can supplement, verify or disprove other available types of evidence (Ashby, 2017). For these reasons, IC3 footage helped police investigate fatal and hit-and-run accidents because the victim may have been dead or severely injured and could not recall what happened during the accident. In such instances, the footage was crucial in helping the police obtain evidence the victim could

not provide. These findings agree with Ashby (2017) that CCTV footage can significantly assist the police in obtaining additional evidence they would not have gotten from other means.

Regarding the use of ALPR technology, qualitative data revealed that it had greatly helped police identify and recover vehicles reported stolen, including those associated with other crimes. This finding substantiates NPS's (2019a) claim that ALPR assisted police in recovering over 3000 stolen vehicles in 2018. A key informant said:

> *It is rare for a blacklisted vehicle to pass through the ALPR cameras without being detected, no matter how long it takes. The cameras always pick up the number plates of wanted vehicles and alert the police. As a matter of fact, we've intercepted and impounded many stolen vehicles using these cameras. The cameras have also aided a lot in tracing and impounding vehicles involved in murders, robberies, abductions, burglaries, terrorist acts, tax evasion, or traffic violations. In fact, they were crucial in locating the vehicle used by terrorists in the Dusit Hotel attack (KIF04, 2021).*

Equally, a FGD participant stated:

> *Tracing stolen motor vehicles is easy since the cameras have ALPR, which gives real-time alerts whenever they detect such vehicles on the roads. When such a vehicle is detected, officers on the ground are immediately mobilised to intercept it. Besides reading the license plates and alerting the police, the ALPR cameras also capture the suspected drivers' images, making it easier to pursue and apprehend them. For traffic offences, the work is much easier. When the cameras capture the license plate of a wanted vehicle, it becomes easier for IOs to trace their owners from the NTSA database using an App (PTA07, 2021).*

A FGD participant deployed to traffic duties also commented:

> *ALPR has been very beneficial to us, particularly when investigating road accidents. For example, if a person is fatally injured by a hit-and-run driver or is crushed between two vehicles during rush hours, the police would quickly obtain the registration number of the concerned vehicle from the IC3 and use ALPR to track down the concerned vehicle and bring the suspected driver to book (PTB02, 2021).*

Even though ALPR had considerably helped the police investigate vehicle-related crimes, the study found that it was not always helpful. According to FGD participants, APLR data was sometimes incomplete or of poor quality, limiting the successful investigations of vehicle-related crimes. Key informants concurred with FGD participants, adding that ALPR was not assisting police in recovering vehicles reported stolen in other counties and driven into Nairobi County because the details of such vehicles were not being entered into its database. This finding was worrisome because it implied that using a vehicle stolen in another county in Nairobi County would attract less police attention unless discovered by other means. A key informant said:

> *It would have been good if the system had data on all vehicles reported stolen across the country. That would help deter criminals from using such vehicles in Nairobi County (KIF04, 2021).*

Similarly, a FGD participant said:

> *The ALPR cameras aren't helping much these days. I had a case where a lorry was carjacked after leaving a cargo godown. The driver and the turn-boy claimed the lorry was blocked by a Subaru car along MTT124 Road. After that, two armed men jumped out of the car and forcibly gained entry into their lorry, blindfolded and bundled them into the lorry's cabin. They then drove the lorry, abandoned them along MIS125 Road, and vanished with the lorry and its cargo. The footage I obtained from the command centre showed the lorry leaving the godown and entering MAT349 Road, but its images are missing from there. Besides that, the footage lacked images of the thugs and their getaway Subaru car (PTB02, 2021).*

These quotes suggest that criminals have adapted to ALPR over time by devising ways to circumvent its use and evade detection and arrest. Such evasion methods, according to participants, included criminals driving along roads with faulty cameras or close to vehicles in front to conceal their vehicles' license plates. Other ALPR evasion methods mentioned by participants included criminals affixing fake number plates on stolen

vehicles or those used to commit crimes. These findings support Ozer's (2016) observation that ALPR is ineffective when a stolen vehicle's license plate is altered, or a vehicle used to commit a crime is hidden. A FGD participant said:

> *It is impossible to detect or track a wanted vehicle driven in areas with faulty CCTV cameras or if it has been fitted with a false license plate. The cameras may also fail to read the number plate of a vehicle driven closer to the one in the front because the visibility lines of the cameras are blocked (PTB07, 2021).*

Likewise, a key informant said:

> *There was this reported burglary incident, which occurred in a garage along MJH43 Street. According to the security guards on duty at the garage at the time of the incident, the burglars carted looted merchandise on a cream lorry. ALPR vividly captured the license plate registration details of the vehicle used by the burglars. However, following a search, they clashed with those we found in the National Transport and Safety Authority (NTSA) database (KIF04, 2021).*

The sentiments expressed in the above quotes suggest that criminals have become craftier at stealing vehicles by devising ways of avoiding ALPR detection, and their evasion tactics have, to some degree, reduced the effectiveness of ALPR. These findings support RCT's proposition that criminals are rational and adapt their criminal tactics to the measures in their environment. Despite the few limitations of ALPR, participants agreed that it is a valuable investigative tool that has greatly aided police in recovering stolen vehicles. This finding reinforces research from Canada and the USA, which found that ALPR considerably aids police in recovering stolen vehicles and successfully investigating other vehicle-related crimes (Roberts & Casanova, 2012; Cohen & Plecas, 2007).

Furthermore, focus groups and key informant interviews confirmed that IC3 footage had greatly aided the police in successfully proving cases in court and clearing pending ones. A FGD participant commented:

> *Many criminal cases that couldn't have been resolved have been cleared since police started using CCTV in Nairobi County. Ideally, a case is almost done when the IOs have identified the suspects and witnesses from the footage (PTB03, 2021).*

Equally, a key informant said:

> *The CCTVs have been a game-changer in criminal investigations. The evidence IOs get from the video clips from the IC3 has greatly assisted them in building watertight cases in courts. As a result, they have proven cases in court beyond a reasonable doubt and secured convictions for a number of them (KIF02, 2021).*

In terms of the value of IC3 footage in assisting the investigation and prosecution of traffic cases, qualitative data revealed that it greatly aided the police in adducing evidence in court and proving offences. A FGD participant said:

> *I can attest that it is strong evidence because I have used it to obtain convictions for three suspects (PTC01, 2021)*

Similarly, another FGD participant attached to traffic duties stated:

> *I had a traffic case where the culprit denied committing the offence, but he was speechless when the footage was played in court (PTC06, 2021).*

The above quotes indicate that police regarded IC3 footage as incontrovertible evidence that would help them build strong cases and secure suspects' convictions in court. They also show that IC3 footage has improved police efficiency in resolving and clearing

cases. These results corroborate the reviewed studies that suggested that CCTV footage enhances the police's ability to clear and solve cases (Jung & Wheeler, 2019; Morgan & Dowling, 2019; Ashby, 2017). In particular, Morgan and Dowling (2019) discovered that CCTV increases clearance rates by around 20 per cent in their Australian study, demonstrating that CCTV footage greatly aids police in clearing and resolving crimes.

Unlike Murphy (2010), who found that courts in the UK were hesitant to admit CCTV footage as evidence, the study discovered that courts in Nairobi County willingly admitted CCTV footage as evidence as long as it met the legal requirements. A key informant stated:

> *We have had no problems with the courts. All cases involving footage from the IC3 as evidence have gone well in court, with some resulting in convictions. Our procedures comply with Section 106B of the Evidence Act. With that, I don't anticipate a court of law refusing to accept footage from police CCTV cameras as evidence (KIF02, 2021).*

Although the police had no difficulty using IC3 footage as evidence in court, the study established that they had only successfully used it to obtain traffic convictions. It emerged that criminal charges based on IC3 footage were pending in court partly due to prosecutorial challenges and potential corruption concerns. These findings are in tandem with Eggarsasi and Sa'diyah's (2018) observation that CCTV can effectively support traffic prosecutions but contradict Farrington et al.'s (2010) UK study, which found no convictions from police using CCTV footage as evidence. The conflicting findings suggest that the success of using CCTV footage for securing convictions may vary depending on the jurisdiction and crime types. A key informant said:

> *We've successfully obtained convictions for many traffic offences. However, many criminal cases remain pending in court, mainly because of delay tactics employed by defence lawyers for selfish gains (KIF04, 2021)*

There are two possible explanations for the increase in traffic convictions. First, the abundant CCTV footage from the numerous cameras across Nairobi County's major roads readily provided police with evidence of traffic violations, enabling them to process these offences more quickly. Second, many traffic offenders may have pleaded guilty more readily because most traffic offences are only punishable by fines. Pleading guilty quickly to a traffic offence is especially advantageous to the offender when there are strong indications that the case will result in a conviction because it saves them time, money, and other resources while pursuing the case in court. These observations resonate with RCT's notion that criminals choose actions that benefit them.

4.5.2 Use of CCTV to Investigate Crimes and Outcomes of Police Operations

This subsection provides the regression results and the findings from the qualitative data on how the use of CCTV to investigate crime has yielded five predetermined outcomes of police operations. These outcomes were crime reduction, quick incident response, improved road safety, increased police officers' safety and reduced operational costs. The regression results are in Tables 4.2, 4.3, 4.4, 4.5 and 4.6.

4.5.2.1 Use of CCTV to investigate crime and crime reduction

As shown in Table 4.2, the relationship between the use of CCTV to investigate crimes and crime reduction is positive (b = .608) and statistically significant (p = .002). This implies that increased use of CCTV in investigating crime is associated with an increased reduction in crime. The OR of 1.837 (95% CI 1.246–2.709) indicates that the odds of crime reduction would increase by 84 per cent for every one-unit increase in using CCTV to investigate crime.

Findings from the qualitative data substantiated that crime commissions had decreased in areas under CCTV surveillance. The decrease, according to FGD participants, was caused by criminals avoiding offending in these areas because they knew the risk of being caught if they committed a crime was high. A FGD discussant said:

> *These CCTVs have reduced crimes since criminals can be easily detected and arrested. For example, police recently arrested a youth who had stabbed another along MRR127 Road. The arrest was so fast as it happened soon after the officers at the IC3 replayed the scene recording, which enabled the officers on the ground to pick him up from the crowd gathered at the scene. Do you think people who witnessed or heard about this incident will be daring enough to mess up in front of these cameras? I doubt it! (PTB07, 2021).*

The quote highlights the link between CCTV coverage and responsible behaviour. Knowing that police could easily detect and apprehend lawbreakers through footage, people acted more responsibly, leading to a decline in crime in these areas. These findings support RCT's assertion that potential offenders make choices based on risk-reward assessments. The findings also resonate with Cavoukian's observation that the successful use of CCTV in investigating crime can significantly deter future criminal activity in areas under CCTV coverage. They further support prior research on CCTV, suggesting that its use in crime investigation and offender prosecution can significantly reduce crime (Auditor-General Western Australia, 2011; La Vigne et al., 2011a). Moreover, the findings support the findings of Piza et al. (2018a), who found significant crime reductions of 20 per cent and 30 per cent in the UK and South Korea, respectively, following CCTV implementation.

4.5.2.2 Use of CCTV to investigate crime and quick response to incidents

The regression results in Table 4.3 show that the relationship between the use of CCTV to investigate crime and police response to incidents is positive and statistically

insignificant (b = .113, p = .589). This finding means that the use of CCTV in investigating crime does not significantly improve police incident response time. This lack of impact likely stems from two factors. First, criminal investigations are primarily reactive undertakings, typically initiated after a crime happens (Osterburg et al., 2019). Second, police might have rarely used CCTV for proactive crime investigations, particularly for crimes with foreknowledge of occurrence, such as through intelligence.

Although quantitative data did not clearly show that CCTV significantly impacted police response times, qualitative data showed that it had assisted police in quickly piecing together cases by providing valuable investigative leads and clear accounts of incidents. These findings support Piza et al. (2018), Ashby (2017) and Robinson and Tilley (2009) that CCTV can provide potential leads to crimes, which speeds up investigative processes. A FGD participant remarked:

> *Cases with footage from the command centre proceed fast. The footage provides clues about an incident, such as the criminal's identity, movement, accomplices and other modus operandi information. This has allowed IOs to trace and bring criminals to justice quickly (PTB06, 2021).*

Overall, the study's results suggest that the presence of CCTV has fast-tracked the investigation of crimes in its installed areas. However, it has not translated into a quicker response by the police to incidents. This disconnect can be partially explained by the significant time and effort required to review footage for suspects, witnesses and evidence, often delaying actionable results.

4.5.2.3 Use of CCTV to investigate crime and road safety

Table 4.4 shows a positive and statistically significant relationship between the use of CCTV in investigating crimes and road safety (b = .612, p =.003). This means that the

increased use of CCTV in investigating crimes is associated with increased road safety. The OR of 1.844 (95% CI 1.237–2.747) indicates that a one-unit increase in police use of CCTV in investigating crimes increases the odds of road safety by 1.8 times if all other predictors remain constant.

FGDs and key informants' interviews confirmed the significant decrease in traffic violations and accidents in CCTV-covered areas. This reduction stemmed from the awareness among road users, particularly drivers, that police actively used CCTV to detect traffic violations, track offenders, and make arrests. Consequently, they avoided committing traffic violations in areas under CCTV surveillance. These findings substantiate RCT's assertion that the certainty of arrest and punishment discourages offenders and would-be offenders from engaging in criminal behaviour (Winfree & Abadinsky, 2017). A FGD participant said:

> *The footage from the command centre has greatly assisted us [police] in establishing the precise time of traffic accidents, their surrounding circumstances, and the involved parties. This information has been critical in reconstructing the events that led to the accidents, determining their causes, and preventing them in the future. You're also aware that drivers are problematic and cannot admit liability when they're involved in road accidents. So, the footage from the command centre has helped us identify the drivers at fault, which has been especially useful when filing insurance claims (PTC07, 2021).*

Similarly, a key informant commented:

> *The [CCTV] cameras have reduced traffic violations and hit-and-run accidents. Drivers avoid breaking traffic laws because they fear being recorded and later on followed, arrested and prosecuted (KIF02, 2021)*

The above quotes highlight how IC3 footage has played a vital role in road safety. It has helped police assess accident causes, hold responsible parties accountable, manage

insurance claims reasonably, and develop strategies to reduce accidents. It has also assisted in traffic offence investigations and prosecutions, deterring violations and contributing to fewer accidents. These findings are consistent with police crime data from 2020 and 2021. According to these data, traffic offences in Nairobi County dropped from 53 in 2019 to 7 in 2020, a decrease of 86.8 per cent, and further dipped to 6 in 2021, a 14.3 per cent decrease from 2020 (NPS, 2020, 2021). While other contextual factors, such as changes in police tactics and improved road infrastructure, may have played a part, the magnitude of the decrease suggests that CCTV's role in curbing traffic violations cannot be understated. This study's findings also support prior studies showing that using CCTV evidence in investigating and prosecuting traffic violations can improve road safety (Alghnam et al., 2018; Desai et al., 2018; Adminaite et al., 2016; Wilson et al., 2010). Such use can reduce traffic violations and road accident risks by increasing drivers' adherence to traffic rules. This study's findings also support Conche and Tights's (2006) observation that reviewing traffic accident footage can improve road safety by assisting the police in determining the causes of accidents and developing strategies to reduce their occurrence.

