APPLICATION OF GEOSPATIAL TECHNIQUES BY POLICE IN CRIME PREVENTION IN NAIROBI CITY COUNTY, KENYA.

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A THESIS REPORT SUBMITTED IN PARTIAL FULFILMENT FOR THE REQUIREMENT FOR THE AWARD OF MASTERS IN SECURITY MANAGEMENT AND POLICE STUDIES TO THE SCHOOL OF LAW, ARTS & SOCIAL SCIENCES OF KENYATTA UNIVERSITY.

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DECLARATION

This thesis is entirely my unique work and has never before been submitted for a study program at another university or for any other award.

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DEDICATION

To Almighty Lord for seeing me through the academic journey. I also thank my children, my spouse Stella Musangi, and my entire extended family for their support in this endeavor.

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LIST OF ABBREVIATIONS & ACRONYMNS

ANPR: Automatic Number Plate Recognition Reader

CAD: Computer Aided Dispatch

CCTV: Closed Circuit Television

CompStat: Computer Statistics

DCI: Directorate of Criminal Investigation

ESRI: Environmental Systems Research Institute

GIS: Geographical Information Systems

GPS: Global Positioning System

IC3: Integrated Command and Control Centre

NPS: National Police Service

KPS: Kenya Police Service

RS: Remote Sensing

OPERATIONAL DEFINITION OF TERMS

Geospatial techniques: Involves a variety of tools such as GPS (global positioning systems), GIS (geographic information systems), and RS (remote sensing) that are used to collect, store, analyze, and evaluate geospatial data in order to develop new policing strategies and increase performance and effectiveness.

Remote sensing: Tools for generating spatial data capable of detecting environmental crimes and their offenders, which is essential for police operations and investigations.

CompStat: a performance management system used by the police department to minimize crime and accomplish other objectives.

Crime analysis: Function to aid police operations in identifying and analyzing patterns and trends of crime, all of which are critical for crime prevention.

Geographical information system: A system that is designed to capture, store, manipulate, analyze, manage, and present geographical data connected to a crime that enables law enforcement agency in making critical decision to prevent or reduce crime.

Global positioning System: A navigational application that can help with a range of policing and criminal justice duties.

ESRI: an international company that supply the geographic information system (GIS) software.

ABSTRACT

Geospatial techniques play an important role in analysis of crime and designing of crime prevention strategies. The use of the new technological tools such as remote sensing and GIS has enhanced and improved capabilities and effectiveness of police agencies. The main objective of the research was to assess the application of geospatial techniques in crime prevention through police crime response strategies examining the technological innovations as a driving force that can lead to reform of crime prevention and control strategies. There were three specific objectives in this the study. First, is to assess the components of geospatial techniques in crime prevention through police response strategies, secondly it was to examine how the application of geospatial techniques influenced crime prevention through police response strategies and thirdly it was to determine the extent of application of geospatial techniques for crime prevention through police response strategies in Nairobi City County, Kenya. The study was underpinned on two theories, the situational crime prevention and crime pattern theory. In this study descriptive survey research design was adopted and the methodology aimed at gathering information utilizing the questionnaires and in-depth interviews. The choice of Nairobi City County as the area of study was informed by accessibility of the essential infrastructure that Geospatial techniques innovation can ride on. One hundred and sixty-five police officers formed the sample size of the study from a target population of 206. Stratified purposive sampling was adopted for the study where each stratum consisted of relatively homogeneous sub group that was randomly selected to reduce biases. Both quantitative and qualitative data was collected. Quantitative data was analyzed utilizing SPSS for computation of statistical summaries. The qualitative data was in the first place arranged systematically into text format and then exported into a spreadsheet. As revealed by the results of the study, the three components of geospatial techniques i.e Geographical Information Systems, Global Positioning System and Remote Sensing were being used for capturing, analyzing and storing crime data. Service delivery in terms of efficiency in police crime response strategies have improved with application of geospatial techniques in crime prevention in Nairobi City County. In order to create harmony in in dissemination of crime data obtained through geospatial techniques the study recommended for a policy to guide the sharing and protecting the information from non-intended dissemination. The researcher has recommended two studies that can be conducted in the future. One, future scholar should conduct a study on dependability of the Integrated Command and Control centre in crime prevention. Secondly, a study should be conducted on the use of Geospatial technology to identify the road traffic accident hotspots in Nairobi.

CHAPTER ONE
INTRODUCTION

1.1. Introduction

This section provides an overview of the study's background information, problem statement, study purpose, study goals, research questions, rationale, significance, scope, limits, and delimitations.

1.2. Background of the study

We encounter crimes of different types and forms every day. Piquero and Weisburd (2010) contend that since criminal opportunities are dispersed randomly, environmental factors greatly influence the likelihood of criminal activity. To effectively prevent crime, it is necessary to comprehend the correlation between criminal activity and up-to-date spatial information in a particular area. Law enforcement agencies generate large amounts of crime data that may be useless if not analyzed to inform police strategies to reduce crime. According to (Jaishankar,2009; Elmes *et al.*,2016; Ramteke *et al,*.2018; Choudhury & Das, 2014) geospatial technologies such as GIS, GPS, and Remote sensing have been used by police in the recent past to collect, analyze, and map crime data. By analyzing and mapping crime, law enforcement agencies can infer connections between the physical environment and crime, thereby assisting in crime prevention planning. It would be interesting to conduct a study to evaluate the use of geospatial techniques in crime prevention through police response strategies.

Crime prevention according to the (United Nations Economic & Social Council, [ECOSOC], 2002), is an activity that comprises strategies and methods aimed at reducing the possibility of crimes occurring and their negative impacts on people and society, including fear of crime, by addressing their underlying causes. However, Dilton & Farrall (2017) contend that crime prevention strategies frequently try to alter the offender's motivations and predispositions. Welsh

and Farrington (2006) contend that crime prevention should be logical and grounded in the best available evidence.

According to Wilson & Smith (2008), the use of baseline data that includes details about the jurisdiction's physical, demographic, and economic makeup as well as incident data—such as calls for service, incidents, or arrests—police departments can learn more about the physical environments within their jurisdiction by applying geography to crime prevention. Crime analysts are better able to convert a working theory into an immediate solution when they combine applied geography, crime theory, and crime mapping. Intelligence-led policing entails officers gathering, evaluating, and applying intelligence information to guide law enforcement operations. This technique aids in the identification of new crime patterns, criminal networks, and key persons involved in criminal activity, allowing for proactive resource deployment and strategic crime prevention planning (Njeru, 2016; Waringa, 2021).

The late 1990s saw the introduction of automated dispatch and data recording systems, along with new desktop GIS software, by law enforcement officials to support their crime intervention and control strategies. Global positioning system (GPS)-enabled devices and related geospatial datasets are widely available today, which has set the stage for yet another major change. With the aid of these technologies, analysts will be able to provide long-standing answers regarding the locations of criminal activity and police patrol patterns (Wilson & Smith,2008).

Globally, developed countries such as the US and the UK have achieved great success in crime prevention through the application of geospatial technology. The need to gather timely and accurate information about where the crime is occurring led to the development of the Compstat (Computer Statistics) policing model in 1994. Studies have shown that crime has decreased in the states of New York, Chicago, Texas, and Massachusetts since the introduction of CompStat (Getis *et al*.,2000; Jang *et al.* 2010; Willis *et al.* 2004). The studies focused on violent crimes in New

York and Chicago, property crimes in Texas, and internal conflicts in Massachusetts, respectively. While all of the above studies emphasized the committed crimes, none of them examined the police response strategies, which the current study sought to comprehend.

Chainey & Ratcliffe (2005) assert that GIS has fundamentally changed the mapping of crime thus improving police performance. Studies have revealed that adopting GIS in crime mapping reduced all crimes in West Midlands in the UK by 20%. North Yorkshire Police have introduced innovative new handheld digital crime-fighting kits into their patrols, allowing them to view incidents on real-time maps, log evidence within moments of arriving at a crime scene, and reduce time-consuming trips to the station for form-filling. The latest technology enables frontline officers to gather and compile evidence at a crime scene, including photographs, videos, and other documents, and immediately upload them to the police systems for analysis and action. (Flanagan, 2018; Cole, 2018).

The Asian countries have not been left behind. According to Yalcinkaya (2007), Turkey has adopted POLNET to combat crime. Additionally, several studies in India have revealed that geographic information systems (GIS) have become an important tool in social crime prevention systems (Kumar& Somashekar, 2012; Ansari &Kale, 2014; Kannan *et al.* 2017). Khalid *et al.* (2014) state that the introduction of the CompStat model by police in Faisalabad City in Pakistan enabled the police department to undertake operational analysis for resource allocation and police officers were deployed based on generated crime hotspots. After the execution of crime control approaches, it was discovered that in comparison with the previous year, there was a 41.74% reduction in street crimes. While it is evident that analysis of crime using GIS is better than the traditional methods it was important to understand how it had influenced the police response strategies to prevent crime in Nairobi city county.