4.5.2.4 Use of CCTV in investigating crime and police officers' safety

The regression results in Table 4.5 show a positive (b = .575) and statistically significant (p = .006) relationship between the use of CCTV to investigate crimes and the safety of police officers. This suggests that as the use of CCTV to investigate crimes increases, the safety of police officers also increases. In other words, CCTV can help protect police officers from harm while performing their operational duties. Additionally, the OR of 1.777 (95% CI 1.181–2.674) indicates that a unit increase in

the use of CCTV to investigate crime is more likely to increase police officer safety by 1.8 times, assuming that all other factors in the model remain unchanged.

Qualitative data confirmed that the safety of police officers on operational duties has improved. Participants attributed this increase in officer safety to criminals fearing that their attacks on officers would be recorded on CCTV and the records used to aid their arrest and prosecution. This finding aligns with RCT's observation that criminals tend to avoid committing crimes in areas where they believe they are highly likely to be detected and arrested. A FGD participant said:

> *Being on patrol or beats in the city is much safer these days. Before the cameras were installed, attacks and killings of police officers on duty were common but are almost unheard of today (PTC03, 2021).*

The finding that assaults and killings of police officers had decreased in Nairobi City County contradicts police crime data, which shows that they had increased significantly. According to police annual crime data, 11 police officers were killed in the county while on duty in 2020, up from 6 in 2019 (NPS, 2020b). By 2021, the number had more than doubled to 23 (NPS, 2021). The disparities between the study's findings and police crime data suggest that the safety of police officers may have only improved in areas under CCTV surveillance. It is also possible that such gains have faded over time, possibly due to other contextual factors such as criminals adapting to police use of CCTV and rising crime rates.

4.5.2.5 Use of CCTV to investigate crime and the cost of police operations

According to Table 4.6, the use of CCTV to investigate crimes and the cost of police operations are statistically and positively related (b = .634, p = .002). This means that

increased use of CCTV in investigating crimes would result in an increased reduction in the cost of police operations. The OR of 1.884 (95% CI 1.268–2.799) indicates that a one-unit increase in using CCTV to investigate crime would increase the odds of reduction in police operations cost by 1.9 times if the predictors in the model remain unchanged. This finding suggests that using CCTV to investigate crimes is a cost-effective way to reduce the cost of police operations.

The qualitative data findings aligned with the regression results. They revealed that the use of IC3 footage had reduced the need for extensive investigations and resources, particularly in terms of the time and officers required to track down suspects, search for relevant evidence and prepare cases for trial. These findings support Morgan and Dowling's (2019) and Ashby's (2017) findings that CCTV can improve the efficiency and cost-effectiveness of criminal investigations. A key informant said:

> *It [CCTV] has made investigations easier and faster, unlike before. Cases with CCTV footage take a short time to investigate and often require a few IOs. You know time is money! (KIF05, 2021).*

Although investigative costs had decreased overall, qualitative data revealed that police officers had to purchase their own devices to store the footage they needed for investigations due to a lack of provision from the NPS. As a result, some officers did not use IC3 footage in their investigations to avoid incurring personal expenses. This implies that while IC3 footage is a valuable investigative tool, its usefulness was hampered by inadequate resource allocation. A FGD participant from the DCI said:

> *The process by which footage is requested, extracted, and stored is the responsibility of an individual IO. There is no support from the NPS to get a CD or flash disk to save footage, putting unnecessary costs on the IO. So, if one doesn't have a device to store the footage, they only view it at the IC3 and proceed with their investigations without it (PTB04, 2021).*

Despite the personal expenses incurred by IOs, the study's findings suggest that the cost of conducting criminal investigations in CCTV-covered areas in Nairobi County has decreased to some extent. This finding is consistent with those of Moyo (2019), Lawson et al. (2018) and Levesley and Martin (2005), which suggest that installing CCTV in an area can reduce investigatory costs by efficiently directing police resources to improve crime detection and investigation, and reducing the time police spend searching for evidence and preparing cases for trial.

4.6 Moderating Effect of CCTV Policies on the Relationship Between the Use of CCTV and the Outcomes of Police Operations

This section provides the findings of the fourth specific objective of the study, which examined whether CCTV policies moderated the relationship between the use of CCTV and police operations outcomes in Nairobi County, Kenya. The findings are presented in two subsections. The first subsection covers the quantitative and qualitative data findings on how CCTV policies influenced the use of CCTV in police operations in the county. The second subsection provides findings on how CCTV policies moderate the relationship between CCTV use and the outcomes of police operations.

4.6.1 Effect of CCTV policies on police operations

Table 4.7 summarises respondents' views on how CCTV policies have influenced the use of CCTV in police operations in Nairobi City County on a scale of 1 (*very little extent* [VLE]) to 5 (*very great extent* [VGE]).

Table 4.7

Respondents' perceptions of the effect of CCTV policies on the use of CCTV in police operations

Policy Type	Statement	Frequency and Percentage (N=347)				
		VLE	LE	ME	GE	VGE
Legal	a) Existing laws effectively guide police officers when using CCTV	30 (8.6%)	64 (18.4%)	114 (32.9%)	86 (24.8%)	53 (15.3%)
	b) Existing laws sufficiently guide police officers when seizing footage for use as evidence in court	15 (4.3%)	58 (16.7%)	111 (32.0%)	106 (30.5%)	57 (16.4%)
	c) There are sufficient legal policies on CCTV in Kenya	28 (8.1%)	91 (26.2%)	108 (31.1%)	78 (22.5%)	42 (12.1%)
	d) Legal policies have positively affected the use of CCTV in police operations	24 (6.9%)	63 (18.2%)	100 (28.8%)	109 (31.4%)	51 (14.7%)
NPS	e) NPS policies ensure the proper use of CCTV.	27 (7.8%)	50 (14.4%)	109 (31.4%)	105 (30.3%)	56 (16.1%)
	f) NPS policies clearly specify the areas to be monitored and activities to be recorded when using CCTV.	26 (7.5%)	44 (12.7%)	104 (30.0%)	112 (32.3%)	61 (17.6%)
	g) NPS policies ensure skilled officers operate CCTV.	24 (6.9%)	42 (12.1%)	71 (20.5%)	126 (36.3%)	84 (24.2%)
	h) NPS policies provide adequate retention time for CCTV data that may be required as evidence in court.	31 (8.9%)	33 (9.5%)	98 (28.2%)	105 (30.3%)	80 (23.1%)
	i) NPS policies clearly specify how to disseminate CCTV data, if necessary.	26 (7.5%)	37 (10.7%)	93 (26.8%)	118 (34.0%)	73 (21.0%)

Source: Field Data (2021)

The data summarised in Table 4.7 show that respondents had mixed views on how legal policies on CCTV have influenced police operations in Nairobi City County. Nearly half (40%) said they have significantly guided police officers in using CCTV in their operations, and a third (33%) said they have moderately guided. Over a third (35%) said legal policies on CCTV were sufficient, and a third (31%) and another third (34%) said they were moderate and insufficient, respectively. Almost half (47%) said legal policies on CCTV greatly guided police officers when seizing footage for use as evidence in court, and a comparable proportion (46%) said they have positively affected the use of CCTV in police operations. While these results suggest that there is no clear consensus on how legal policies on CCTV have influenced police operations in Nairobi County, the policies appear to have positively impacted the use of CCTV in police operations. One possible reason for the mixed views is that the legal regulations governing the use of CCTV in Kenya are found in various legislations. No single national law governs CCTV, making it difficult for police officers to understand the specific law and how it applies to their use of CCTV. Another possible reason for the conflicting views is that the legal policies on CCTV are not always clear or easy to understand, leading to confusion and uncertainty among police officers about how they should use CCTV in their operations.

Table 4.7 also shows that respondents had positive views on the impact of NPS policies on the use of CCTV in police operations in Nairobi City County. Nearly two-thirds (61%) said NPS policies on CCTV greatly ensured skilled officers operate CCTV. Over half (55%) and a similar proportion (53%), respectively, said NPS policies on CCTV clearly specify how to disseminate CCTV data and provide adequate retention time for CCTV data that may be required as evidence in court. Half (50%) stated that NPS policies on CCTV clearly specify the areas police officers are to monitor and the

activities they are to record when using CCTV. Nearly half (46%) stated they greatly ensure police officers use CCTV systems and data appropriately. These findings suggest that NPS policies on CCTV are comprehensive and have significantly impacted the use of CCTV in police operations in Nairobi City County.

The findings from the qualitative data were mixed. Regarding legal policies on CCTV, most FGD participants and key informants agreed they were adequate and greatly guided police when using CCTV in their operations. A FGD participant said:

> *Our use of CCTV is based on various laws, such as the Evidence Act (2018) and the Communications Authority Act (2011) on photographic evidence. These laws have made our [police] work much clearer and enabled us to win big against offenders in court, which is a significant achievement (PTB03, 2021).*

This quote demonstrates that legal policies on CCTV followed by police in Nairobi County comply with existing laws and have greatly enhanced police operations. These findings support Hartmus's (2014) view that CCTV policies in most countries are consistent with the existing laws. The findings also affirm Shukla et al.'s (2020) observation that CCTV policies ensure users use CCTV systems and data appropriately and in a way that yields the desired results.

Disturbingly, qualitative data showed that many police officers performing operational duties were unfamiliar with legal policies surrounding CCTV, particularly its admissibility as evidence. This knowledge gap implied that many of them could not effectively use CCTV for crime investigations and secure convictions. The sentiments of the following participants attest to these findings:

> *I don't know much about the policies. Please ask the officers at the IC3 about them (FGD participant PTA03, 2021).*

Also, a key informant stated:

> *Many officers on the ground are not conversant with CCTV policies. Hence, they do not know that the footage is admissible in court (KIF04, 2021).*

The finding that many officers were unfamiliar with CCTV policies is consistent with those of Ngwenya (2012), who found that many South African police detectives were unaware of the legal requirements for CCTV footage admissibility as evidence in court. Equally, the study established that many police officers viewed legal policies on CCTV as complicated and impeding their work. This led some officers to avoid using CCTV footage as evidence in court. These findings corroborate the findings of studies by Schuck (2015) and Donald (2010), which found that police officers are less likely to use technologies if they believe the policies governing their use are restrictive. A FGD participant said:

> *The existing laws limit police officers from accessing CCTV data and presenting the same as evidence in court. The IO must comply with stringent and time-consuming procedures before the footage is allowed as evidence in court. As a result, some IOs do not use CCTV evidence in their cases (PTC04, 2021).*

The qualitative data on the NPS policies on CCTV agreed with the quantitative data that they were comprehensive and adequately guided police when using CCTV systems and data. For instance, in criminal investigations, participants pointed out that NPS policies clearly outlined the procedures for obtaining, retrieving, storing, and sharing CCTV data and using it as evidence in court. One FGD participant said:

> *Our [NPS] policies and procedures are okay. They align with the existing regulations on electronic evidence and clearly outline how CCTV footage is used in criminal investigations. So, they have made it possible for police to understand what is required when obtaining CCTV evidence and presenting it in court (PTA02, 2021).*

However, some FGD participants noted that NPS policies on CCTV did not specify the areas the police should monitor or the activities they should record when using CCTV. Hence, CCTV operators had discretion over what they could view and record on camera. A FGD participant stated:

> *The service [NPS] policies are not clearly spelt out. CCTV operators, for example, have the discretion on what and where they observe or record on camera during their tour of duty (PTA05, 2021).*

The lack of clarity in NPS policies regarding the areas and activities that police officers should monitor and record while using CCTV may lead to misuse of the police CCTV system. For example, CCTV operators may use the system to monitor people or activities unrelated to law enforcement. This could infringe on people's privacy rights and could also lead to discrimination and dissatisfaction with the police CCTV system. According to the findings of this study, the NPS policies on CCTV violated the FIPPs of use limitation, which requires that CCTV systems and data be used only for a specific purpose (DHS, 2007). The study's findings are similar to those of Goold (2003), who investigated five police-operated CCTV systems in the UK and established that they lacked adequate policies governing their use. However, this study's findings differ from those of La Vigne et al. (2011b), who discovered that Washington, DC CCTV policies limited police officers to viewing public areas only and required them to sign a statement acknowledging that they respected people's privacy rights while performing monitoring duties. The disparate findings imply that the scope of CCTV policies implemented by police services worldwide varies and may change over time.

While quantitative data indicated that NPS policies provided adequate storage time for CCTV data, qualitative data indicated that they did not. According to FGD participants,

the policies required the footage to be kept for 30 days before being automatically erased unless it was still required for investigative purposes. They claimed that this time frame was insufficient because it limited the availability of footage for police to investigate incidents that came to their attention after it had been erased. This finding backs up Ashby's (2017) claim that storing CCTV footage for a shorter period of time limits its availability for investigative purposes. A FGD participant said:

> *Since there's no primary storage, the CCTV images are stored procedurally for a maximum of 30 days, after which they're automatically deleted. In practice, this time frame is too short because the images aren't available for investigating incidents that are discovered after they've been automatically overwritten (PTC08, 2021).*

Despite its limitations, the study established that the NPS 30-day retention period for CCTV footage complied with Sections 34 of the Data Protection Act (2019) and Section 83H of the Kenya Information and Commission Act (2019). These sections of the law allow for the retention of electronic records for any length of time as long as the storage, processing, and erasure conditions are met. Also, the NPS's 30-day retention period for CCTV footage accorded with practices in jurisdictions other than Kenya. For example, Moyo (2019) found that South African police kept CCTV footage for 31 days before erasing it, as required by law. Moreover, the study established that the NPS 30-day retention period for footage adhered to the FIPPs of minimisation and integrity. The minimisation principle states that CCTV data should only be kept as long as it is still needed to fulfil a specified purpose. The integrity principle states that CCTV footage with no evidentiary value should be routinely destroyed after a set time (DHS, 2007). The rationale for destroying footage after a reasonable period is to minimise privacy concerns and storage and management costs (Lin, 2016). Even so, it is essential to

review the NPS 30-day footage retention period to ensure that CCTV footage is available for investigating incidents that come to the attention of the police late.

Qualitative data also supported the quantitative data that NPS policies on CCTV ensured that only competent police officers operated CCTV. According to the qualitative data, an officer needed a number of qualifications to be deployed to work at the command centre. These included good observation skills, IT knowledge, a solid understanding of the law, and at least five years of police experience. In addition, the selected officers had to undergo induction training before starting work at the command centre. This training covered critical CCTV user skills, such as how to operate, control, troubleshoot and maintain CCTV equipment, surveillance techniques, legal and ethical considerations, and emergency procedures. A key informant remarked:

> *There is a clear criterion for selecting officers to work as CCTV operators. For instance, one must have a computer certificate or training in IT, at least five years of service, good observation skills, and passed all police law exams. The selected officers are also appropriately trained in the legal ways of using CCTV and the standard operating procedures before commencing work at the IC3. In addition, their performance is evaluated continuously, and underperformers are relieved of their duties (KIF01, 2021).*

The above quote demonstrates that the NPS policies specified the eligibility criteria for selecting competent police officers to operate CCTV systems. It also shows that the policies outlined ways to ensure the selected officers are effective in their roles, primarily through training and performance evaluation. These findings imply that the officers stationed at the command centre were properly selected and possessed relevant CCTV competencies. This contradicts Shukla et al.'s (2020) observation that police organisations often deploy incompetent officers to operate CCTV systems.

Aside from ensuring that competent officers operated CCTV, the qualitative data showed that NPS policies ensured that CCTV data was handled only by authorised officers. FGD participants stated that only officers with a written request from their station commander could get the footage from the command centre. They also needed to identify themselves and get approval from a senior authorised officer. Additionally, officers who handled CCTV footage were required to record the time they handled it, its intended use and their personal information, such as their employment number, rank and workstation. According to the FGD participants, these measures ensured that the IC3 footage was properly managed. These findings are affirmed below.

> *NPS policies have streamlined how CCTV is used and reduced incidents of misconduct. Only skilled and authorised officers are permitted to operate the cameras and access footage and other CCTV records (PTA06, 2021).*

Key informants agreed with the FGD participants that only authorised officers could operate the police CCTV system or handle its data. They also said that IC3 footage could only be disseminated in accordance with legal and police procedures. According to them, such regulations have ensured the effective use of the CCTV systems and reduced CCTV malpractices. One key informant said:

> *NPS policies are clear and detailed. Only a few officers can access CCTV equipment, footage, and records. The IO, for example, is the only person who can request and receive footage. Also, the request must be for a reported matter only and made on a prescribed memo form. I can say that these measures have ensured the chain of custody of footage by ensuring that it is in the right hands and adequately secured throughout its entire lifetime (KIF0I, 2021).*

This quote demonstrates that NPS policies provided a variable way of establishing the handling of CCTV data throughout its lifecycle. This is important because it can help

prove its integrity and authenticity in court. The quote also shows that NPS policies prevented IC3 footage from being shared with unauthorised persons or viewed by large numbers of people. These measures help protect individuals' privacy and ensure that the data is used for legitimate purposes. The findings of this study are similar to those of a study by La Vigne et al. (2011b), which found that Washington, DC, police had documented policies governing the acquisition, sharing and retention of CCTV data. The study's findings also support the view that CCTV policies help to ensure that CCTV systems and data are only used for their intended purposes and following the law. This is consistent with the observations of Donald (2010), Schlosberg and Ozer (2007) and Levesley and Martin (2005), who all found that CCTV policies help to ensure that police officers follow the rules of evidence when seizing CCTV footage for legal purposes.

4.6.2 Moderating effect of CCTV policies

The study used a binary logistic regression model to test whether CCTV policies moderated the relationship between CCTV use and police operations outcomes. Hayes' (2018) PROCESS macro software for SPSS was used to conduct the regression analysis. The predictor variables for the analysis were the use of CCTV in monitoring public spaces (CCTV_MON), coordinating incident responses (CCTV_RES), and investigating crime (CCTV_INV). The dependent variable in the analysis was police operations outcomes, whereas the moderating variable was CCTV policies (CCTV_POL). The regression model utilised the composite indices of all variables. Table 4.8 presents the regression results.

Table 4.8

Regressions Results on the Moderating Effect of CCTV Policies

Model	Variables	B	SE	Z	P	LLCI	ULCI
2	Constant	-8.137	2.821	-2.884	.004	-13.667	-2.608
	CCTV_MON	.879	.743	1.184	.237	-.577	2.335
	CCTV_RES	.534	.212	2.516	.012	.118	.951
	CCTV_INV	.203	.226	.896	.370	-.241	.646
	CCTV_POL	.692	.824	.840	.401	-.922	2.306
	Int_1	-.001	.209	-.005	.996	-.410	.408
Sample Size: 347						Level of Confidence: 95.000	
Model Summary: Log-Likelihood = 118.344, df = 5, p = .000, Nagelkerke R^2 = .387							

Source: Field Data, 2021

Table 4.8 indicates that the overall regression model is statistically significant (p =.000), meaning that the independent and moderating variables will likely significantly impact the dependent variable. The log-likelihood (LL) of 118.3 implies that the model fits the data well. The Nagelkerke R^2 of .387 indicates that the model explains 39 per cent of the variability in the moderated effect of CCTV policies on the association between CCTV use and the outcomes of police operations. This means other variables not included in the model explain 61 per cent of the variability.

Table 4.8 also shows that the interaction between CCTV use and the outcomes of police operations (Int_1) is not statistically significant (b = -.001, 95% C.I [-.410, .408], p = .996). This means that CCTV policies do not significantly affect the relationship between the use of CCTV and the outcomes of police operations. Table 4.8 further shows that the regression coefficients for the three independent variables are all positive (0.879, 0.534 and 0.203 for the use of CCTV to monitor public spaces, coordinate

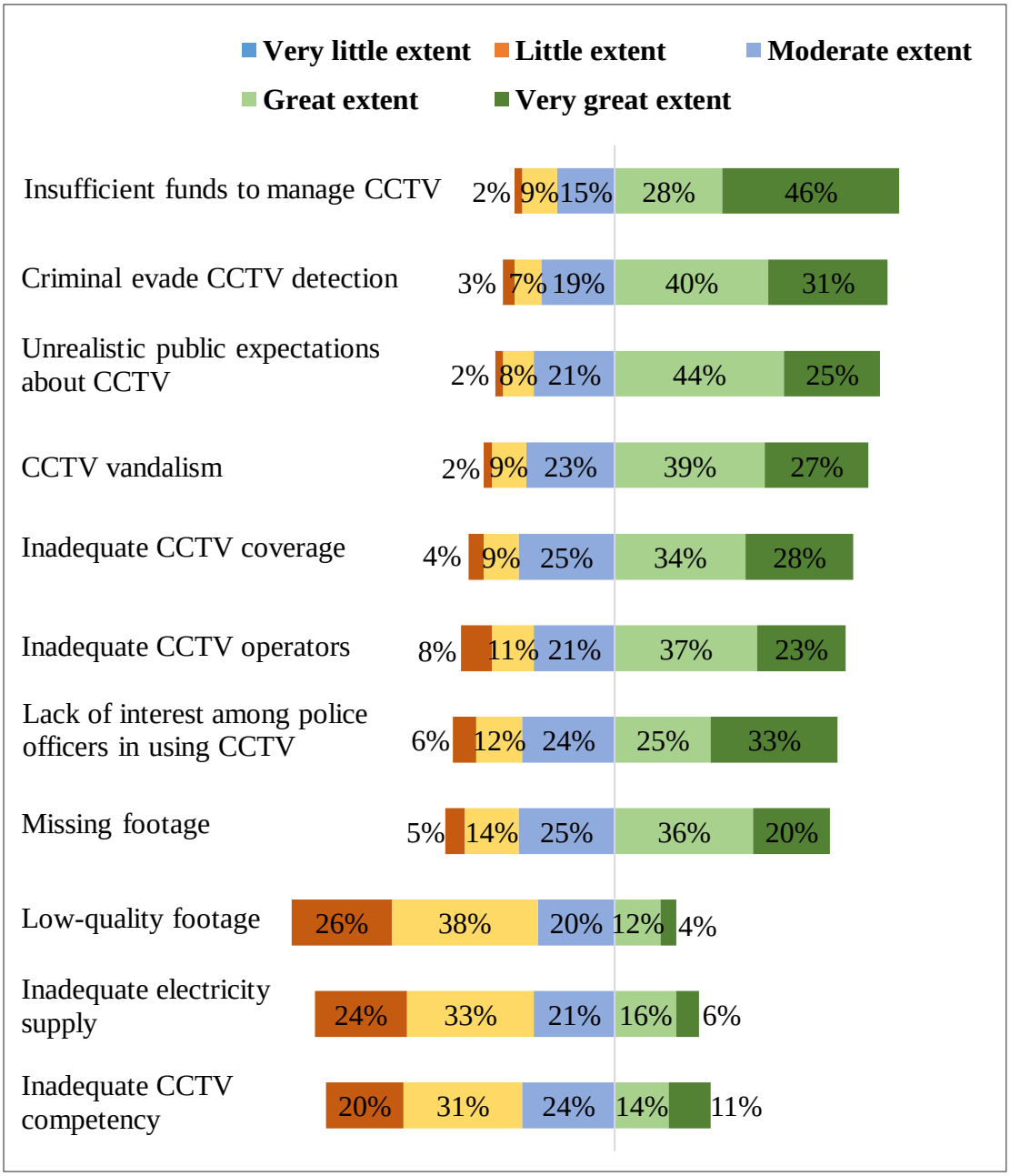
responses to incidents and investigate crime, respectively). This means that using CCTV in any of these ways is more likely to improve the outcomes of police operations than using it in combination with CCTV policies. In other words, CCTV policies do not make the use of CCTV more or less effective in improving the outcomes of police operations. These findings contradict the findings of a study by Lee (2020), which found that policies significantly impact policing outcomes.

4.7 Challenges to the Effective Use of CCTV in Police Operations in Nairobi City County

This section responds to the fifth specific objective of this study, which sought to establish the challenges hindering the effective use of CCTV in police operations in Nairobi County, Kenya. The reviewed studies identified 11 of such challenges. These were inadequate CCTV coverage, limited funding, inadequate electricity supply, insufficient CCTV operators, and limited CCTV user skills. Others were low-quality footage, lack of interest among police officers in using CCTV, criminals evading CCTV detection, unrealistic public expectations, CCTV vandalism, and missing footage. In order to assess the extent to which these challenges hindered the effective use of CCTV in police operations in Nairobi County, respondents were asked to rate each challenge on a five-point Likert scale, from 1 (*very little extent)* to 5 (*very great extent*). Figure 4.11 summarises the results of the survey.

Figure 4.11

Respondents' ratings of the challenges hindering the effective use of CCTV in police operations in Nairobi City County



Source: Field Data (2021)

Figure 4.11 shows that respondents rated insufficient funding as the most significant challenge to the effective use of CCTV in police operations in Nairobi City County, with nearly three-quarters (74%) saying it greatly hinders its use. Key informants and

FGD participants attributed the inadequate funding to limited budgetary allocations by the national treasury and NPS's failure to seek out alternative funding sources. They observed that, due to insufficient funding, the NPS could not adequately maintain the CCTV system, upgrade it, or pay allowances to CCTV operators regularly. A FGD participant lamented:

> *When we first started working here [IC3], we used to get an allowance, but this is no longer the case. When we ask for it, we are told that there is no money (PTA05, 2021).*

Similarly, a key informant said:

> *Payments are rarely made in full or on time to the contracted company. As a result, the company has threatened to turn off the CCTV system several times… Unfortunately, the cameras are not properly maintained and have not been upgraded or expanded as envisaged due to limited funds... I wish the [NPS] management could ask for more funds to manage it [the system] (KIF04, 2021).*

The quotes suggest that the funding for the police CCTV system in Nairobi County was inadequate and often delayed. This hampered the system's operations and put it at risk of collapse. Research has shown that CCTV systems are expensive to maintain. They require adequate and consistent funding to repair or replace worn-out components, clean the cameras, update the software, pay operators, and expand footage storage capacity, especially if the system records high-definition footage (La Vigne et al., 2011a). This can be challenging to resource-constrained police services like the NPS. These findings support Chapman's (2018) observation that limited funding negatively impacts the implementation, effectiveness and sustainability of policing technologies.

Figure 4.11 shows that nearly three-quarters (71%) of respondents said that criminals evading CCTV detection greatly impacted the effective use of CCTV in police operations in Nairobi City County. Qualitative data revealed that some criminals were aware of the benefits of CCTV and had developed several evasion strategies to avoid detection and arrest. These strategies included covering their faces with hoods or masks to disguise their identities, fitting stolen or getaway vehicles with fake, obscured, or numberless license plates to make it difficult for police to track their movement or identify who owned them, and committing crimes in areas with poor CCTV coverage. A FGD participant stated:

> *We've nabbed several criminal elements that camouflage their appearance by wearing balaclavas, sunglasses, caps, hoods and kanzus to commit crimes. The mandatory legal requirement to wear masks to curb COVID-19 seems to have aided such criminals. As you know, a mask partially hides a person's face, making it difficult to identify them in CCTV footage. As a result, some criminals have gotten away with their crimes (PTB07, 2021).*

Likewise, a key informant said:

> *There have been reports of criminals on motorbikes armed with knives and guns who snatch mobile phones and other valuables from unsuspecting pedestrians on the streets and highways. Many of these criminals are caught on CCTV. However, it is difficult to identify and apprehend some of them because they wear masks and helmets or ride motorcycles with number plates that are either fake, covered, or folded (KIF04, 2021).*

These quotes suggest that astute criminals had learnt the limitations of CCTV cameras in helping police identify people and vehicles as well as track and apprehend offenders over time. Consequently, they have developed tactics to reduce their chances of being identified or arrested when they commit crimes in areas with CCTV cameras. The implication of these findings is that the police need to modify their crime-fighting to address the evolving criminal CCTV evasion tactics. The findings of this study are

consistent with those of other studies, which have found that criminals respond to CCTV schemes and other policing strategies by changing their offending tactics (Rahman, 2017; Willis et al., 2017; Gill & Loveday, 2003). These findings also support RCT's view that criminals are rational and van Sintemaartensdijk et al.'s (2021) view that they develop unique expertise over time, allowing them to assess crime opportunities quickly and circumvent existing guardianship measures.