As a crime prevention strategy, the police use regular patrols and increased visibility. The visible presence of police personnel and patrol vehicles can deter potential criminals, provide citizens with a sense of security, and enable rapid response to incidents. Additionally, foot patrols in high-crime areas help establish a police presence and improve community-police interaction (Andresen & Shen, 2019; Basford *et al.,* 2021). A study conducted on GPS's role in law enforcement highlights its effectiveness in Minneapolis. Jaishankar (2009) found a 60% reduction in auto theft after a month of using a GPS-equipped bait vehicle. Martinez (2017) cited SMART (Satellite Monitoring and Remote Tracking) in Florida for tracking criminal offenders. Weisburd *et al.* (2015) found that the Dallas Police Department used automated vehicle locating (AVL) technology to control patrol locations, achieving higher levels of patrol in crime hotspots identified through crime mapping. These studies highlight the potential of GPS in enhancing law enforcement operations.

Following several terrorist acts in China's Xinjiang region where cars were used as the primary mode of transportation and tools of attack, Phillips, (2017) contends that the authorities ordered that all vehicles be outfitted with GPS tracking devices. This was aimed at assisting police units in locating any suspicious itinerary or gathering.

(Chen *et al*., 2011) assert that Remote sensing tools increase the understanding of the relationship between location and geographical perspective in crime analysis. Aerial photographs and distance images can be good sources of information for law enforcement. The growing demand for evidence-based policing, coupled with advances in technology, has led to the increased use of surveillance tools such as closed-circuit television (CCTV) in police departments in recent years. Surveillance tools are installed to collect evidence and provide virtual control for crime prevention and deterrence, investigation, and prosecution (Vigne *et al*., 2011). According to Ashby (2017) in a study analyzing 251,195 crimes recorded by British Transport Police that occurred on the British

railway network between 2011 and 2015, CCTV footages were made available to investigators in 45% of cases and surveillance evidence was found useful in 65% of cases in which it was available. In Africa, few states have started using GIS tools in law enforcement (Ahmed &Salihu, 2013; Yelwa & Bello, 2012). According to Schmitz *et al* (1999), a pilot study on the integration of GIS within policing in South Africa enabled the law enforcement agency to realize how GIS could transform their mode of operation. Most significant was the provision of crime mapping that assisted the police in the two cases of serial killing in the city of Johannesburg. Using the crime mapping of the cellular calls and crime scenes and the evidence from those maps, the SAPS was able to successfully prosecute and convict the two murderers and hijackers in the Brixton murder case and a murderer in the Dquad robbery case (Breetzke, 2006). Mswela (2019) claimed that Malawi has been in the forefront of utilizing GPS technology to combat violent crimes targeting those with albinism. The GPS devices were allocated to individuals with albinism in areas of high incidence. The devices have an electronic panic button that may be activated by pushing a knob in times of peril. Mswela (2017) claims that this electronic monitoring system has provided a tangible solution to prevent and mitigate brutal attacks on persons with albinism.

In Kenya, the use of GPS technology is evident in both the public and private sectors. The commercial application of location data is what makes GPS technology essential in our everyday lives. Kenya Wildlife Service has been using technology in the protection of endangered species such as elephants and rhinos since 1986 (Kenya Wildlife Service, [KWS], 2016). Wandera (2021) avers that to monitor the cessation of movement to and from the Nairobi metropolis to curb the spread of COVID-19, the police were using unmanned aerial vehicles equipped with high-density cameras to track remotely the movement along the busy Thika-Garissa highway.

The Vision 2030 development blueprint had envisioned that GIS would play a critical part in security operations in Kenya. The creation of the Integrated Command, Control, and

Communication (IC3) Centre by the National police service in 2015 was aimed at embracing this technology in crime prevention. The call for service and computer-aided dispatch programs are managed from IC3. The police officers in the field are issued with GPS-enabled walkie-talkie sets that are linked to IC3 making it easy to locate them to respond to calls for service. In June 2020, the National police service launched the digital occurrence book for use by police officers. This was a huge step towards the use of technology to improve the operational performance of the police service. Each of the police officers in Nairobi was issued with a hand-held gadget that is GPS enabled for recording crime incidents.

According to Okeyo (2021), advances in technology have opened many doors in the field of security. The new norm has become the driving force behind crime prevention in Kenya. This technology has aided law enforcement agencies in their efforts to fight crime and maintain public order. For example, the installation of 1800 CCTV surveillance cameras in Nairobi and Mombasa has contributed significantly to solving security problems. Reports indicate that thanks to the surveillance system, police were able to recover 69 stolen cars in less than 24 hours. The police commanders and the police officers in operational areas are now able to generate real-time crime maps that make it easy to plan and execution of prevention strategies. It is for this reason that a study was carried out to find out how the application of geospatial techniques had influenced police response strategies to prevent and reduce crime.

The National Police Service has in the recent past adopted new technologies and procedures into its system intending to create new policing strategies and improve their performance and effectiveness. It was, therefore, important to find out if the application of Geospatial techniques had any influence on police response strategies to prevent and reduce crime in Nairobi City County.

Besides, the police utilizing technology and data analysis, the police in Nairobi County employ crime mapping techniques to identify crime patterns and analyze their causes. By understanding the geographical distribution of crime, law enforcement agencies can focus their resources on high-crime areas and develop targeted preventive measures. Crime mapping also aids in resource allocation, policy formulation, and evaluation of crime prevention initiatives (Mbani *et al.*, 2017). Furthermore, police in Nairobi City County work in collaboration with other government agencies, such as the County government, National Transport and Safety Authority, and regulatory bodies, to address crime prevention comprehensively. By coordinating efforts and sharing information, these agencies can implement joint initiatives, such as improving street lighting, enhancing transportation security, and enforcing regulations that contribute to crime prevention (Mutembei & Gitau, 2017).

1.3. Statement of the problem

The use of technology in law enforcement has long been recognized as a critical part of strategy and tactics. Historical advances such as the telephone, the automobile, and the radio in the 20th century revolutionized police performance and enabled more efficient responses to citizen requests for assistance. In the 21st century, the introduction of powerful technological tools such as closed-circuit television cameras (CCTV), automatic license plate readers (LPRs), and predictive policing software have further enhanced law enforcement capabilities, resulting in greater efficiency and better outcomes.

In line with the National Police Service (NPS) 2016 Crime Situation Report, the NPS was recommended to improve its ICT infrastructure to use innovative technologies such as geographical information systems (GIS) to counter ever-evolving criminal methods. Under the Safer City program, a partnership between Safaricom, Huawei and NPS led to the establishment of the Integrated Command, Control, and Communication (IC3) Center in 2015. The aim of this

project was to make the police more efficient. They deal proactively with security situations and professionalize their response to incidents. The implementation of the IC3 center resulted in a significant decrease in crime rates of 46% in 2015 in the areas covered.

Recently, however, the NPS has moved away from traditional law enforcement methods that were primarily responsive to perceived or actual threats or based on tips. Instead, they have begun using advanced technologies such as GPS and GIS to develop proactive police response strategies to prevent and combat crime. It would be ideal if the National Police made full use of advanced technologies such as GPS and GIS to create comprehensive and effective law enforcement strategies. By integrating these technologies into their operations, the NPS would be able to proactively detect and respond to potential security threats, improve its overall efficiency, and improve public safety. This would result in significant reductions in crime rates, create safer communities and increase trust in law enforcement.

Currently, the NPS has made progress in adopting technology, particularly through the establishment of the IC3 Center and the implementation of advanced tools such as GPS and GIS. These efforts have yielded positive results as crime rates have decreased in the areas covered by the project. However, it is important to assess the extent to which the NPS has fully integrated these technologies into its operations and whether it is effectively using the available data and resources. In addition, the current reality should consider any challenges or limitations faced by the NPS in terms of infrastructure, training, or budget constraints that could hinder the full realization of the technology's potential benefits in law enforcement.

If the NPS does not fully leverage technology in law enforcement, it could result in missed opportunities to effectively prevent and respond to crime. Without comprehensive integration of technologies such as GPS and GIS, the NPS may continue to rely on reactive measures, which could result in delayed response times, reduced efficiency, and a higher likelihood that criminals will evade detection. Additionally, the potential benefits of data-driven approaches, predictive

analytics, and real-time information sharing may not be fully realized, limiting the NPS's ability to proactively address emerging crime trends. This could lead to increased crime rates, reduced public trust in law enforcement, and negative impacts on overall community safety.