Figure 4.11 shows that over two-thirds (69%) of survey respondents felt that unrealistic public expectations about the capabilities of the police CCTV system greatly hindered its effective use in police operations in Nairobi County. This finding was corroborated by key informants and FGD participants, who stated that the public expected the CCTV system to function flawlessly and often blamed the police when the system failed to assist with incident management. A FGD participant said:

> *We occasionally encounter embarrassing questions from the members of the public concerning these cameras because we're uneasy about how to answer them. For example, I was investigating a traffic accident when a concerned driver asked him, "Do you want to say your cameras didn't capture that?" I was taken aback because I knew that the cameras in that area weren't working (PTC08, 2021).*

Also, a key informant stated:

> *There are some claims outside there that these CCTV cameras are useless, but that is not the case. They have helped to foil and solve many crimes in the city, including terrorist incidents. In reality, there is nothing that is 100 per cent perfect. The cameras may miss recording an incident because they are focused elsewhere or are defective. It's also not that easy to capture and monitor a single incident in a dense crowd or traffic and for operators to see everything. In addition, these cameras do not record sound. Due to such limitations, it is not easy for police to identify suspects captured on CCTV footage without the help of members of the public (KIF02, 2021).*

The above quotes suggest that the public had low confidence in the police CCTV system mainly because they did not understand its capabilities, uses and legal guidelines. If this low confidence is not addressed, it could lead to a lack of public participation in identifying and prosecuting criminals captured by the system. These findings are in tandem with Noris's (2012), Levesley and Martin's (2005) and Isnard's (2001) observations, which indicate that the public often has misconceptions and unrealistic expectations about CCTV systems due to a lack of information. This can undermine the success of CCTV systems. However, the current study only considered the views of police officers, which may differ from those of the members of the general public. Hence, its findings should be interpreted with caution.

Figure 4.11 shows that two-thirds (66%) of respondents reported that CCTV vandalism greatly hindered the effective use of CCTV in police operations in Nairobi County. FGD participants agreed with this finding, stating that miscreants sometimes destroy and steal CCTV equipment and fixtures, disrupting CCTV coverage and making it more difficult for police to detect and respond to crimes in the affected areas. A FGD participant said:

> *On that [vandalism], I can say they have started. For example, the memory card and battery of the mast in the FXX1 area were recently stolen. Some CCTV infrastructures also have missing screws, bolts, nuts, and pole-mounted battery boxes opened or damaged. If this menace is not addressed, it will render the cameras inoperable (PTA08, 2021).*

The vandalism of CCTV components was unexpected for three main reasons. First, the CCTV cameras had tamper-resistant features such as built-in detection sensors, concealed cabling, and vandal-resistant housing. These features were expected to make the cameras less attractive targets for vandals. Second, the cameras were installed on

sturdy steel poles at least five meters above the ground, with some poles having rows of spiked anti-climb collars. These features were supposed to make it harder for vandals to gain access to and damage the cameras. Third, the majority of camera sites had at least one pan-tilt-zoom (PTZ) camera and two bullet cameras, which means that the cameras could monitor each other and make it difficult for vandals to determine their exact field of view. Based on RCT, these findings imply that determined or skilled criminals had devised ways to circumvent the protective measures and vandalise CCTV components with less risk of detection and arrest. The findings also suggest that the police were not consistently monitoring CCTV, which would have allowed them to detect any potential vandalism incidents before they happened. The findings further suggest that CCTV vandalism incidents received less police attention, allowing vandals to commit crimes without fear of arrest. These findings were shocking because they implied that if the vice is not curtailed, emboldened criminals may vandalise the system on a large scale, severely destabilising its operations.

The above findings support La Vigne et al.'s (2011a) view that vandalism is a serious problem in implementing CCTV systems because it raises maintenance costs, primarily through regular repairs, and reduces effectiveness. On the contrary, the findings are inconsistent with those of Alabi (2018), who found no CCTV vandalism incidents in Kwara State College of Education, Oro, Nigeria, despite the initial concerns or predictions to occur by the college's security staff. The contradictory findings from these two studies suggest that the frequency of CCTV vandalism may vary across settings partly due to differences in demographic, social and economic conditions, as well as the nature of the security measures in place.

Figure 4.11 shows that nearly two-thirds (62%) of respondents said that insufficient CCTV coverage greatly hindered the effective use of CCTV in police operations in Nairobi City County. This finding was supported by FGD participants and key informants, noting that the police CCTV system only covered a small portion of the county, mainly the NCBD and major roads and streets. This limited coverage meant the police could not use CCTV to manage incidents across the county. A key informant remarked:

> *The cameras are a significant boost in combating crime and monitoring traffic in the county. However, they only cover a few areas. There are no cameras in slums and backstreets in the NCBD, which are areas with high crime rates. This means that incidents in these areas are more likely to go unnoticed unless they are reported [to the police] (KIF04, 2021).*

The above quote demonstrates that the number of CCTV cameras in Nairobi County cannot cover the entire county, limiting the areas where the police can monitor and conduct operations with the help of the cameras. This finding partly explains why crime rates in the county had not declined despite police using CCTV in their operations. The study's findings corroborate NPS's (2019c) claim that using CCTV cameras to detect crime in Nairobi County is inadequate. They also support Morgan and Coughlan's (2018) and La Vigne et al.'s (2011b) view that insufficient CCTV coverage substantially reduces the usefulness of CCTV systems.

The study also established that several factors had worsened insufficient CCTV coverage. These included the removal of some camera sites to make way for road expansions and damage to others by reckless or drunk drivers crashing into them. Additionally, road constructors occasionally damaged CCTV sites and fibre optic

cables. These factors led to a drop in CCTV coverage, making it difficult for police to monitor and secure the affected areas. A key informant remarked:

> *Some camera sites have been taken down to make way for road construction. The constructions have disrupted the camera network by damaging the fibre optic cables. Reckless and drunk drivers have also crashed into several camera poles, damaging some cameras beyond repair and rendering our [police]efforts to use them in combating crime ineffective (KIF02, 2021).*

It is worth noting that the police-operated CCTV system in Nairobi City County transmits data using fibre optic cables, making it vulnerable to disruption if the cables are tampered with or cut. The fact that this happened, as indicated by the above quote, raises questions about whether the physical planning for the system was adequate. Figure 4.12 shows a CCTV site with cameras removed for unknown reasons, while Figure 4.13 depicts others damaged by motorists' crashes.

Figure 4.12

A CCTV site with cameras removed

Source: Field Data (2021)

Figure 4.13

CCTV sites crashed into by motorists

Source: Field Data (2021)

The study also found that the inadequacy of CCTV operators posed a significant challenge to the effective use of CCTV in police operations in Nairobi County. Figure 4.11 shows that nearly two-thirds (60%) of survey respondents said it greatly hampered the use of CCTV. According to qualitative data, the number of CCTV operators has reduced over time, primarily due to frequent transfers and a lack of replacements. A FGD participant attached to the command centre stated:

> *Initially, our strength was okay because many officers thought being deployed here [IC3] would be lucrative. However, when they found out otherwise, many sought transfers. Additionally, over time, many officers have been transferred but not replaced. As a result, our strength is insufficient, which is affecting our work so much. For example, one operator now monitors ALPR and CCTV cameras covering one sub-county. We also work 12 hours in a shift and take a few short breaks in between, which is very long and exhausting. The worst time to be on the screens is at night, when the lights from street lamps and vehicle headlights strain our eyes much (PTC07, 2021).*

A key informant commented:

> *The personnel at the command centre are insufficient, which limits the monitoring of cameras around the clock. Who knows! This problem could make some incidents in areas with cameras go unnoticed (KIF04, 2021).*

These quotes reveal that the high turnover rate of CCTV operators has created a situation where there are not enough operators to cover all the required shifts. This shortage has forced operators to work long shifts and monitor multiple cameras simultaneously, causing them to become tired, lose focus and miss some incidents. The quotes also reveal that the continued exposure of CCTV operators to distressing situations, such as nighttime glare from street lights and long shifts with short breaks, has caused some operators to lose passion for their jobs. These findings suggest that the working conditions for CCTV operators are relatively poor, which lowers their productivity and the effectiveness of the CCTV system in detecting and deterring crime. The implication is that the NPS should find ways to engage and retain motivated operators to enhance the effectiveness of its CCTV system. The findings echo Ubioworo's (2015) view that CCTV operators are ineffective when monitoring a wide area or several cameras simultaneously. This is because they are likelier to miss spotting events occurring in other areas while focusing on a given area or recordings from other cameras. The findings also echo the observations of other researchers who found that heavy workloads and long working hours reduce CCTV operators' productivity and the effectiveness of CCTV systems (La Vigne et al., 2011a; Donald, 2010; Dadashi, 2008).

Missing footage in some CCTV-covered areas was another significant challenge to the effective use of CCTV in police operations in the county. Over half (58%) of survey respondents said this significantly hampered CCTV use (Figure 4.11). Key informants

and FGD participants cited various reasons for the missing footage. These included faulty cameras and blockage of the cameras' views by overgrown trees, new buildings and billboards. A FGD participant attached to operational duties stated:

> *These cameras are not always as useful as they once were. For example, you can ask the controller at the command centre to help you figure out what's going on in a specific area, only to be told that the cameras in that area aren't working (PTC04, 2021).*

Similarly, a key informant said:

> *Some CCTV cameras have been rendered useless due to malfunction and blockage by overgrown trees, newly erected billboards and buildings. For instance, the one at the MJ14 junction can no longer rotate to capture events in all directions. This makes it less helpful in monitoring and recording what is happening in the roundabout from all sides (KIF03, 2021).*

Figure 4.14 shows examples of CCTV cameras that trees had blocked.

Figure 4.14:

CCTV Sites with Overgrown Trees and Overhanging Branches Obstructing Cameras' Field of View

Source: Field Data (2021)

The above pictures exemplify how a lack of routine maintenance of CCTV sites caused some cameras to malfunction and trees to block others' fields of view. Such camera malfunctions and blockages rendered footage from the affected cameras unavailable, hindering various police operations, primarily traffic surveillance and criminal investigations. These findings align with past studies that have demonstrated that a lack of regular checks, cleaning and adjustment of CCTV cameras, as well as neglect to clear vegetation around CCTV sites, can render CCTV systems ineffective (La Vigne et al., 2011a; Keval & Sasse, 2008; Wells et al., 2006).

The study also discovered that a lack of interest by police officers in using CCTV was another significant challenge to its effective use in police operations in Nairobi City County. According to Figure 4.11, over half (56%) of respondents said this greatly hindered CCTV use. Qualitative data revealed that the disinterest varied greatly depending on an officer's deployment area, rank and age. For example, some officers stationed at the command centre were unhappy with their work due to a lack of allowances, long working hours, insufficient equipment, and the perception that their pivotal roles were unappreciated. A FGD participant lamented:

> *We are feeling demoralised! How are we expected to work well with little equipment, meagre and often unpaid allowances, and our directorate [IC3] not being recognised as important? (PTA06, 2021).*

Previous studies have also found that CCTV operators may become disinterested in their work if they have poor working conditions and feel underappreciated. For example, a study by Ansong and Ofori-Dwumfuo (2015) in Ghana found that security staff at university campuses were reluctant to monitor CCTV because they were not adequately financially motivated. Similarly, Singh (2009) observed that CCTV

operators might dislike their work when they feel their role and efforts are not valued. Generally, CCTV systems perform less effectively when operators are disinterested in their jobs, mainly because they are less likely to be proactive in identifying potential threats or paying close attention to suspicious activity.

In the case of officers performing investigative duties, their disinterest in using CCTV was due to the perception that it increased their workloads and investigation time. Similarly, besides increased workloads, constables assigned to patrol and traffic duties disliked being monitored on CCTV while on duty, and as a result, they rarely used radiophones equipped with cameras capable of recording and relaying real-time video of crime scenes to the IC3 for analysis. The following quote attests to this:

> *Some of us feel CCTV is burdensome, especially regarding the time it takes to visit the command centre [IC3] and shift through voluminous footage. Also, many officers in the field have resisted using cameras on police pocket phones as they dislike being monitored and controlled (PTA04, 2021).*

On the other hand, older officers felt that CCTV complicated their investigations because it provided additional data in digital form, which they claimed was challenging to use as evidence in court. As a result, some preferred using their traditional investigation tactics. For example, FGD participant PTA03 stated: "It is sometimes sensible and safe to avoid including CCTV footage as evidence in your investigation file to evade trouble in court." These sentiments suggest that some police officers performing operational duties were disinterested in using CCTV. Their lack of interest suggests that they were not making the best use of the CCTV system, reducing its effectiveness and wasting the resources used to operate and maintain it. These findings support past studies from the UK, USA and Australia that found that police officers are less likely to use CCTV when they believe it increases their workloads, is complex,

erodes their discretion, or introduces new levels of accountability (Rogers & Scally, 2018; Koper et al., 2015; Byrne & Marx, 2011; Levesley & Martin, 2005; Goold, 2003).

Figure 4.11 shows that respondents reported that the three challenges that least hindered the effective use of CCTV in police operations in Nairobi were low-quality footage (64%), inadequate electricity supply (60%), and inadequate user competencies (51%). Qualitative data supported these findings. Regarding footage quality, FGD participants and key informants revealed that the police CCTV system recorded high-resolution footage around the clock, making significant events and targets visible, clear, and distinguishable. On this, a key informant said:

> *These cameras are high-tech and record crystal-clear video images 24/7. They are digital and wireless. A number of them also have PTZ controls that allow operators to view targets remotely from different distances. When zoomed in and there are no obstructions, the cameras can clearly and vividly capture the details of a person or vehicle at different distances (KIF02, 2021).*

The finding that IC3 footage was high-quality contradicts Keval and Sasse (2008), who found that CCTV systems in London recorded low-quality video that was less useful in criminal investigations and prosecutions. The disparity in findings between this study and Keval and Sasse's (2008) study can be attributed to advancements in CCTV technology over the past 13 years, the period between the two studies.

Although the majority of the video was of high quality, some participants expressed concern that the footage from some cameras, particularly those in industrial and construction areas, was blurry. This blur made the footage less useful for criminal investigations and prosecutions. The participants attributed the blur to smoke and dust covering the cameras' lenses. This finding supports the earlier observations that the CCTV cameras were rarely cleaned. A FGD participant remarked:

> *Some of these CCTV cameras don't see well or capture clear footage. This is especially problematic for cameras near industries, construction sites, and areas with smoke from jua kali artisans or burning waste. The footage from these cameras doesn't help much in investigating crimes and adducing evidence in court (PTC02, 2021).*

In terms of insufficient electric power supply, qualitative data confirmed survey findings that it hampered the effective use of CCTV in police operations in Nairobi County the least. This was because power outages were rare and usually quickly resolved. Additionally, the CCTV cameras had backup batteries, and the control room had an automatic standby generator, which kept operations running even during an interruption in the power supply. A key informant said:

> *We don't have any problem with electricity. The supply is sufficient and reliable. Blackouts are rare, and we're always in touch with KPLC [Kenya Power and Lighting Company] to fix any interruptions that may occur. In addition, the command centre [IC3] has a backup generator, and the cameras have emergency backup batteries, so our operations have never been disrupted, even during power blackouts (KIF02, 2021).*

The above quote attests that the police CCTV system in Nairobi County had a reliable and stable power supply, with backup generators and batteries to keep it running in the event of a power outage. These findings suggest that the system was less likely to experience performance issues commonly associated with insufficient or interrupted power supply, such as loss of surveillance coverage, gaps in recorded video, image flickering, or corruption. As a result, the study concluded that the system supported police operations consistently. These findings contradict those of other studies, which have found that inadequate electricity supply and frequent power outages are major challenges in using CCTV and other technologies in policing. For example, a study by Yau (2019) found that insufficient electricity supply was among the main challenges limiting the effective use of public CCTV systems in Abuja, Nigeria. Carli (2008) also

found that many entities struggle to manage CCTV systems due to the high cost of supplying constant electricity and installing and maintaining standby generators. The contradictory findings suggest that the impact of electricity supply on the use of CCTV in police operations can vary significantly by jurisdiction. This could be due to differences in the quality of electricity infrastructure, the availability of backup power, and geographical factors such as storm and earthquake proneness, which can cause power outages.

Concerning inadequate CCTV incompetence, qualitative data confirmed quantitative data that it was a minor challenge. This was because the majority of CCTV operators had computer application certificates and had received CCTV training. Specifically, those performing monitoring duties had received training in operating and maintaining control room equipment and proactive and reactive surveillance. Those processing footage requests had also received training in retrieving, transcoding, disseminating, retaining and disposing of CCTV data and how to use CCTV data as evidence in court. A FGD participant said:

> *Most of us have computer applications certificates, diplomas and university degrees in IT-related courses. We've also attended diverse courses on operator skills, control room operations, and procedures while serving here [IC3]. Not only that, some of us have attended overseas courses on handling CCTV data and their use as evidence in court (PTA03, 2021).*

A key informant also said:

> *The [CCTV] operators are skilled and experienced. They are deployed per their respective fields of expertise. Also, many of them have received extensive CCTV training locally and outside the country, such as in South Korea, Japan, China, and the USA. I'm confident that they clearly understand their duties and responsibilities and carry out their work in accordance with the law and the operating procedures (KIF01, 2021).*

The above quotes show that officers stationed at the IC3 had received training that was tailored to their job functions and the essential skills required to carry out their duties effectively. This training made them competent in using CCTV. This finding contradicts previous studies that found insufficient competence among CCTV operators to be a significant challenge in implementing CCTV systems (Yau, 2019; Al-Rawahi & Edirisinghe, 2015; Kerr, 2009; Carli, 2008).

While CCTV operators were proficient in using CCTV technology, the study found that many police officers in the field were not. This was because the majority of them had not received any CCTV training. One participant in a FGD said:

> *I have not had any CCTV training. My knowledge of CCTV is from my personal experiences, books, the internet, the media, court cases, and discussions with other officers (PTC01, 2021).*

Besides a lack of CCTV training, the above quote indicates that some police officers performing operational duties learned how to use CCTV through experience and self-study. This means that many of these officers could not use CCTV competently. The finding that police officers monitoring the cameras had received CCTV training but those in the field had not suggests that there is a CCTV competency gap between the two groups of police officers. This gap could make it difficult for the two groups of officers to collaborate effectively in managing CCTV-detected incidents. This finding supports the previous finding that incident responses were poorly coordinated. These findings are consistent with those of Kerr (2009) and Gerrard et al. (2007), who found that CCTV operators are often trained, while patrol officers and investigators are rarely trained. This suggests that police officers in the field should receive more CCTV training in order to use CCTV more effectively to support their operational duties.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This last chapter summarises the study's main findings. It also presents the conclusions and recommendations of the study and the areas requiring further research.

5.1 Summary of the Main Findings

The study investigated how the police-operated CCTV system in Nairobi City County has impacted police operations. Its specific objectives were to assess the effects of using CCTV in monitoring public spaces on the outcomes of police operations, analyse the impact of using CCTV in coordinating incident responses on the outcomes of police operations, evaluate the influence of using CCTV in investigating crimes on the outcomes of police operations, determine the moderating effect of CCTV policies on the relationship between CCTV use and the outcomes of police operations, and examine the challenges to the effective use of CCTV in police operations in Nairobi City County. Subsections 5.1.1 to 5.1.5 summarise the study's key findings, organised by the five specific objectives.

5.1.1 Impact of CCTV Monitoring on the Outcomes of Police Operations

The study found that CCTV monitoring has greatly aided police operations in Nairobi City County in gathering real-time information on incidents, monitoring and supervising traffic flow, identifying areas with traffic congestion and obstructions, and detecting traffic violations, crimes and suspicious activity. Also, it has greatly helped police identify crime hotspots, gather intelligence on common crimes and habitual criminals, and understand the methods criminals use to commit crimes. Additionally, it has significantly reduced crime, particularly carjacking, vehicle theft and bank robberies. It has also reduced the cost of conducting police operations and improved

road safety and the safety of police officers. However, it has not significantly quickened police response to incidents. In addition, police could not monitor activities in many parts of the county due to insufficient CCTV coverage.

5.1.2 Impact of the Use of CCTV to Coordinate Responses to Incidents on the Outcomes of Police Operations

The study found that the use of CCTV to coordinate incident responses has greatly aided police in tracking incidents in real-time, assessing their severity, determining the appropriate enforcement action, determining the quickest and safest response routes, assessing and mitigating threats to responding officers, and improving road safety and police officer safety. However, it has not significantly reduced crime or the cost of police operations nor quickened police response to incidents. This is mainly due to limited CCTV coverage and poor coordination between police officers monitoring the cameras and those performing operational duties.

5.1.3 Impact of the Use of CCTV to Investigate Crime on the Outcomes of Police Operations

The study found that the use of CCTV in investigating crime has greatly assisted police in identifying, tracing and arresting suspects and obtaining evidence to aid their prosecution. It has also been of great help to police in getting evidence for traffic violations, corroborating suspects' and witnesses' statements, and proving cases and clear cases. However, it has only been used to obtain convictions for traffic offences. In addition, CCTV footage was not always helpful in investigating crimes because it was sometimes of poor quality, missing, or incomplete. Furthermore, some police officers were not using CCTV footage in their investigations because the NPS was not providing the devices to record the needed footage.

The study also established that CCTV cameras with ALPR have significantly assisted police in recovering reported stolen vehicles and investigating other vehicle-related crimes. However, they have not helped police recover vehicles reported stolen outside of Nairobi County because their details were not in its database. Additionally, some criminals have adapted to ALPR over time by devising ways to evade its use.

Moreover, the study found that the use of CCTV in investigating crimes has reduced crime, enhanced officer safety, improved road safety, and lowered the cost of police operations in areas with CCTV cameras. It has, however, not significantly quickened police response time to incidents.

5.1.4 Moderating Effect of CCTV Policies on the Relationship between CCTV Use and Outcomes of Police Operations

The study found that legal policies on CCTV were adequate and have positively impacted the use of CCTV in police operations in Nairobi County. They have also effectively guided police in the use of CCTV, mainly when seizing footage for evidentiary purposes. Equally, NPS policies on CCTV have ensured the appropriate use of the police CCTV system, and that only skilled and authorised officers operate and handle its data. However, they provide a shorter retention period for footage (30 days), limiting its availability for investigating incidents that come to the attention of police after being erased. Additionally, NPS policies do not specify the areas or activities police officers should monitor or record when using CCTV, which could lead to CCTV abuse. The study also established that many police officers performing operational duties were less conversant with CCTV policies, while others felt they were restrictive. The study further found that CCTV policies do not significantly moderate the relationship between the use of CCTV and the outcomes of police operations.

5.1.5 Challenges to the Effective Use of CCTV in Police Operations

The study established that insufficient funding was the greatest challenge to the effective use of CCTV in police operations in Nairobi City County. It was followed by criminals evading CCTV detection, unrealistic public expectations about CCTV, CCTV vandalism, and insufficient CCTV coverage. The insufficient coverage had been exacerbated further by the removal of some camera sites to pave the way for road construction, the destruction of CCTV road infrastructure by motorists involved in accidents, and frequent fibre optic cable cuts during road construction. Other significant challenges included inadequate CCTV operators, a lack of interest by police officers in using CCTV, and footage missing in some areas with CCTV cameras due to poor maintenance of the CCTV system. However, low-quality footage, CCTV incompetencies and insufficient electricity supply were insignificant challenges.

5.2 Conclusions

The police-operated CCTV system in Nairobi City County has significantly improved police operations. It has enhanced police operational tasks regarding monitoring public spaces, coordinating responses to incidents and investigating crimes. It has also significantly reduced crimes, lowered the cost of police operations and enhanced road safety and the safety of police officers on operation duties in areas with CCTV cameras. However, several gaps, concerns and challenges negatively impact the CCTV system's effectiveness. The most critical of these is inadequate funding, which has resulted in poor maintenance of the CCTV system and put it at risk of collapsing. Other critical challenges are limited CCTV coverage and strained working relationships between police officers monitoring CCTV cameras and those in the field, which have significantly hampered incident responses. Overall, the study concludes that police-operated CCTV systems can be effective tools for supporting police operations and

achieving desired outcomes, but only when they have adequate coverage, are well-maintained, and have adequate and regularly reviewed policies.

5.3 Recommendations

Based on its findings, the study made several recommendations. For specific objective one, it recommends that the national and Nairobi City County governments consider expanding CCTV coverage in areas with no cameras and high crime rates, such as slums and NCBD backstreets, to improve CCTV monitoring. They should also consider installing CCTV cameras in blind spots and reinstalling them in areas where they were removed to make way for road construction. The expansion of CCTV coverage needs to be based on sound physical planning to ensure the permanence of the installed cameras.

For specific objective two, the study recommends that the NPS consider forming quick response squads and holding regular meetings between police officers operating CCTV cameras and those performing operational duties to enhance their use of CCTV in coordinating incident responses. The proposed quick response squads should be established and managed at the police station level to prevent conflicts with other officers on operational duties. They should be strategically placed on standby in high-crime areas and adequately resourced to respond immediately and effectively to CCTV-detected incidents. Some squad members should wear civilian clothes to be less noticeable and heighten the element of surprise. The regular meetings between police officers operating CCTV cameras and those in the field would facilitate communication and feedback on the use of CCTV. They would also help identify solutions to existing problems and strengthen the working relationships between the two groups of police officers in coordinating responses to CCTV-detected incidents.

For specific objective three, the study recommends that the NPS could improve the use of CCTV in investigating crimes in four ways. First, it needs to consider publicising the successful uses of CCTV in detecting crime and arresting and prosecuting offenders through community policing forums and print and electronic media. This would enhance the deterrent effect of CCTV and help to reduce crime and traffic violations in the county. It is essential to disguise the images of individuals in the disclosed videos to protect their privacy rights. Second, the NPS can consider requesting the Nairobi City County government to install adequate lighting in CCTV-monitored areas. Adequate lighting would ensure that footage recorded at night and in poor-lit areas like underpasses is always of high quality. High-quality footage would allow IOs to accurately identify suspects and vehicles involved in crimes. It would also help reduce CCTV vandalism by denying criminals hiding places when dismantling or destroying CCTV equipment and accessories. Third, the NPS needs to consider providing IOs with devices to store the footage they need for their investigations. These devices should be write-protected and only readable on specified computers to safeguard the integrity of the copied and stored footage. Fourth, the NPS needs to intensify crackdowns on vehicles with fake license plates and collate and enter the registration numbers of all vehicles reported stolen across Kenya into the ALPR database. Crackdowns on vehicles with fake license plates would help discourage criminals from using such vehicles to defeat ALPR detection. Collating and entering the registration numbers of all vehicles reported stolen across the country in the ALPR database would allow the police to detect and seize such vehicles when used in Nairobi City County.

For specific objective four, the NPS should consider publishing its CCTV policies, reviewing them regularly, and sensitising police officers about them and the effective methods and benefits of using CCTV. The sensitisation programmes may include

simulation training to provide police officers monitoring the cameras and those in the field with practical skills in coordinating incident responses. In reviewing its CCTV policies, the NPS may consider extending its footage retention period from 30 to at least 90 days. The extension would ensure that footage is available for investigating incidents that come to the attention of the police late. One way to extend the retention time is for the NPS to consider expanding footage storage capacity by investing in video compressors or backup devices. Another way is to mandate CCTV operators to copy footage of significant incidents onto separate storage devices for possible investigative purposes. Moreover, the review of CCTV policies needs to specify the areas police officers monitor and the activities they record when using CCTV to minimise misuse.

With respect to specific objective five, the study recommends that NPS consider asking the national treasury to increase and disburse funds for the CCTV system in Nairobi County on time. It may also seek funding from other stakeholders to supplement exchequer provisions. To reduce CCTV vandalism, the NPS needs to respond quickly to vandalism incidents and petition Parliament to enhance its penalties, particularly fines. Harsher vandalism penalties would deter reckless and inebriated drivers from knocking down and destroying road CCTV infrastructure. In addition, the NPS could consider fortifying road CCTV sites with steel barricades cushioned with reflective rubber materials to reduce damage during road accidents.

To address CCTV operators' inadequacy and low interest in their work, the NPS could consider deploying more police officers to the command centre and improving their working conditions. Also, to address the unrealistic public expectations about what the police CCTV system can accomplish, the NPS could consider sensitising Nairobi County residents about its capabilities and how it has improved their safety and

security. Such public awareness campaigns would improve relations between the police and Nairobi County residents and their collaboration in crime management efforts. Moreover, the NPS should regularly maintain its CCTV system to ensure it optimally functions and supports police operations, especially in ensuring consistent footage availability for surveillance and investigative purposes. Regular maintenance should involve periodic inspections, servicing or replacing defective cameras, clearing vegetation around CCTV sites, and removing billboards obstructing cameras' views. Clearing vegetation that obscures CCTV cameras would necessitate the NPS working with the Nairobi City County government to develop and implement a CCTV tree maintenance plan.