Despite technological advances, crime continues to exist in major cities, particularly in Nairobi County, Kenya. To effectively prevent and respond to crime, police officers need to adopt more advanced technologies such as geospatial techniques, without which they will continue to find it difficult to respond to and contain criminal activities in Nairobi City County.

1.4. The purpose of the study

The study addresses the pressing need to create safer communities for the residents of Nairobi County. Geospatial techniques empower law enforcement agencies to analyze and visualize crime patterns, enabling them to strategically deploy resources and interventions where they are most needed. By enhancing overall public safety, the study contributes to a heightened sense of security among citizens, fostering social well-being and community development.

1.5. Objectives of the study

1.5.1. General Objectives

The main objective of the study was to assess the application of geospatial techniques in crime prevention through police response strategies in Nairobi City County, Kenya.

1.5.2. Specific Objectives

1. To assess the components of geospatial techniques that are used for crime prevention through police response strategies in Nairobi City County, Kenya.
2. To analyze the influence of application of geospatial techniques for crime prevention through police response strategies in Nairobi City County, Kenya.
3. To determine the extent of application of geospatial techniques for crime prevention through police response strategies for crime prevention in Nairobi City County, Kenya.

1.6. Research Questions

1. What are the components of geospatial techniques that are used for crime prevention through police response strategies in Nairobi City County, Kenya?
2. What is the influence of the application of geospatial techniques for crime prevention through police response in Nairobi City County, Kenya?
3. What is the extent of application of geospatial techniques for crime prevention through police response strategies in Nairobi City County, Kenya?

1.7. Justification and Significance of the study

The intent of this research was to evaluate the application of geospatial techniques in crime prevention through police response strategies in Nairobi City County, Kenya. Broadly and mostly in developed countries the application of geospatial technology by law enforcement agencies has received significant attention. While most of the studies in developing countries like Kenya have been centered on modeling the use of GIS in the mapping of crime there has been little attention on the application of geospatial techniques in crime prevention through police response strategies. The intended value of geospatial techniques in crime prevention strategies is to enhance efficiency in response to crime incidents by the police agency. This is reinforced by Temelow (2018) who asserts GIS does not replace the policing processes like collection and analysis of data but aims at enhancing those processes to improve service delivery.

Geo-referencing technology can be applied to reduce crime at both the analytical and operational levels. As a result of its quick delivery of analytical depth, geospatial technology has created highly targeted interventions that are intelligence-led and problem-focused as opposed to routine police deployment (Lyew-Ayee & Greene, 2013; Pore, 2021; Sangimithra, Kalaikumaran & Karthik, 2012). Therefore, the results of this study have enabled the National Police Service to derive an

understanding of the impact of geospatial techniques in the detection and analysis of crime data for decision-making at the tactical, intelligence, and administrative levels.

The police service has been reliant on traditional methods in the collection of crime data that was subsequently manually collated and analyzed in a very cumbersome and unreliable process. Over the last few years, the National Police Service has embraced the use of geospatial technology to enhance the efficiency of policing in Kenya. The results of this study have provided insight into the management of the police service and why more resources should be directed to geospatial technology to enhance the efficiency of police response.

Impact on Policing

The integration of geospatial technologies into policing practices revolutionizes the efficiency and effectiveness of law enforcement agencies. Real-time mapping of crime hotspots, identification of trends, and predictive analysis enable proactive policing rather than reactive responses. This shift not only minimizes response times but also allows for the allocation of resources based on data-driven insights, optimizing the utilization of personnel and equipment.

Contribution to Policy Formulation

The study serves as a cornerstone for evidence-based policy formulation. By synthesizing geospatial data with crime statistics, policymakers gain valuable insights into the root causes of criminal activities. This knowledge facilitates the development of targeted policies and interventions, addressing specific challenges within distinct geographical areas. Policymakers can thus tailor their approaches to the unique needs of different neighbourhoods, fostering a more nuanced and effective response to crime.

Enriching the Knowledge Bank

The research significantly contributes to the academic and practical knowledge surrounding crime prevention. By harnessing geospatial techniques, the study expands the understanding of how

environmental factors, urban planning, and socio-economic dynamics intersect with criminal behavior. This knowledge not only benefits local law enforcement but also becomes a valuable resource for academic institutions, researchers, and other stakeholders interested in the interdisciplinary study of criminology and urban planning.

Validation of Existing Theories

Through empirical analysis and the application of geospatial methodologies, the study provides a platform for the validation or refinement of existing criminological theories. The spatial distribution of crime incidents, when analyzed in conjunction with socio-economic and environmental factors, can either affirm or challenge prevailing theories. This process of validation ensures that the strategies employed by law enforcement are grounded in a comprehensive understanding of the local context, fostering more effective crime prevention measures.

Future Prospects

Beyond the immediate advantages, the study opens avenues for ongoing improvement and innovation in crime prevention strategies. It establishes a foundation for ongoing collaboration between law enforcement agencies, researchers, and technology experts. This collaborative effort can lead to the development of advanced predictive policing models, the integration of emerging technologies, and continuous adaptation to the evolving nature of criminal activities.

1.8. Scope of the Study

The study assessed the application of geospatial techniques in crime prevention through police response strategies in Nairobi City County, Kenya. The geographical scope encompassed the entirety of Nairobi City County, ensuring a comprehensive examination of crime dynamics in both urban and suburban areas. The study aimed to scrutinize specific components of geospatial techniques, including Geographic Information Systems (GIS), remote sensing, and other spatial analysis tools utilized by law enforcement agencies within the defined geographical boundaries.

The research aimed to to evaluate the integration and effectiveness of geospatial techniques in police response strategies. The research was defined by three specific objectives: first, to assess the components of geospatial techniques used in crime prevention; second, to examine the influence of these techniques on police response strategies and their impact on crime prevention; and third, to determine the extent of integration of geospatial techniques in overall police response strategies within Nairobi City County.

1.9. Limitations of the Study

Despite its comprehensive scope, the study encountered certain limitations that merit consideration. Firstly, the effectiveness of geospatial techniques heavily depended on the quality and availability of data. Limitations in data sources, such as incomplete or outdated information, also constrained the depth and accuracy of the research findings.

Secondly, the temporal scope of the study was bounded by its completion date. Crime patterns and police strategies are dynamic, and the study may not capture the most recent developments in the application of geospatial technology in crime prevention.

Additionally, the study primarily adopted a law enforcement perspective, focusing on police response strategies. While this provided valuable insights, it might have not fully encapsulated the perspectives of other stakeholders, such as community members, local government officials, or technology experts. A more holistic understanding of the societal impact would require a subtler exploration of diverse perspectives.

1.10. Assumptions of the study

1. There was a sufficient amount of geospatial data available for Nairobi County, including accurate maps, satellite imagery, census data, transportation networks, and other relevant spatial datasets. This data will be crucial for the implementation of geospatial techniques in crime prevention.

2. The police department in Nairobi County maintained a comprehensive and reliable crime database that includes accurate and up-to-date information on crime incidents, locations, types, and other relevant details. The accuracy and completeness of this data will greatly impact the effectiveness of geospatial techniques in crime prevention.
3. The police department had the necessary technical infrastructure to implement and utilize geospatial techniques effectively. This includes access to appropriate hardware, software, and skilled personnel who can handle geospatial data, perform spatial analysis, and generate actionable insights for crime prevention strategies.
4. There was a willingness among relevant stakeholders, including the police department, local government authorities, and other agencies, to collaborate and share geospatial data for the purpose of crime prevention. Data sharing and collaboration are crucial for a comprehensive and holistic approach to tackling crime using geospatial techniques.
5. The police department in Nairobi County had access to adequate funding and resources to support the implementation and maintenance of geospatial techniques for crime prevention. This includes financial resources for acquiring geospatial data, investing in technical infrastructure, and training personnel in geospatial analysis and interpretation.
6. There was a certain level of public awareness and willingness to participate in crime prevention efforts utilizing geospatial techniques. This includes the cooperation of community members in reporting crimes, sharing information, and actively engaging with the police department to enhance the effectiveness of crime prevention strategies.
7. The application of geospatial techniques by the police in crime prevention adhered to relevant legal and ethical guidelines. This includes ensuring data privacy, protecting the rights of individuals, and using geospatial techniques within the boundaries of the law.

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

The chapter offers a review of other scholars' work underpinning the research study. Additionally, the theoretical and conceptual framework is also presented. Gaps missing in previous related studies and literature have been pointed out. The chapter concludes by giving an outline of how the study attempted to fill the highlighted gaps in previous research works.

2.2. Empirical Review

Khushi et al. (2022) argues that the conventional approach to crime detection, monitoring, and management has proven inadequate in effectively addressing the current crime situation. The ever-changing crime situation of the modern world has rendered the manual and unreliable traditional intelligence and criminal records maintenance irrelevant. To improve on productivity and effective utilization of manpower, there is a need to embrace information technology in crime prevention.