5.3.1 Areas for Further Research

Given the scope and the limitations of this study, future research could address the following four areas:

1. Compare the use of CCTV in police operations in Nairobi and other counties to understand better how CCTV impacts policing outcomes across Kenya.
2. Assess the effectiveness of CCTV in a wider range of settings because the current study focused solely on the police-operated CCTV system in the county.
3. Determine the impact of different CCTV camera types (such as PTZ, infra-red, dome, and bullet) on police operations in Nairobi County.
4. Examine the impact of CCTV use on citizen-police relations in Nairobi County.

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APPENDICES

Appendix I: Informed Consent Form

Introduction

I am Gideon Kirui, a PhD student in Security Studies at Kenyatta University. I am researching the ***impact of the CCTV system operated by police in Nairobi City County on police operations***. The data I collect will help me complete my PhD studies.

Procedures to be followed in the study

I will either interview you, ask you to complete a questionnaire or have you participate in a focus group. I will record the interview and focus group discussion information in a notebook.

Voluntarism

Your participation in this study is entirely voluntary. You are free to withdraw from this study at any given time without giving any reason and with no consequence.

Discomforts and Risks

There are no known risks for participating in this study. However, you can skip answering any question if you feel uncomfortable answering it.

Benefits

This study will not directly benefit you but will help us understand how CCTV supports police operations in Nairobi City County.

Reward

There is no reward or payment for participating in this study.

Confidentiality

Your responses will be kept anonymous and confidential. Therefore, your name, service number, or other identifying information shall not be recorded in any research instrument. Also, no identifying details will be used in discussing and reporting data.

Contact Information

If you have any questions or need clarification, please do not hesitate to contact me on mobile phone No. 0720 757 293 or the Chairperson, Department of Security and

Correction Science, Kenyatta University, P.O Box 42844-00100 Nairobi; Tel: 0202710901/19 Ext: 3292/3; Email chairperson-sus@ku.ac.ke

If you have any questions about your rights as a study participant, please get in touch with the Kenyatta University Ethical Review Committee Secretariat on Tel. +254(20)8714388 or Email chairman.kuerc@ku.ac.ke

Participant's Statement

I confirm that I have read and understood the above information regarding my participation in this study. I have also been allowed to ask questions, which have been answered to my satisfaction. I, therefore, agree to take part in this study.

Sign_____ Date_____

Investigator's Statement

I confirm that I have explained to the volunteer in the language that he/she understands the procedures to be followed in this study and the risks and benefits involved.

Investigator's Name: _____

Investigator's Signature: _____ Date: _____

Questionnaire No._____

Appendix II: Questionnaire for Police Officers Performing Operational and IC3 Duties

Introduction

This questionnaire seeks your views on how the police CCTV system in Nairobi County has supported police operations. It should take 15 minutes to complete. Your responses will be anonymous, confidential and used for research purposes only. Therefore, please do not include your name, Force/Service number, or other personal information on this questionnaire. Kindly respond to the items/questions in this questionnaire by either ticking (√) the appropriate checkbox or writing down your answer in the provided blank space(s).

Section A: Background Information

1. Please indicate your Service/Directorate.
   - ☐ KPS
   - ☐ DCI
   - ☐ IC3
2. Please indicate your gender.
   - ☐ Female ☐ Male
3. Please indicate your age bracket.
   - ☐ 18-24 years
   - ☐ 25-34 years
   - ☐ 35-44 years
   - ☐ 45-60 years
4. Please indicate your rank.
   - ☐ Constable
   - ☐ NCO
   - ☐ Member of the Inspectorate
   - ☐ Gazetted Officer (ASP & above)
5. Please indicate the period you have served in Nairobi City County.
   - ☐ 0-3 years
   - ☐ 3-5 years
   - ☐ Over 5 years
6. Please indicate the highest level of education you have completed.
   - ☐ Primary
   - ☐ Secondary
   - ☐ Diploma
   - ☐ University

Section B: Use of CCTV to Monitor Activities in Public Spaces

7. Please indicate the extent to which CCTV monitoring by the IC3 has helped police carry out the functions stated in the table below.

S/No.	Statement	Very little extent	Little extent	Moderate extent	Great extent	Very great extent
a)	Detect suspicious activities	☐	☐	☐	☐	☐
b)	Detect crimes	☐	☐	☐	☐	☐
c)	Track traffic flow	☐	☐	☐	☐	☐
d)	Detect traffic violations	☐	☐	☐	☐	☐
e)	Gather intelligence	☐	☐	☐	☐	☐

8. Kindly comment on how CCTV monitoring by the IC3 has assisted police in their operations in Nairobi City County.

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Section C: Use of CCTV to Coordinate Responses to Incidents

9. Please indicate the extent to which the use of the IC3 CCTV system to coordinate incident responses has helped police conduct the activities stated in the statements below.

S/No.	Statement	Very little extent	Little extent	Moderate extent	Great extent	Very great extent
a)	Assess the severity of incidents and determine the appropriate response to take	☐	☐	☐	☐	☐
b)	Deploying officers and other resources to incidents	☐	☐	☐	☐	☐
c)	Determining the quickest and safest routes to incident scenes	☐	☐	☐	☐	☐
d)	Guiding police officers at incident scenes	☐	☐	☐	☐	☐
e)	Assessing and mitigating threats facing police officers while responding to incidents	☐	☐	☐	☐	☐

10. Kindly comment on how the use of the IC3 CCTV system to coordinate responses to incidents has assisted police in carrying out their operations in Nairobi City County.

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Section D: Use of CCTV to Investigate Crime

11. Kindly indicate the extent to which IC3 footage has aided the police in carrying out the investigative activities listed in the table below.

S/No.	Statement	Very little extent	Little extent	Moderate extent	Great extent	Very great extent
a)	CCTV has helped police identify suspects.	☐	☐	☐	☐	☐
b)	CCTV has assisted police in tracing and arresting suspects.	☐	☐	☐	☐	☐
c)	CCTV footage has aided police in corroborating statements of suspects, victims, and witnesses.	☐	☐	☐	☐	☐
d)	CCTV has helped police obtain evidence of crimes.	☐	☐	☐	☐	☐
e)	CCTV has enabled police to get evidence of traffic violations.	☐	☐	☐	☐	☐
f)	CCTV cameras integrated with automatic license plate readers (ALPR) have helped police recover stolen vehicles.	☐	☐	☐	☐	☐
g)	CCTV footage from the IC3 has helped police to prove cases in court.	☐	☐	☐	☐	☐
h)	CCTV has assisted police in clearing cases.	☐	☐	☐	☐	☐

12. Please comment on how IC3 footage has helped police investigate crimes.

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Section E: Effect of Policies on the Use of CCTV in Police Operations

13. Please indicate the extent to which CCTV policies have influenced the use of CCTV in police operations in Nairobi City County, as stated in the statements below.

S/No.	Statement	Very little extent	Little extent	Moderate extent	Great extent	Very great extent
a)	Existing laws effectively guide police officers when using CCTV in their operations.	☐	☐	☐	☐	☐
b)	Existing laws sufficiently guide police officers when seizing CCTV footage to be used as evidence in court.	☐	☐	☐	☐	☐
c)	There are sufficient legal policies on CCTV in Kenya.	☐	☐	☐	☐	☐
d)	Legal policies have positively affected the use of CCTV in police operations.	☐	☐	☐	☐	☐
e)	The NPS has policies that ensure the appropriate use of its CCTV system.	☐	☐	☐	☐	☐
f)	NPS CCTV policies clearly specify the areas to be monitored and activities to be recorded by police officers when using CCTV cameras	☐	☐	☐	☐	☐
g)	NPS CCTV policies ensure that skilled officers operate CCTV	☐	☐	☐	☐	☐
h)	NPS CCTV policies provide adequate time for the storage of CCTV data that may be required as evidence in any legal suit	☐	☐	☐	☐	☐
i)	NPS CCTV policies clearly specify ways in which CCTV data can be disseminated	☐	☐	☐	☐	☐

14. Kindly explain how CCTV policies have affected the use of CCTV in police operations in Nairobi City County.

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Section F: Impacts of the Use of CCTV on the Outcomes of Police Operations

15. Please indicate the extent to which the police-operated CCTV system in Nairobi County has achieved the outcomes of police operations stated in the table below.

S/No.	Statement	Very little extent	Little extent	Moderate extent	Great extent	Very great extent
a)	The use of CCTV has reduced crimes in Nairobi County.	☐	☐	☐	☐	☐
b)	The use of CCTV has quickened police response to incidents in Nairobi County.	☐	☐	☐	☐	☐
c)	The use of CCTV has enhanced road safety in Nairobi County.	☐	☐	☐	☐	☐
d)	The use of CCTV has enhanced the safety of police officers when conducting operational duties in Nairobi County.	☐	☐	☐	☐	☐
e)	The use of CCTV has reduced the cost of conducting police operations in Nairobi County.	☐	☐	☐	☐	☐

16. Kindly comment on how the police-operated CCTV system in Nairobi County has supported the achievement of outcomes of police operations in the county.

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Section G: Challenges in Hindering the Effective Use of CCTV in Police Operations

17. Please indicate the extent to which the challenges listed in the table below hinder the effective use of CCTV in police operations in Nairobi City County.

S/No.	Statement	Very little extent	Little extent	Moderate extent	Great extent	Very great extent
a)	Inadequate CCTV coverage	☐	☐	☐	☐	☐
b)	Unavailability of footage in areas covered by CCTV cameras	☐	☐	☐	☐	☐
c)	Low-quality CCTV footage	☐	☐	☐	☐	☐
d)	Inadequate electricity supply	☐	☐	☐	☐	☐
e)	Insufficient funds to manage CCTV systems	☐	☐	☐	☐	☐
f)	Inadequate personnel to manage CCTV systems	☐	☐	☐	☐	☐
g)	Lack of interest among police officers in using CCTV	☐	☐	☐	☐	☐
h)	Criminals use various means to evade detection by CCTV cameras, e.g., wearing masks or caps.	☐	☐	☐	☐	☐
i)	Vandalism of CCTV equipment and accessories, e.g., cameras, mounts, cables and monitors	☐	☐	☐	☐	☐
j)	Unrealistic expectations by the members of the public on what the police CCTV system can do	☐	☐	☐	☐	☐
k)	Inadequate competency among police officers in using CCTV	☐	☐	☐	☐	☐

18. Explain other challenges police experience when using CCTV in their operations in Nairobi City County, if any.

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Thank you for your time in completing this questionnaire.

Appendix III: Focus Group Discussions Guide for Police Officers Performing Operational and IC3 Duties

FGD No._____ Date:_____

Group Description:_____

Introduction

Hello everyone, good morning/afternoon. Thank you for accepting to participate in this FGD. We will be discussing six key areas concerning the use of the police CCTV system in Nairobi County in police operations. I may also ask some follow-up questions to clarify any unclear or arising issues. I will record the discussion and keep all notes and recordings safe and secure. Please take turns speaking and do not interrupt anyone. I am interested in hearing what everyone has to say, so please respect each other's viewpoints. At the end of the discussion, I will give you an opportunity to ask me some questions, which I will try to answer to the best of my ability. The discussion will last for approximately 90 minutes. Let us get started.

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1. How has the IC3's CCTV monitoring aided the police in performing the following surveillance functions?
    a) Detect suspicious activities.
        - Has it led to the detection of large gatherings, unusual sounds, abandoned items, or suspicious individuals or vehicles?
        - Can you provide an example of a case where it helped detect suspicious activity?
    b) Detect crime
        - Has it resulted in detecting ongoing criminal activity or more crimes?
        - Which crimes have been detected the most and the least, and why?
    c) Supervise traffic flow
        - How has it allowed real-time understanding of traffic conditions such as volumes, hazards, accidents, trends or patterns?
        - Has it assisted in informing motorists of traffic conditions?
        - How has it aided in traffic management when there are large crowds (e.g., parades, demonstrations and political rallies) or traffic jams?
    d) Detect traffic violations
        - How has it aided in promptly detecting traffic violations and subsequent enforcement?

e) Gather intelligence
    - How has it aided in identifying criminals and their tactics and routines?
    - How has it aided in understanding crime patterns and trends and deploying appropriate responses?

2. How has the use of CCTV to coordinate responses to incidents helped the police to perform the following actions?

    a) Assess the severity of incidents and determine the appropriate response.
        - How has it aided in understanding the nature of unfolding or ongoing incidents and the best course of action?
        - How has it assisted in determining the number of victims, the severity of injuries, and potential public danger?
        - How has it helped identify escape routes, potential witnesses, and other factors affecting police response?
        - Can you describe an instance where it provided crucial details about the extent of damage or injury and prioritised response efforts?

    b) Determine the quickest and safest routes to incident scenes.
        - How has it assisted in identifying the location of an incident?
        - Can you describe any instance where it assisted officers in navigating the best route to an incident scene?

    c) Deploy personnel and other resources to incident scenes.
        - How has it helped determine the number of personnel and resources to deploy to an incident?
        - Can you explain a scenario in which it successfully helped manage an incident by ensuring the efficient allocation of officers and resources?

    d) Guide responding officers when managing incidents.
        - How has it aided in directing responding officers to safe and accessible routes and entry points to incident sites?
        - In what ways has it enabled responding officers to adjust their response strategies based on changing circumstances?

    e) Identify and mitigate the dangers facing officers responding to incidents.
        - How has it helped officers identify suspects' movements and locations at the scene?

- How has it aided in strategically deploying resources to reduce the risks to responding officers?
- How has it assisted in assessing crowd behaviour and detecting crowd-related dangers?
- Can you provide an example where it resulted in effective risk mitigation strategies?