2.2.1. Components of Geospatial techniques being used for crime prevention

Byrne & Marx (2011) state that police agencies have over the years relied on novel technological improvements to prevent crime as well as improve their performance. Argun & Daglar (2016) aver that the modern police are utilizing high-end tools such as GIS, Remote sensing, and GPS in their daily operations. The intelligence obtained through technological advances is used for the deployment of tactical teams to where the crime is occurring.

According to Ioannidis *et al.* (2024), Spatial analytical tools have revolutionized criminology by providing a comprehensive framework for understanding criminal behavior. Li *et al.*,2023 states that by combining crime incident records, offender profiles, census data, environmental data, and remote sensing data into a GIS framework, researchers can gain insights into crime distribution, identify crime hotspots, and investigate socioeconomic and environmental factors associated with

criminal behavior. This is achieved through statistical analysis and mapping visualization (Horsefield *et al.,* 2023).

Several empirical studies of GIS-related programs have been carried out, in the US and some in other areas. The scope of the studies includes the research on the impact of GIS-assisted hot spot policing on crime (Sherman & Weisburd, 1995; Weisburd & Green, 1995; Braga *et al.,* 1999), the influence of crime maps on the public's perception of crime (Groff *et al.,* 2005; Paulsen, 2004), consequences of geographic-enhanced offender profiling on the criminal investigation (Canter *et al*., 2000; Rossmo, 1995, 2001) and the role of "real-time" crime analysis (Compstat) in reducing crime (Chilvers & Weatherburn, 2004; Eck & Maguire, 2000; Mazerolle *et al*., 2006). However, these were focused application of GIS in various aspects but none of them addressed its application by police for crime prevention through police response strategies which the current study sought to find out.

GPS is a satellite-based technique that reveals the location of a given location (Fakir,2013). While Jaishankar (2009) claims that navigational applications have been used to assist with a variety of policing and criminal justice functions. According to Jaishankar (2009) and Kinney (2022), GPS provides numerous benefits to law enforcement agencies. For instance, when an emergency call comes in, the dispatcher may locate the nearest officer using real-time positioning technology. The GPS tracking technology locates the nearest vehicle and suggests the best route simply by entering an address, which may speed up response times and save on fuel costs.

Since the late 1990s, GPS technology has become more and more popular as a tool for preventing crimes. Its use has extended to encompass post-work release offenders and sex offenders due to its timely notifications and customizable exclusion zones. Due to its ability to be integrated with GPS monitoring to produce a powerful proximity detection system that can identify proximity in

both indoor and outdoor environments, short-range communication technology has great promise for reducing crime.

Remote sensing is a method of gathering information from distant sources and is utilized in criminology to enhance surveillance, crime mapping, forensic investigations, and predictive policing. This technology provides law enforcement with data-driven insights, aiding in crime prevention and evidence gathering (Spatialpost,2023). According to Chen *et al.,* (2005), literature on remote sensing identifies two main approaches in law enforcement: tactical and analytical. The tactical method employ imagery to provide maps and spatial information for on-the-go investigations, while the analytical technique uses images to generate new variables that can predict crime probability in specific locations.

Numerous studies have been conducted to examine crime trends using data from remote sensing. Ioannidis *et al.* (2024) assert that despite the scantiness of literature, research has demonstrated that data derived from remote sensing can capture specific situational aspects of the constructed, natural, and social settings that are pertinent to incidents of crime. Studies have demonstrated correlations between, for instance, crime events and lighting levels (Liu et al., 2020; Zhou *et al.,* 2019); urban change (Algahtany & Kumar, 2016; Mansor *et al.,* 2019); tree coverage and vegetation density (Chen *et al.,* 2016; Wolfe & Mennis, 2012); building density, roof types, the presence of water and shadows (López-Caloca *et al.,* 2009; Patino *et al.,* 2014); presence of slum areas (Duque *et al.,* 2015). A quick scan of the highlighted studies revealed that the focus was on determining the locations prone to crime occurring thus making it necessary to conduct a study on the application of remote sensing by police for crime prevention which was the primary goal of this study.

Previous research has demonstrated that spatial analytical tools can provide important insights into the relationship between crime concentration and various socioeconomic and environmental factors (Bottoms, 2012; Kounadi *et al*., 2020).

2.2.2. Influence of Geospatial techniques in crime prevention through police response strategies

Several studies have revealed that law enforcement agencies are using geospatial technology for crime mapping, identification of crime hotspots, managing operations as well as profiling of offenders (Ferreira *et al*., 2012; Boba, 2013; Daglar & Argun, 2016). Kounadi *et al.* (2020) state that spatial analytical approaches in criminology provide important insights into the dynamics and patterns of crime, allowing for the identification of high-crime areas through hotspot analysis and the direction of law enforcement activities.

Zhang *et al.* (2014) suggest four major applications of Geographic Information System (GIS) in policing: computerized crime mapping, crime analysis, hot spots identification, command-level decision, and geographical investigative analysis. The current study aimed to ascertain the influence of the application of GIS by police in crime prevention through police response strategies. The current study sought to enrich the limited literature on the application of geospatial techniques in the prevention of crime through police response strategies.

According to Afzaal & Masood (2019), spatial decision support systems such as GIS, as well as other modern technologies, are necessary to uncover better outcomes in the setting of escalating crime rates and criminal density. The capacity of GIS to quickly analyze and distribute actionable intelligence makes it an appropriate tool for law enforcement authorities in their attempts to combat crime (ESRI [2012]). Butorac (2017) asserts that GIS may also be used to analyze and make decisions in the sphere of safety, notably in crime and mapping studies. In Australia and the United States, Khushi *et al*. (2022) used GIS to perform crime mapping, including a crime spatial analysis process to obtain information on crime trends, patterns, and dynamics related to time, and place. Newton &Felson (2015) argued that the emergence of geographic data and its active use as a crime analysis and predictive tool can be seen across Europe. For instance, West Midlands Police

in the UK conducted a study that sought to create a paradigm shift in the design of patrol areas from geographically fixed beat areas to a more fluid model based on geographical typologies. Using GIS, the areas were demarcated based on the concentration of crime. Under the new policing method, police officers were deployed to crime hotspots blurring the former jurisdiction boundaries (Chainey & Ratcliffe, 2005). In a similar study by Curtin *et al.,* (2010) the comparable results also revealed that GIS can be used to determine police optimal patrol areas. In Indonesia, GIS-based crime analysis and mapping studies typically input data to focus on specific locations, even near locations of high crime risk (Newton & Felson, 2015). According to Balogun *et al*. (2018) In a study conducted in the city of Benin using buffer analysis, mapped crime hotspots revealed overlapping areas that required constant police patrols.

The commanders can better manage and coordinate their operations by incorporating GPS into their daily routine of police work. Because it can pinpoint the exact location of a patrol car or officers in the field, this technology assists police agency management in better coordinating operations (GPS Technologies, 2019). According to Jaishankar (2009), one of the most popular applications for GPS/GIS technology has been resource management via Automatic Vehicle Location (AVL). The systems enhance response effectiveness by providing police officers and supervisors with information that enables the deployment of the nearest patrol personnel to a particular occurrence. The current study sought to find out whether Geospatial techniques have influenced the design deployment, and effectiveness of police patrol in Nairobi City County, Kenya.

Nemeth *et al.* (2014) claim that employing a Geographic Information System to pinpoint hotspots provides a reliable way to track the spatial distribution and concentrations of criminal activity across time. The current study intend to find out if the application of GIS in crime prevention had

any influence on police response strategies in those hotspots. According to Hutt *et al.* (2021), the increased use of GPS devices by police forces allows for much greater accuracy in tracking where officers move than was previously possible. Ariel *et al.* (2016) argue that police patrols have a significant impact on crime and disorder in a study conducted in Peterborough, UK, to examine the use of GPS data in measuring patrol dosage in crime hotspots. According to Sherman *et al.* (2014), the use of GPS data allows police to precisely measure how much patrolling is done in these hot spots.

Remote sensing technology has significantly improved public safety and criminal activity prevention. Satellite photos provide critical information on illegal activities in specific locations, enabling law enforcement to identify crime hotspots and deter criminal activities. Implementing these technologies effectively provides timely and powerful data to law enforcement agencies (Spatialpost,2023).

Studies have revealed that the Spatial Multi-criteria model has been used to identify areas that are most vulnerable to violence (Camacho-Collados *et al*., 2015; Figueiredo & Mota, 2016; Silva *et al.,* 2015). According to Camacho-Collados *et al*. (2015), Remote sensing (RS) and GIS are utilized to create a more realistic depiction of urban regions that are more vulnerable to violence. The current study sought to determine whether this understanding aided police in Nairobi City County in preventing crime through response approaches.

2.2.3. Extent in application of Geospatial techniques in crime prevention through police response strategies

In comparison to traditional methods, geospatial technology facilitates the creation, manipulation, storage, and use of spatial data much faster (Deneef, 2014). Contemporary criminals are constantly finding new means of committing crimes, offering a challenge to police forces around the world. To meet the needs of policing in the twenty-first century, police should create new policing models that focus on crime prevention and reduction. This explains why strategies that worked in the past

could not function in the present. The current study intended to understand whether the use of geospatial technology in police response techniques has helped to prevent crime.

According to Lwin *et al.* (2013), improvements in the computational power of handheld devices such as smartphones, tablet PCs, and web-based GIS systems have been used to collect, integrate, visualize, and analyze data in real-time, in addition to wireless networking technologies. Fakir (2013) opines that any active police investigation necessitates the collection of evidence. He further argues that police can use GPS technology to collect data that reveals the location of a given person or item of interest. In today's policing, such technology is used in cars and mobile phones to assist in determining the directions and locations of suspects and accused persons. Investigators can precisely match evidence placement to crime scenes or accident reconstruction diagrams using differential GPS (Jaishankar,2009).

Ekblom (1988) argues that crime analysis is fundamental in a series of activities that are pointed toward imagining, executing, and assessing the measures to prevent crime. This is because the analysis of crime creates an opportunity to formulate preventive approaches to the prevailing crime problem and its physical and societal contexts. To support this view Boba, (2013) asserts that crime analysis enables police agencies to gain meaningful information that can be used to reveal underlying meanings and patterns of relationships for operational and administrative purposes. The study by Argun & Daglar (2016) indicates that crime analysis is a policing role whose aim is to find solutions to crime problems. Olajuyigbe *et al.* (2016) in another study hold the view that the analysis of crime can be utilized to evaluate the effectiveness of crime reduction programs such as community policing. However, the two studies agree that the purpose of crime analysis is to identify crime problems to develop effective mitigating measures.

Various disciplines and occupations including policing have employed the use of GIS and crime mapping software in crime analysis. Several studies have cited the exceptional capability of GIS

to overlay data from disparate sources such as calls for service, arrest reports, and spatial and temporal components of crime and displaying the analysis on a digital crime map as an important factor in crime prevention and planning (Kumar & Somashekar,2012; Argun & Daglar 2016; Kannan *et al.*, 2017). Munawar (2016) argues that Crime analysis can be used to look at the problems in detail on a spatial level. By emphasizing crime patterns, and trends, graphic presentations can effectively communicate such results and provide analysts with an avenue to influence significant policy changes in crime prevention.

Fahui (2012) argues that the transformation of geographic maps using GPS and GIS has made them even more useful in the investigation of crimes and their prevention. The investigation of crimes requires meticulous piecing of evidence from the scene of crime. According to Ksenija &Jelena, (2017), some vital information from certain crime events cannot be well represented using the statistical textual reports and tables but can be revealed using the geographical maps. For instance, in geographic profiling of criminals, GIS is used to analyze spatially obtained information to generate a map that can help forecast the likely location of serial criminal's residences (Rossmo, Laverty & Moore, 2005; Argun & Daglar, 2016).

According to (Lega *et al.*, 2014), identifying environmental crimes and their perpetrators is critical in criminal investigations. They claimed that the availability of new technologies had enabled authorities to do so more quickly and accurately than ever before. Kelly & Kelly (2017) opined that law enforcement agencies have attempted to detect crime using remote sensing technologies. Law enforcers have been able to assess where and when certain types of crimes have occurred by utilizing imagery collected remotely from sensors onboard aircraft, unmanned aerial vehicles, and satellites. Fakir (2013) asserts that GPS has been used in criminal investigations to collect informatics data on a much larger scale than that gathered by police officers' visual surveillance through tape recording, telephonic monitoring, and electronic tracking.

According to Davenport (2021), Forensic investigation involves locating, identifying, collecting, and cataloging physical evidence for presentation in court. Remote sensing methods, when applied properly, can considerably reduce the time and expense for the forensic investigator in finding evidence.

The Golden Shield Project in China, according to Schwarck (2018), was developed to give public security organizations automated analysis of bulk data that had been stored and real-time data from video or electronic surveillance that may aid the police in ongoing investigations. According to Walton (2001), the project was a database-driven remote surveillance system that provided instant access to registration records for every Chinese person while connecting to massive networks of cameras aimed at reducing the amount of time it took the authorities to respond to demonstrations. According to Eman *et al.* (2013) and Townsley (2017), crime is a social and spatial phenomenon that requires the use of information technology to determine effective prevention strategies to lessen its severity. A notable example is mapping criminal risk distributions with Geographic Information Systems (GIS). In addition to identifying crime hotspots (Nemeth *et al.,* 2014), Geographic Information Systems can be used to compare the locations of crime hotspots identifying areas with extreme crime patterns for police action. (Tom-Jack *et al.,*2019) argue that Geospatial technologies have become an essential tool in criminal justice, assisting in the assessment and visualization of crime patterns and trends.

According to (Argun & Daglar 2016; and Akpan *et al.,* 2018) police agencies in the developed world are using GIS to map crime in their day-to-day operations. It is therefore imperative to argue that geospatial techniques enable law enforcement agencies to gather accurate information and intelligence promptly. The spatial technological foundation for the analysis of crime leads to intelligence-led policing to combat crime.

Satellite imaging and aerial photography provide critical information on criminal activity worldwide. The use of satellite imagery and GIS in computer mapping has greatly enhanced crime-fighting skills. For example, in Hyderabad, India, the Telangana state police have implemented remote sensing technologies to improve policing and maintain law and order. As Mahender (2020) points out, this technology has been proven to reduce traffic accidents and increase law enforcement efficiency.

According to Reid *et al.* (2011), crime mapping is the process of organizing and visualizing spatial data for formal statistical analysis using a Geographic Information System (GIS). The main goal of spatial analysis is to determine how specific ecological or community factors (such as demographic characteristics or the built environment) affect the spatial patterns of crime. It can be used both exploratorily and more definitively. Moreover, crime mapping can be utilized to see and examine how criminals move or choose their targets. Electronic pin maps can be made with mapping software, and GIS enhances the analytical utility of these maps by arranging the data spatially.

According to Spatialpost (2023), The use of remote sensing to map and analyze crime landscapes provides a powerful tool for understanding the spatiotemporal patterns of criminal activity. Remote sensing improves crime prediction and prevention by acquiring, storing, analyzing, and presenting spatial data. This technical breakthrough provides law enforcement organizations with an empirical foundation for strategy creation, resource allocation, and tactical operations, resulting in accurate and effective crime prevention and control.

This study investigates the application of geospatial technology in crime mapping, which can provide law enforcement agencies with significant insights into crime prevention and policy development. There is limited literature on this topic that this study sought to address.

2.3. Theoretical Framework

In this study, two theories—Situational Crime Prevention (SCP) and Crime Pattern Theory (CPT)—were employed to guide the exploration into the application of geospatial techniques in crime prevention through police response strategies in Nairobi City County, Kenya. Each theory provides a unique perspective on crime, emphasizing specific aspects of criminal behavior and spatial dynamics. The utilization of both theories allowed for a comprehensive examination of the conditions under investigation, enhancing the depth and breadth of the study.

2.3.1. Situational Crime Prevention

Situational Crime Prevention, as outlined by Clarke (1995), is rooted in a preventive approach that focuses on reducing opportunities for crime rather than reforming societal structures. The theory posits that criminal behavior is influenced by a combination of disposition and situation, with offenders making choices based on perceived opportunities. In the context of this study, SCP became the initial theoretical framework as it aligned to assess the application of geospatial techniques in specific crime prevention strategies within Nairobi City County.

Clarke (1995) emphasized that situational crime prevention strategies aim at manipulating specific crimes through environmental changes, targeting opportunities, and minimizing rewards for criminal activities. The approach involves interventions such as surveillance, target hardening, and environmental management to alter proximal causes of crime. SCP focuses on the contexts of criminal acts rather than the characteristics of offenders, honing in on specific crime categories and concentrations (Eck & Clarke, 2019; Clarke, 1995).

The integration of Geographic Information System (GIS) within SCP is highlighted as a crucial tool in mapping crime incidents and analyzing their spatial relationships. GIS, as described by Groff (2007), enables the overlay of crime data with demographics, road networks, and other relevant information, facilitating the identification of crime hotspots and the development of

effective prevention strategies. The visualization of crime patterns through GIS aids law enforcement agencies in understanding spatio-temporal settings, thus enhancing the planning of crime prevention efforts (Roman, 2005; Groff, 2007).