3. How has the use of IC3 footage to investigate crimes helped the police conduct the following investigative tasks?

    a) Identify, track and apprehend suspects.
        - How has it aided in identifying a suspect based on their physical features, clothing and activities before, during and after a crime?
        - Has it helped distinguish multiple suspects in crowded or chaotic scenes or exonerate falsely accused individuals?
        - How has it helped track suspects' movements from the crime scene to other locations?
        - Can you provide an example where it assisted in successfully identifying, tracking, and apprehending a suspect?

    b) Corroborate the statements of suspects, victims and witnesses.
        - How has it helped clarify or disprove statements by various parties?
        - Can you describe a case in which it helped confirm or disprove statements by parties?

    c) Recover stolen vehicles.
        - Have CCTV cameras integrated with ALPR assisted in identifying and tracking stolen vehicles?
        - Can you describe a case where these cameras assisted in intercepting and seizing a stolen vehicle or that involved in a crime?

    d) Obtain evidence for crimes.
        - How has it aided in identifying people, vehicles, objects, or tools used in a crime?
        - How is it often used as a primary source of evidence in criminal investigations?
        - Has it provided multiple perspectives on an incident, possibly capturing details that verbal testimonies may have missed or adding to evidence from other sources?
        - Has it aided in understanding the motivations behind a crime?
        - Has it consistently provided valuable evidence for crimes?
        - Are there any types of crime where it has been especially valuable?

e) Get evidence for traffic violations.
    - Has it helped capture evidence of traffic violations? Please explain.
    - How has it helped reconstruct events before, during and after a traffic accident?
    - Has it been helpful in hit-and-run cases, assisting in vehicle identification and possibly leading to the arrest of involved drivers? Please explain.

f) Prove crimes in courts.
    - Has it been used to prove cases successfully in court? If so, could you list them and explain how they helped prove one of them? If not, explain why.
    - Has it been challenged or questioned in court? If yes, please explain.

g) Clear/solve crimes.
    - How has its use as evidence affected the outcomes of criminal and traffic cases?
    - Are there cases it has successfully resolved? If there, please list them. If not there, please explain why.

4. How have the following policies affected the use of the IC3 surveillance system?

a) Legal policies.
    - Do existing laws provide effective guidance to police officers when using CCTV? If so, could you explain how they have guided police officers when seizing footage for use as evidence in court? If not, please elaborate.
    - Are legal policies on CCTV in Kenya sufficient? If so, have they influenced the use of CCTV in police operations positively? If not, explain why.

b) NPS policies.
    - Do NPS policies specify the areas and activities police officers should monitor and record when using CCTV? If **yes**, what areas and activities are involved? If this is **not** the case, please explain why.
    - Do NPS policies ensure that skilled officers operate CCTV? If so, what qualifications do officers need to work at the IC3? If not, please elaborate.
    - How long do NPS policies allow for the retention of footage? Is this enough time? If **not**, please explain why.
    - Do NPS policies clearly specify how to disseminate CCTV data, if necessary? If **yes**, who is authorised to do so for what purposes, and what is the procedure? If this is **not** the case, please explain why.

5. Are there challenges impeding police officers from effectively using the IC3 CCTV system in their operational duties?
    a) Are there any financial, technical, legal or competency challenges hindering the optimal use of the IC3 surveillance system?
    b) Have there been instances where poor IC3 footage quality or unavailability hampered police operations? If **yes**, please explain.
    c) What effect does the public's perception of the system impact its use?
6. Has the use of the IC3 CCTV system resulted in the following outcomes of police operations?
    a) Crime reduction
        - Has the number of crime commissions changed significantly since the implementation of the IC3?
        - Are there any specific types of crime that have shown a notable reduction since its implementation? If so, please list them and explain why they have declined. If no, explain why.
        - Is there any area with IC3 CCTV cameras where crime rates have not declined? What factors might have contributed to this?
        - Have criminals been observed changing their behaviour due to the presence of IC3 CCTV cameras?
        - Are there any innovative ways in which police are using IC3 data to predict and prevent crimes proactively?
    b) Quick response to incidents
        - How has IC3 CCTV monitoring aided in the rapid response to ongoing or developing incidents?
        - Has the real-time CCTV monitoring by IC3 helped with more efficient emergency response, allowing officers to be dispatched to incidents as they occur? Please explain.
        - Has IC3 footage improved the quality and efficiency of evidence collection, potentially shortening the time and effort required for investigations? Please elaborate.
        - Can you provide an example of a case where police took immediate action based on live feeds from the IC3?
    c) Enhanced road safety
        - How has IC3 CCTV monitoring helped to manage traffic congestion and hazards, reduce bottlenecks, and improve traffic flow?
        - Could knowledge of IC3 CCTV monitoring have influenced driver behaviour and deter traffic law violators? Please elaborate.

- Has analysing IC3 footage aided in understanding traffic or accident patterns and identifying areas prone to frequent traffic violations or accidents? Please give an example of how this analysis influenced traffic management strategies.
- Can you share a case where timely identification of incidents by IC3 led to a faster response to a potential or an actual accident, potentially preventing collisions, reducing disruptions or mitigating their severity?

d) Improved safety of police officers
   - Have the live CCTV feeds from IC3 helped police officers maintain operational awareness of ongoing situations and potential threats?
   - How have they aided in coordinating incident responses and promoting overall officer safety?
   - Has IC3 footage analysis aided in identifying strategic patrol routes, allowing officers to cover high-risk areas more effectively and safely?
   - When officers attend to incidents or are on patrol, how has IC3 data aided in planning effective backup/reinforcement and response strategies?
   - Can you give an example of how timely awareness provided by IC3 live video feeds allowed officers to assess the level of risk before engaging in potentially dangerous situations or saved officers from encountering dangers or risks on the scene?

e) Reduction in police operations costs
   - Has IC3 footage analysis enabled police to assess incidents remotely and determine whether an on-site response is necessary, potentially saving resources?
   - Could IC3's live CCTV monitoring have reduced the need for officers to patrol specific areas physically, resulting in less vehicle use and associated fuel costs? Please explain.
   - What impact has the use of IC3 footage had on police resource allocation? Has it resulted in a more targeted deployment of officers and vehicles?
   - Is there any evidence that IC3's live CCTV monitoring or footage analysis contributed to overall financial efficiency?

7. Do you have any additional suggestions, ideas, or questions?

Thank you for your participation and input.

Appendix IV: Key-Informant Interview Schedule for Police Managers

Interview No._____ Date:_____

Informant Description:_____

Introduction

Good morning/afternoon. Thank you for agreeing to participate in this interview. I will ask you six questions about the critical areas related to the use of the police CCTV system in Nairobi County in police operations. I may also ask some follow-up questions to clarify any unclear or arising issues. I will record the interview and keep all notes and recordings safe and secure. At the end of the interview, I will give you an opportunity to ask questions and do my best to answer them. The interview will last for approximately 80 minutes. Let us begin.

---

1. In your opinion, has IC3's CCTV monitoring assisted police in undertaking the following?
    a) Detect suspicious activity.
        - How has real-time CCTV monitoring by IC3 helped to detect suspicious activity, such as large gatherings, unusual sounds, and abandoned items?
        - Can you provide an example of a case where IC3 footage helped detect suspicious activity?

    b) Detect crime.
        - How has real-time monitoring aided in detecting ongoing criminal activity?
        - Have police detected more crime since the installation of IC3?
        - Which crimes have been detected the most by the IC3 and why?
        - What crimes have been detected the least by the IC3 and why?

    c) Supervise traffic flow
        - How does real-time CCTV monitoring by IC3 help understand traffic conditions (e.g., jams, hazards, accidents, trends or patterns) in real-time?
        - Has it aided in directing traffic when there are large crowds (e.g., parades, demonstrations and political rallies) or traffic jams?
        - How has IC3 footage been used to inform motorists of current traffic conditions?
        - Are there instances where the dissemination of real-time traffic information by the IC3 improved overall traffic management?

d) Detect traffic violations
    - How has real-time monitoring of CCTV feeds by the IC3 aided in the prompt detection of traffic violations and subsequent enforcement?

e) Gather intelligence
    - How has the real-time CCTV monitoring by IC3 aided in identifying criminals and their modus operandi?
    - In what ways has the analysis of IC3 footage aided in understanding crime patterns, trends and criminal routines?

2. In your view, has the use of CCTV to coordinate response to incidents aided the police in:
    a) Assessing the severity of incidents and determining the appropriate response.
        - How has IC3 information aided in understanding the nature of unfolding or ongoing incidents and the needed enforcement action?
        - How has the information provided by the IC3 assisted in determining the number of victims, severity of injuries, and potential public danger?
        - Can you describe an instance where IC3 footage provided crucial details about the extent of damage or injury and prioritised response efforts?

    b) Determining the quickest and safest response routes.
        - How has the coordination between IC3 officers and those on the ground ensured the selection of quick and safe routes during incident responses?
        - Are there instances where IC3 information enhanced the police's ability to select optimal routes? If so, please discuss. If not, explain why.

    c) Deploying personnel and other resources to manage incidents.
        - How has IC3 CCTV data aided in determining the number/quantity and location of personnel and resources to deploy to an incident based on the incident's characteristics?
        - Can you explain a scenario in which information provided by the IC3 successfully helped manage an incident by ensuring the efficient allocation of officers and resources?

    d) Guiding officers responding to incidents.
        - How has IC3 data aided in directing responding officers to safe and accessible routes and entry points to incident sites?
        - In what ways has IC3's real-time CCTV monitoring enabled responding officers to adjust their response strategies based on changing circumstances?

e) Mitigating dangers facing officers responding to incidents.
    - In what ways has IC3 CCTV information aided in strategically deploying resources to reduce risks to responding officers?
    - How has information provided by IC3 helped officers identify suspects' movements and locations at the scene?
    - How has IC3 footage information assisted officers in monitoring crowd behaviour and detecting potential crowd-related dangers?
    - In what ways has IC3 CCTV data assisted officers in assessing the potential for de-escalation based on real-time visual data?
    - Has there been an instance where communication between the IC3 officers and those on the ground resulted in effective risk mitigation strategies? Please explain.

3. In your view, has the use of CCTV footage from the IC3 to investigate crimes helped the police to:

    a) Identify suspects.
        - In what ways has IC3 footage aided in identifying a suspect based on their physical features, clothing and activities before, during and after a crime?
        - Has IC3 footage analysis assisted in distinguishing multiple suspects in crowded or chaotic scenes or exonerating falsely accused individuals?
        - Can you discuss a case where insights from IC3 footage helped identify a suspect?

    b) Track and arrest suspects.
        - How has reviewing IC3 footage aided investigators in tracking suspects' movements from the crime scene to other locations?
        - Can you provide an example where police used IC3 footage to successfully track down and apprehend a suspect?

    c) Corroborate statements of suspects, victims and witnesses.
        - In what ways has IC3 footage helped clarify or validate the timelines, the sequence of events and the identities of persons described by statements by various parties?
        - Have there been any instances where IC3 footage contradicted/disproved the information, including alibis, provided by parties in their statements? If so, please explain.

d) Obtain evidence for crimes.
    - How has reviewing IC3 footage helped investigators identify people, vehicles, objects, or tools used in a crime?
    - How often is IC3 footage used as a primary source of evidence in criminal investigations?
    - How has reviewing IC3 footage provided multiple perspectives on an incident, possibly capturing details that verbal testimonies may have missed or adding to evidence from other sources?
    - In what ways has reviewing individual behaviour in IC3 footage aided in understanding the motivations and intentions behind a crime?
    - Has IC3 footage consistently provided valuable evidence for crimes?
    - Are there any types of crime where evidence from IC3 footage has been especially valuable?

e) Obtain evidence for traffic violations.
    - Has IC3 footage been instrumental in capturing evidence of traffic violations such as speeding, running red lights, or making illegal turns? If so, please explain with specific examples. If not, explain why.
    - How has reviewing IC3 footage aided in reconstructing events before, during and after a traffic accident?
    - Has IC3 footage been useful in hit-and-run cases, assisting in vehicle identification and possibly leading to the arrest of involved drivers?

f) Recover stolen vehicles.
    - Have CCTV cameras with ALPR assisted in identifying and tracking stolen vehicles? If yes, has it always been helpful? If not, explain why.
    - Can you describe a case where these cameras assisted in intercepting and seizing a stolen vehicle or that involved in a crime?

g) Prove crimes in court.
    - Have any cases been successfully proven in court using IC3 footage? If so, could you list them and explain how one was proven? If not, please explain why.
    - Is there any instance where IC3 footage was challenged or questioned in court? If it is there, please explain why.

h) Clear/solve cases.
    - How has the use of IC3 footage as evidence affected the outcomes of criminal and traffic cases?
    - How many cases have been successfully resolved using IC3 footage?

4. According to you, how have the below policies affected the use of CCTV?
    a) Legal policies.
        - Do existing laws provide effective guidance to police officers when using CCTV? If so, could you explain how they have guided police officers when seizing footage for use as evidence in court? If not, please elaborate.
        - Are legal policies on CCTV in Kenya sufficient? If so, have they influenced the use of CCTV in police operations positively? If not, explain why.

    b) NPS policies.
        - Do they specify the areas and activities police officers should monitor and record when using CCTV? If yes, what areas and activities are involved? If this is not the case, please explain why.
        - Do they ensure that skilled officers operate CCTV? If so, what qualifications do officers need to work at the IC3? If not, please elaborate.
        - How long do they allow for the retention of footage? Is this enough time? If not, please explain why.
        - Do they clearly specify how to disseminate CCTV data, if necessary? If yes, who is authorised to do so for what purposes, and what is the procedure? If this is not the case, please explain why.

5. What challenges, in your opinion, hinder the effective use of CCTV in police operations in Nairobi County?
    a) Are there any financial, technical, legal or competency challenges police officers face in optimally using the IC3 CCTV system?
    b) Have there been instances where poor video quality or unavailability hampered police operations? If yes, please explain.
    c) What effect does the public's perception of the system impact its use?
6. According to you, has the use of the IC3 CCTV system resulted in the following outcomes of police operations?
    a) Crime reduction
        - Has the number of crime commissions changed significantly since the implementation of the IC3?
        - Are there any specific types of crime that have shown a notable reduction since the implementation of the IC3 CCTV system? If so, please list them and explain why they have declined. If no, explain why.
        - Is there any area with IC3 CCTV cameras where crime rates have not declined? What factors might have contributed to this?