However, while SCP provides valuable insights into specific crime prevention strategies, it may not fully capture the broader spatial patterns and routine activities influencing criminal behavior. This limitation led to the incorporation of a second theory to complement and enrich the theoretical framework.

2.3.2. Crime Pattern Theory

Crime Pattern Theory, as presented by Brantingham and Brantingham (2008), integrates propositions from routine activity theory and rational choice theory. The theory highlights that perpetrators are more inclined to engage in criminal activities in locations they are acquainted with, termed as their activity spaces. The theory posits that individuals, including offenders, develop activity spaces during their daily routines, and crimes are more likely to occur within these spaces. The relevance of Crime Pattern Theory is evident in its consideration of the spatial distribution of attractive targets and the understanding that crimes occur where such targets are present (Daglar & Argun, 2016). This theory complements SCP by focusing on the spatial and temporal patterns of crime, addressing the limitations of SCP in capturing routine activities and spatial behaviors of offenders (Weisburd *et al.,* 2009; Ksenija & Jelena, 2017; Brantingham *et al.,* 2017; Menting *et al.,* 2019).

Incorporating Crime Pattern Theory into the theoretical framework allows for a more nuanced exploration of how offenders navigate their environments and select locations for criminal activities. The theory adds depth to the understanding of crime occurrence by considering distance-decay patterns within major activity nodes and paths between them (Menting *et al.,* 2019). The spatial significance of crime is underscored by the theory, reinforcing the relevance of geospatial

techniques, especially GIS, in analyzing vast crime data and generating visual representations of spatial and temporal patterns (Zhang & Peterson, 2007; Hawkins *et al.,* 2003).

The utilization of both Situational Crime Prevention and Crime Pattern Theory provides a holistic theoretical framework for the study. While SCP addresses specific crime prevention strategies, Crime Pattern Theory broadens the perspective to encompass routine activities and spatial behaviors of offenders. Together, these theories offer a robust foundation for exploring the multifaceted dimensions of geospatial techniques in crime prevention, ensuring a comprehensive understanding of the interplay between situational factors, routine activities, and spatial patterns within Nairobi City County.

2.4. Summary of literature review and Theoretical Framework

The literature review offered detailed empirical context from an array of studies. A study by Khushi et al., (2022) investigated the application of geospatial technology by law enforcement by examining crime distribution and trends of various types of crime to improve prevention of crime and maintenance law and order. Butorac's (2017) study employed GIS to analyze spatial patterns between crime and other demographic and social economic aspects by visualizing spatial data. The study emphasized the importance of GIS in the quality of police work, as well as policy and decision making at the operational, tactical, and strategic levels, in order to prevent and reduce crime.

According to Daglar & Argun (2016), their work was focused on the application of GIS and crime mapping in analysis of crime to identify patterns and trends. According to the study, GIS enabled a wide range of problem-solving and spatial decision-making applications in crime and crime settings. This is critical for the police agency to develop reaction strategies for preventing and reducing crime.

Mansor *et al.* (2019) investigated the use of satellite imagery and remote sensing techniques for detecting urban changes. The study's findings demonstrated a positive association between urban development and criminal behaviours, specifically violent crime and drug abuse. The findings can help police departments combat the growing number of illegal activities in urban areas.

In his study spanning small areas in England, Horsefield (2023) used spatial analysis to explore the association between the availability of alcohol and violent crime. The study emphasized the need of employing spatial models to better understand the links between alcohol availability and violence. Kounadi *et al.* (2020) conducted an in-depth study of spatial crime forecasting, addressing the need for law enforcement to understand and combat crime with emphasis on real-time crime prediction in both time and location. The study by Loannidis *et al.* (2024) examined the degree to which data from remotely sensed imagery can be used to explain patterns in house burglaries and street thefts. According to the study, small area crime geographies are the result of intricate processes that unfold in an area and it offers potential offenders spatially varied patterns of risk and opportunity. With this understanding the law enforcement agencies are able to plan on the appropriate response strategies. Theoretical framework was reviewed and their linkage to the current study explained.

2.5. Conceptual framework

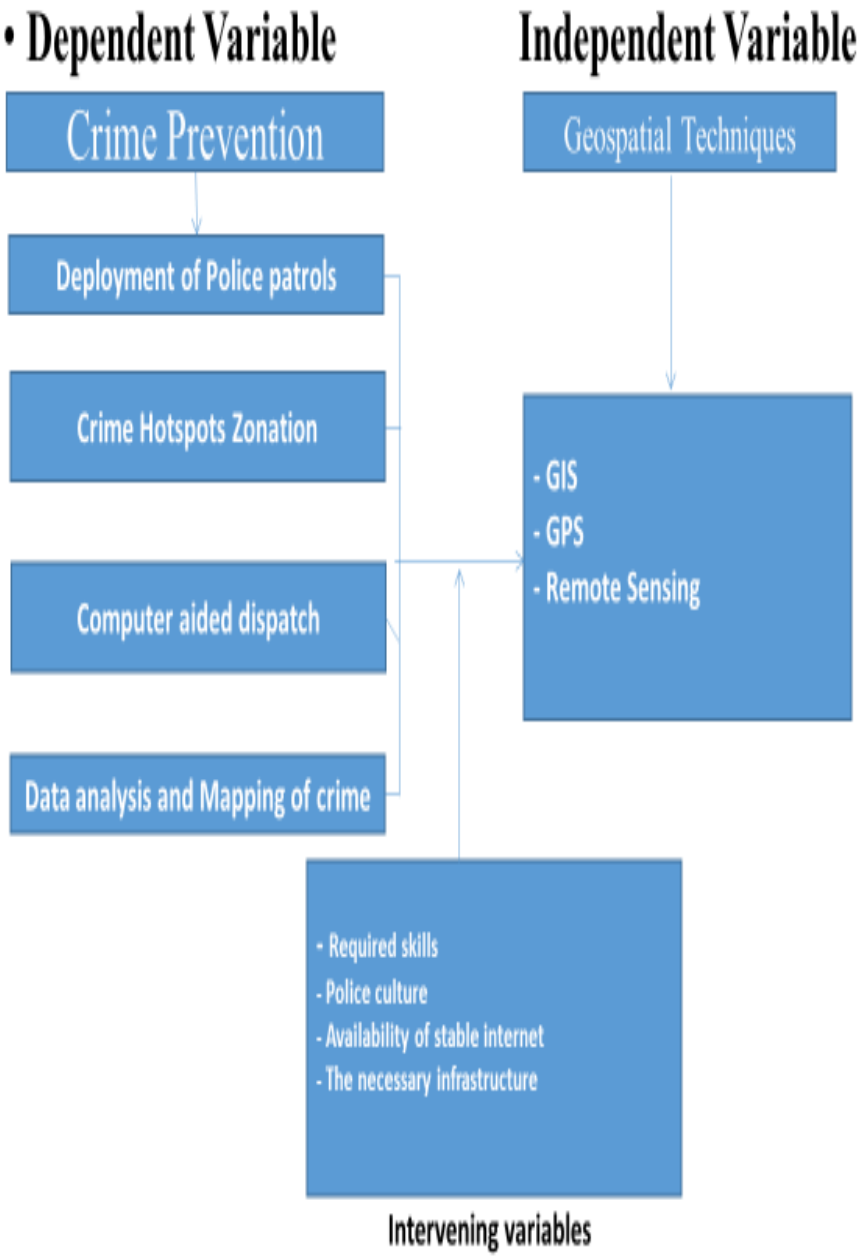

Figure 2: 1 Conceptual Framework

The conceptual framework for this study has three parts. Variables that constitute this framework are based on the review of previous literature and field observations of the study area.

The first part identifies the geospatial techniques that are applied to crime prevention. They include Geographic information systems, Global Positioning Systems, and remote sensing. These factors are significantly related to the application of Geospatial techniques in crime prevention.

The second part of the framework includes response strategies that apply geospatial techniques. The variables were categorized into crime response strategies such as hotspot identification, police patrols, and computer-assisted dispatch. Other variables are data collection, storage, analysis, and crime mapping. Mediating variables such as user perception, police culture, and required skills were also studied.

The third part consists of independent variables. To reduce crime and improve quality of life, the elements of timely and accurate information, rapid decision-making, rapid response to criminal incidents, and accountability of police officers are critical. These factors form the independent variables in this study. They have a direct impact on crime prevention strategies.

The concept that an individual's deliberation to engage in a particular behavior is a product of the individual's attitudes, subjective norms, and perceived behavioral control determines an individual's actions or actions. The likelihood that a decision will be influenced is increased by good and accurate knowledge of the factors and reasons behind an individual's decision to engage in a particular activity or action. An important first step in designing and developing effective countermeasures, strategies, interventions, and strategies that can be utilized successfully to support affected individuals to adapt and change their behavior is understanding and recognizing the determinants of conceptual framework.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter explains the research design, target audience, sampling procedure, research instruments, piloting of the study, and data analysis procedures.

3.2. Research Design

A descriptive survey research design that employed both quantitative and qualitative data collection methods was adopted. This design was preferred because of its easily accessible way for respondents to express their perspectives on the topic of study. In the research, the independent and dependent variables were utilized to define the scope of the study but could not be explicitly controlled by the researcher. The design therefore suited well with this study that sought to obtain views from the police officers on the application of geospatial techniques in crime prevention through police crime response strategies in Nairobi City County, Kenya.

3.3. Study variables

3.4. Location of the study

The study was geographically located in Nairobi City County which covers a total area of 696.1 square Km. According to (the Kenya National Population and Housing Census, [KNBS, 2019]) the city-county of Nairobi has a population of 4,397,073 persons. The city has a labor force of 2,148,605 persons out of which 1,832,751 persons were classified as employed while 315,844 persons were seeking employment. Significantly the youthful proportion of the labour force consists of 561,457 males and 648,756 females. (Kenya National Population and Housing Census, [KNBS, 2019]).

According to (Amnesty International, [AI], 2009) there are several slum dwellings in Nairobi. These include Kibra, Mathare, Deep Sea, Korogocho, and Mukuru Kwa Njenga. The informal settlement is situated adjacent to the formal settlements. The [AI], 2009) report further indicates that there are 2.5 million slum dwellers who only occupy 6% of the land in Nairobi. Life is risky in a population representing 60 % of the total population in the city county.

The Kenya Police Headquarters is at Vigilance House and the Criminal Investigation Department is at Mazingira on Kiambu Road. Each of the sub-counties in Nairobi has a sub-county police command which housed both the general police and criminal investigators. The selection of Nairobi City County as the study area was based on its suitability for having the necessary infrastructures for geospatial technologies. The location was ideal for the study because of the rampant cases of criminal activities reported in the media, and also being one of the counties in Kenya with advanced technological applications in the police force sector.

3.5. Target population

For this study, the target population included all serving police officers from the Kenya Police Service and Directorate of Criminal Investigations. More emphasis was put on officers in various sub-county police operation rooms, the crime and intelligence section at Kenya Police Headquarters, the criminal intelligence bureau at the Directorate of Criminal Investigations, and the Integrated Command and Control Centre. The views of the police officers deployed to these sections were obtained and the results were generalized for the study. The officers were considered because they are directly and indirectly involved in crime prevention and respond to criminal incidences in Nairobi County; hence, would provide adequate information on the subject matter.

Table 3: 1 Showing Target Population

S/No.	Category of population	Target pop. (N)
1.	Senior police officers	12
2.	Mid-level commanders	48
3.	Junior Police officers	138
	Total	**198**

3.6. Sampling techniques and Sample size

3.6.1. Sampling Techniques

According to Yin (2016), purposive sampling is used where the samples are probably going to be picked deliberately to choose explicit investigation units that can yield the most applicable and abundant information for the study. Stratified purposive sampling was used and to reduce biases respondents from each stratum were randomly selected.

In this study, the respondents were drawn from police officers working at various sub-county police operation rooms, the crime and intelligence section, the crime intelligence bureau, and the integrated command Centre. This sampling technique helped the researcher to select a sample that provided the relevant information for the study. A representation of senior officers was obtained from a sample taken randomly from the commanders at the county and sub-county level, those in charge of the crime and intelligence section, the crime intelligence bureau, and the integrated command Centre.

3.6.2. Sample size

Hair *et al.* (2006) argue that a least sample size of 100-150 is suggested to guarantee a constant maximum likelihood approximation solution. In the current study, the standard formula for calculating sample size was adopted

$$\text{Sample size, } n = N * \frac{\frac{Z^2 * p * (1-p)}{e^2}}{[N - 1 + \frac{Z^2 * p * (1-p)}{e^2}]}$$

Where:

- N = Population size,
- Z = Critical value of the normal distribution at 95% at the required confidence level is 1.96
- p = Sample proportion being 0.5
- e = Margin of error being 5% or 0.05

According to Sekaran (2016) where the samples are divided into subsamples a minimum sample size for each category is necessary. Therefore, this formula was used to calculate the respondents from each category which was then summed up to achieve the total sample size (n).

Table 3: 2 Distribution of Sample size

S/No.	Category of population	Target pop. (N)	Sample size (n)	Sampling procedure
1.	Senior police officers	20	20	Simple random
2.	Mid-level commanders	48	43	Purposive
3.	Junior Police officers	138	102	Purposive
	Total	**206**	**165**	

3.7. Research Instruments

Questionnaires were used as the most suitable instruments to collect data in research because many respondents could be reached within a limited time and they were easy to use and administer. In addition to being utilized to find important information about a population, this method was also convenient, and inexpensive and it offered greater anonymity (Kumar, 2011).

The researcher conducted face-to-face in-depth interviews with the senior management cadre who possess a lot of experience in the service. According to Marshall & Rossman (2015) in-depth interviews are useful when aiming for exhaustive perceptions, opinions, and attitudes. Even though the method is time-consuming it allows the researcher to probe explanations from the responses. Kumar (2011) avers that using this method enables the researcher to observe and interpret body language and facial expressions.

To gather more information about the topic, the researcher also employed focus group discussion. This method was used to gauge how the officers were applying and utilizing the various geospatial techniques. Basnet (2018) emphasizes the importance of focus group discussions in qualitative inquiry because they provide a deeper understanding of phenomena, uncover individual feelings, experiences, and insights, and aid in understanding multiple realities of a problem, thereby increasing the trustworthiness and credibility.

Through observation of police officers' routines in Nairobi City County, the researcher sought to understand the implementation of geospatial technology. According to Baker (2006) and (Ciesielska *et al.*, 2018), participant observation entails spending a significant amount of time participating in the activities of cultural members while also observing them in their daily lives in order to have a deeper comprehension of their actions and activities. The researcher was able to gain a thorough understanding the target population attributable to this method.

To understand the context in the application of geospatial techniques for policing in Nairobi city County, the researcher also reviewed various documents that provide insights into the conditions that impacted on the phenomena under investigation. According to Bowen (2009) document review can be used in triangulation of other research instruments. The review of documents helps the researcher to understand the historical roots of specific issues.

3.8. Validity and reliability

3.8.1. Validity

Validity is the most vital criterion that shows the level to which an instrument estimates what it should gauge (Kothari, 2004). It reflects the degree to which true differences among those being tested as compared with the differences found with a measuring instrument. Research instruments were presented to the supervisors for review. Oluwatayo (2012) argues that this practice is meant to establish whether the tools are relevant, reasonable, unambiguous, and clear and whether they reflect the themes of the study objectives. The supervisors assisted in determining the question content and whether they were correctly worded. The opinion of the experts was sought to determine whether the items in the instruments revealed the content universe for the generalization of instruments (Straub *et al.,* 2004). Hence improving the overall quality of the study.

Kumar (2011) avers that validity is also established when there is a logical link between the questions and the objectives of the study. He also opines that hard evidence is obtained through statistical procedures in the calculation of the coefficient of correlations between the questions and the outcome variables.

The tests used in the study were considered valid because of two reasons as stated by Borsboom *et al*. (2004). Firstly, based on Borsboom and others' opinions, there is an existing attribute, which for the case of this research is the adoption of GIS technology in crime detection and prevention by the Kenyan police service sector. Secondly, variations in the application of the GIS technology lead to variations in the effectiveness of detection and response to criminal activities in Nairobi city.

3.8.2. Reliability

Kumar (2011) defines reliability as the quality of a measurement procedure to provide repeatability and accuracy. According to Mugenda and Mugenda (2003), the reliability of a measuring instrument is obtained when it delivers consistent outcomes. To ensure the reliability of the

instruments in this research, the tools were subjected to a pilot study involving police officers. The questions were subsequently reviewed to ensure that the expectations of the study were realized. To achieve the levels of precision in this study the questions were derived from already available literature. The respondents were guaranteed of their secrecy and to ensure the objectivity of the study. They were encouraged not to discuss with their peers when filling out the questionnaire. This condition was reasonable to evoke the right information for the study without anyone else influence.

3.8.3. Pilot study

A pilot study alludes to a little report for testing the examination conventions and information assortment instruments preceding the full study (Hassan, Schattner & Mazza, 2006). To verify the clarity of the questions in the questionnaire and the interview schedule a pilot study was conducted in Mombasa. This exercise helped the researcher to estimate the time a respondent needed to fill it (Lancaster *et al.*, 2004). Whitehead *et al*. (2016) in quoting the works of Browne in 1995 assert that the use of 30 is commonplace for a pilot sample. In this study 30 police officers who are based at the coast region police headquarters were used. For the pilot study to be representative officers were drawn from all cadres. The individuals who participated in piloting the study were ineligible for selection in the research.