- Have criminals been observed changing their behaviour due to the presence of CCTV cameras?
- Are there any innovative ways in which police are using IC3 data to predict and prevent crimes proactively?

b) Quick response to incidents
   - How has IC3's real-time CCTV monitoring aided in the rapid response to ongoing or developing incidents?
   - How has the real-time CCTV monitoring by IC3 helped with more efficient emergency response, allowing officers to be dispatched to incidents as they occur?
   - In what ways has IC3 footage improved the quality and efficiency of evidence collection, potentially shortening the time and effort required for investigations?
   - Can you give an example of police officers taking immediate action based on live feeds from the IC3?

c) Enhanced road safety
   - How has IC3's live CCTV monitoring helped to manage traffic congestion and hazards, reduce bottlenecks, and improve traffic flow?
   - Could knowledge of IC3's live CCTV monitoring have influenced driver behaviour and deter traffic law violators? Please elaborate.
   - Has analysing IC3 footage aided in understanding traffic or accident patterns and identifying areas prone to frequent traffic violations or accidents? Please give an example of how this analysis influenced traffic management strategies.
   - Can you share a case where timely identification of incidents by IC3 led to a faster response to a potential or an actual accident, potentially preventing collisions, reducing disruptions or mitigating their severity?

d) Improved safety of police officers
   - Have the live CCTV feeds from IC3 helped police officers maintain operational awareness of ongoing situations and potential threats?
   - How have IC3 live video feeds aided in the coordination of incident responses, promoting overall officer safety?
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   - When officers attend to incidents or are on patrol, how has IC3 data aided in planning effective backup/reinforcement and response strategies?
   - Can you give an example of how timely awareness provided by IC3 live video feeds allowed officers to assess the level of risk before engaging in

potentially dangerous situations or saved officers from encountering dangers or risks on the scene?

e) Reduction in police operations costs
   - Has IC3 footage analysis enabled police to assess incidents remotely and determine whether an on-site response is necessary, potentially saving resources?
   - Could IC3's live CCTV monitoring have reduced the need for officers to patrol specific areas physically, resulting in less vehicle use and associated fuel costs? Please explain.
   - What impact has the use of IC3 footage had on police resource allocation? Has it resulted in a more targeted deployment of officers and vehicles?
   - Is there any evidence that IC3's live CCTV monitoring or footage analysis contributed to overall financial efficiency?

7. Do you have any additional suggestions, ideas, or questions?

Thank you for your time and input.

Appendix V: Approval by the Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School **DATE:** 26th October, 2020

TO: Mr. Kirui Gideon Kipngeno **REF:** C82/CTY/PT/37214/2017
C/o Department of Security & Correction Science

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting on 21st October, 2020, approved your Research Proposal for the Ph.D. Degree entitled, **"Effectiveness of the Use of Closed-Circuit Television in Supporting Police Operations in Nairobi County, Kenya."**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

By copy of this letter, the Registrar (Academic) is hereby requested to grant you substantive registration for your Ph.D studies.

Thank you.

JULIA GITU
FOR: DEAN, GRADUATE SCHOOL

CC. Registrar (Academic) Att. Mr. Richard Chweya
Chairman, Security & Correction Science Department
Supervisors:

1. Dr. Bernard Munyao Muiya
C/o Department of International Relations, Conflict & Strategic Studies
Kenyatta University

2. Dr. Duncan Onyango Ochieng
C/o Department Security & Correction Science
Kenyatta University

3. Dr. Stephen Waithaka Titus
C/o Department Computing & Information Technology
Kenyatta University

Appendix VI: Ethical Approval by Kenyatta University Ethics Review Committee

KENYATTA UNIVERSITY
DIRECTORATE OF ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 29th January, 2021

Gideon Kirui
P.O Box 43844, 00100
Nairobi.

Dear Mr. Kirui

APPLICATION NUMBER: PKU/2183/I1337 -EFFECTIVENESS OF THE USE CLOSED –CIRCUIT TELEVISION IN SUPPORTING POLICE OPERATIONS IN NAIROBI CITY COUNTY, KENYA

This is to inform you that ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE*** has approved version 4 of the study protocol together with the attached consent forms dated 12.09.2020. Your application approval number is **PKU/2183/I1337.** The approval period is ***29th January, 2021 TO 29th January, 2022.***

This approval is subject to compliance with the following requirements;

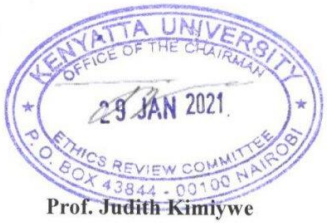
i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY DIRCTORATE OF ETHICS REVIEW COMMITTEE***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITYDIRECTORATE OF ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.

vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE***.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely



Prof. Judith Kimiywe

DIRECTOR- KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE.

Appendix VII: Research License from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **418658**

Date of Issue: **23/November/2020**

RESEARCH LICENSE

This is to Certify that Mr.. Gideon Kipng'eno Kirui of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: Effectiveness of the Use of Closed-Circuit Television in Supporting Police Operations in Nairobi County, Kenya for the period ending : 23/November/2021.

License No: **NACOSTI/P/20/7831**

418658

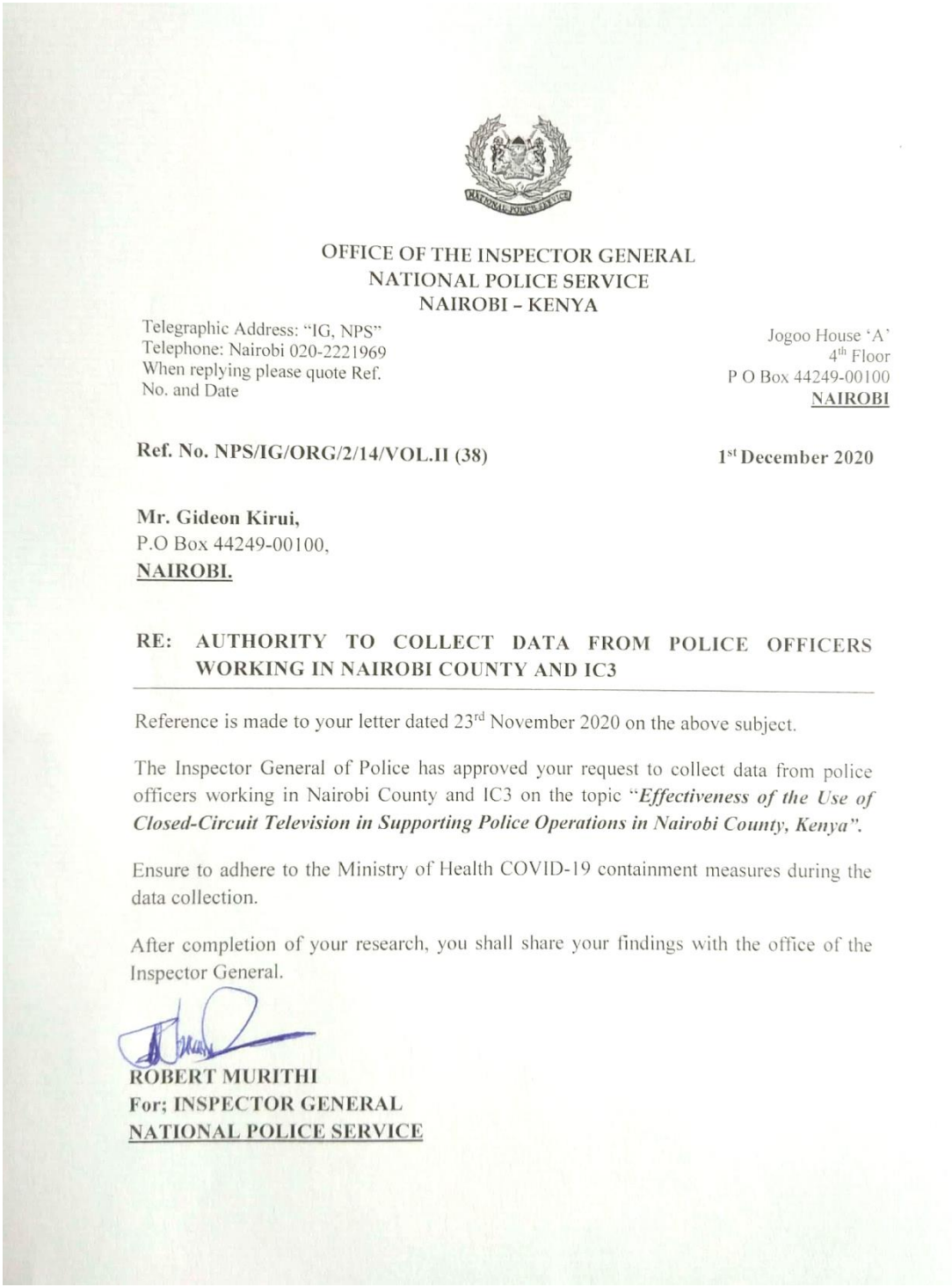
Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix VIII: Approval Letter from the Inspector General National Police Service



OFFICE OF THE INSPECTOR GENERAL
NATIONAL POLICE SERVICE
NAIROBI – KENYA

Telegraphic Address: "IG, NPS"
Telephone: Nairobi 020-2221969
When replying please quote Ref. No. and Date

Jogoo House 'A'
4th Floor
P O Box 44249-00100
NAIROBI

Ref. No. NPS/IG/ORG/2/14/VOL.II (38) **1st December 2020**

Mr. Gideon Kirui,
P.O Box 44249-00100,
NAIROBI.

RE: AUTHORITY TO COLLECT DATA FROM POLICE OFFICERS WORKING IN NAIROBI COUNTY AND IC3

Reference is made to your letter dated 23rd November 2020 on the above subject.

The Inspector General of Police has approved your request to collect data from police officers working in Nairobi County and IC3 on the topic "***Effectiveness of the Use of Closed-Circuit Television in Supporting Police Operations in Nairobi County, Kenya***".

Ensure to adhere to the Ministry of Health COVID-19 containment measures during the data collection.

After completion of your research, you shall share your findings with the office of the Inspector General.

ROBERT MURITHI
For; INSPECTOR GENERAL
NATIONAL POLICE SERVICE

Appendix IX: Approval Letter to Collect Data from Police Officers Working in Nairobi County

KENYA POLICE SERVICE

Telegraphic address: "VIGILANCE", Nairobi
Telephone: Nairobi 341411-6
Fax: 330495
When replying please quote

POLICE HEADQUARTERS
P.O. Box 30083-00100
NAIROBI

Ref. No. C/GEN/6/11 VOL VII/59 and date 16TH DECEMBER 2020

The Regional Police Commander
Nairobi City County - Nairobi Area
P.O. Box 30051-00100
NAIROBI

RE: AUTHORITY TO COLLECT DATA FROM POLICE OFFICERS WORKING IN NAIROBI CITY COUNTY BY MR. GIDEON KIRUI, SP

The above named officer is currently attached to the NPS headquarters. He is pursuing a PhD course at Kenyatta University and his thesis is on:

"Effectiveness of the Use of Closed – Circuit Television in Supporting Police Operations in Nairobi County, Kenya."

This is to inform you that he has been granted permission to collect data from police officers working in Nairobi City County to assist him in finalizing his thesis.

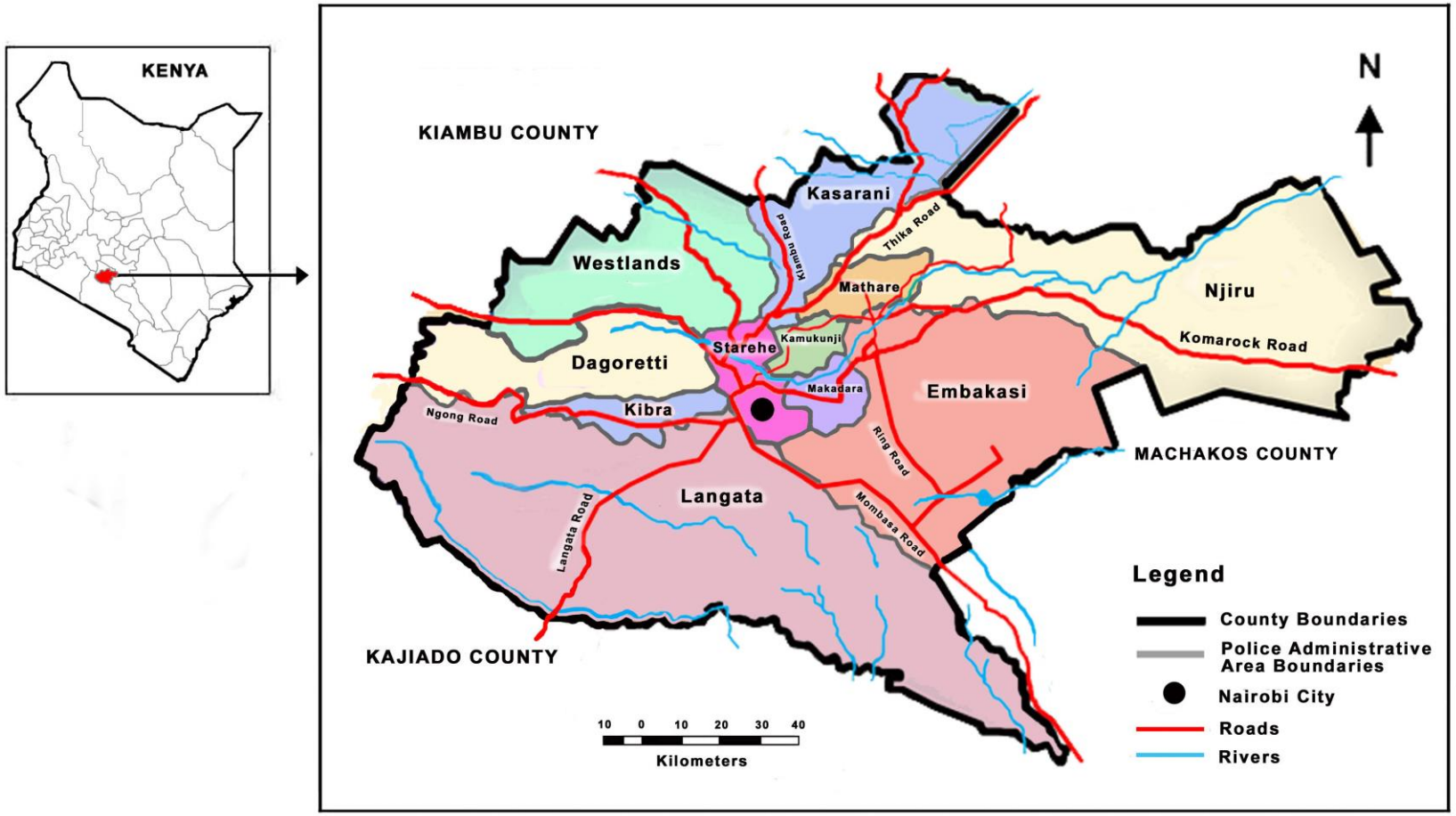
Kindly according the officer necessary assistance to facilitate data collection.

Thank you.

(JASPHER NYAUMA), MBS, AIG
FOR: DEPUTY INSPECTOR GENERAL
KENYA POLICE SERVICE

C/C. Gideon Kirui, SP
NPS Headquarters
NAIROBI

Appendix X: Map of Nairobi City County Showing the Police Administrative Areas



Source: NPS (2020)