3.9. Data Collection Methods

This study used structured and semi-structured questionnaires the 145 respondents comprising those in junior and middle management level. Two undergraduate students were trained as research assistants to administer the questionnaires to the participants who were given a time frame within which to complete them. To ensure a high completion rate the research assistants were required to check for completeness of the filled-up questionnaires before collecting them. Any detected

anomaly was corrected before the questionnaires were received from respondents. The completed questionnaires were then handed over to the researcher for final verification.

The researcher performed in-depth interviews with top management cadre who have extensive service experience. Their views of how geospatial techniques have impacted crime prevention strategies were very crucial. They are senior police officers who have dealt with information records cases for a period hence forming the key respondents. To get in-depth information the researcher will need to spend substantial time with them. Gill *et al*. (2008) aver that to protect data obtained from interviews against bias, it should be tape-recorded and subsequently transcribed verbatim. They also argued that it is important for the researcher to make field notes about his observations, thoughts, and ideas about the interview during and immediately after. These notes were used during the data analysis process.

Three focus group discussions were held. Two groups were having eight police officers, one of the groups drew police officers from Crime and intelligence bureau at DCI headquarters while the other one was comprised of police officers based at IC3. The third had six police officers from Langata police station. An expert in the application of geospatial techniques was used to facilitate the discussions and the responses were recorded.

As part of the study, the researcher examined various documents and the report was incorporated into the findings. Some of the documents that were evaluated, include journals, newspaper articles, police magazines and documentaries, crime reports, casefiles, crime and research bureau reports, crime maps and charts, and other public records.

The process of observation entailed choosing several key informants among the police officers. They were urged to monitor their colleagues at work and clarify issues during informal talks. These would be documented in the form of field notes to aid in the creation of a narrative that explained various factors such as perception on the application of the geospatial technology and ease of use.

With the help of an MS Excel spreadsheet, nominal scales were utilized to analyze closed-ended inquiries into totally unrelated categories and frequencies. In the investigation of open-ended inquiries for conceptual content, the process included the creation and translation of recurrence tallies and tables that were used to portray and summarize the data. The researcher used means, correlations, to derive conclusions and comparisons.

Table 3: 3 Showing Sample sizes for Instruments

Research instrument	**Type of data**	**sample**
Questionnaire	Quantitative	145
In-depth interviews	Qualitative	20
Focus group discussion	Qualitative	30

Table 3: 4 showing how objectives will be measured & presented

Objective	Analysis	Presentation
Demographics	Quantitative	• Frequencies
components of Geospatial techniques in crime prevention by police service	Qualitative	• Themes • Verbatim
	Quantitative	• Percentages, • bar charts
Influence of Geospatial techniques on police response strategies	Qualitative	• Themes Verbatim
	Quantitative	• Percentages, • pie charts
	Qualitative	• Themes • Verbatim

Extent of application of Geospatial techniques in police crime response strategies	Quantitative	• Percentages, • bar charts

3.10. Data analysis and presentation

Both quantitative and qualitative data were gathered. Before the analysis of the data, the questionnaires were checked for completeness to ensure that they were usable or required to be discarded (Kent, 2015). The responses were verified for accuracy and consistency, the necessary corrections were made before deciding whether some or all parts of the questionnaire should be discarded. Subsequently, the data was recorded in an Excel spreadsheet before exporting to data analysis software. Quantitative data was evaluated utilizing a statistical program for social sciences (SPSS) for the computation of statistical summaries. Tables, graphs, bar charts, and pie charts were utilized to present the data.

The qualitative data was in the first place arranged systematically into text format and then exported into a spreadsheet. This was followed by organizing the data following research objectives and recording it in a table to make it easily observable. The information was then coded by the themes and formed patterns. The outcomes were presented in narrative and verbatim structures. A Chi-square test was utilized to test the hypotheses on the correlations between GIS use and its effectiveness in crime prevention and response. The Chi-square test helped compare the discrepancies between the data observed and the expected results. With the Chi-square test, it was determined that there was a relationship between the use of GIS and the prevention, as well as response to crime and criminal activities by the law enforcement officers in Nairobi city.

After collecting data, data analysis was done to establish how each variable contributed to project quality. The collected data was analyzed qualitatively and quantitatively using percentages, means,

and frequency distribution. Data was descriptive; hence frequencies, percentages, and means were utilized to present the results of the study.

Table 3: 5 Showing how variables were measured

Objective	Variables	measurement
Demographics	• Age • Education level • Length of service • Cadre of service	Nominal scale
Components of geospatial techniques in crime prevention	- GIS - GPS - Remote sensing and Aerial imagery	• Ordinal scale • Interval scale
Influence of application of Geospatial techniques in crime prevention through police response strategies	• Effective decision making • Quality Police patrols • Investigation of crimes • Effectiveness in Computer Aided Dispatch	• Ordinal scale • Interval scale
Extent in the application of Geospatial techniques in crime prevention through police crime response strategies	• Quality crime Data collection • Proper Data storage • Effective crime analysis • Proper personnel management • Generating crime maps	• Ordinal scale • Interval scale

3.11. Data Management and Ethical consideration

The study dealt with matters classified as sensitive and confidential because the sought data concerned national security. To overcome this challenge, the researcher sought for approval from Kenya University graduate school and ethical review committee and then permission from the NACOSTI. Authorization was gotten from the Inspector General of Police to carry out the study within Nairobi County police divisions, the DCI, and the integrated command centre.

The researcher gave assurance to the management of the Police service that the research was being conducted for academic use only. Upon obtaining consent from the respondents, they were given assurance that their identity and discretion would be upheld.

Geospatial technologies can capture sensitive personal information. During the conduct of the study, the researcher was able to identify the privacy and security concerns and recommended that mitigating measures be put in place for the dissemination of information.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

4.1. Introduction

This chapter contains the results from the findings and a discussion of the related results based on the study's research objectives. The chapter ends with an elaborate conclusion.

4.2. Results

4.2.1. Response rate

The study enlisted the participation of 206 police officers. A total of 165 of them participated in the survey. The questionnaires were filled out by 115 of the 145 respondents yielding a 79.3 percent response rate. Another twenty-two (22) out of thirty (30) police officers were involved in focus group discussions. It represented 73.3 % of the intended sample. Twenty (20) senior police officers were also interviewed using a semi-structured interview guide. This represented 100 % of the intended sample of the interviewees. According to Berg (2004), a response rate of 70% or higher is considered a good response rate; this is more than two-thirds of all respondents, and even two-thirds of all respondents is statistically efficient.

Table 4. 1 showing Response Rate

Respondents	**Intended sample**	**Obtained sample**	**Percentage**
Questionnaires	145	115	**79.3**
In-depth Interviews	20	20	**100**
Focus group discussion	30	22	**73.3**
Total	**145**	**115**	**79.3**

4.2.2. Socio-demographic Characteristics of the Respondents

The study begins by collating the respondents' social demographic characteristics in terms of age, level of education, years of service, and cadre. The respondents' functional features were reflected by their age, years of service, and education level, whereas the NPS's structural aspect was represented by the cadre.

Table 4. 2 Showing respondents age distribution

		Frequency	Percent
Valid	Under 25Years	7	6.1
	25-30 Years	38	33.1
	30-35 Years	25	21.7
	35-40 Years	22	19.1
	40-45 Years	15	13.1
	45-50 Years	6	5.2
	Over 50 Years	2	1.7
	Total	115	100.0

As depicted in Table 4.2, the results indicate a demographic distribution among respondents, with 6.1% below 25 years, 33.1% between 25 and 30 years, and 21.7% between 35 and 40 years. Additionally, 5.2% fall in the 40-45 age group, and 1.7% are above 50 years. Notably, officers below 35 years, predominantly engaged in tactical teams. This team comprised of the middle level managers who are responsible to supervise and command the team at this level. Furthermore, the data highlights that individuals in the 25-30 age bracket are more likely to use and adapt to new technology, a significant observation given the focus on geospatial techniques in the police service. The concentration of younger officers in tactical teams and their affinity for technology suggests a potential receptiveness to the integration of geospatial techniques. As these younger officers are more adept at embracing new technology, the study implies a promising outlook for the effective adoption and utilization of geospatial tools in the police service, facilitating enhanced crime prevention strategies.

Table 4. 3 Showing the length of service

		Frequency	Percent
Valid	Below 5 Years	7	6.1
	5-10 Years	33	28.7
	10-15 Years	46	40.0
	15- 20 years	24	20.9
	Above 20 years	5	4.3
	Total	115	100.0

As portrayed in Table 4.3, the study's findings reveal a distribution of respondents based on their officers' capabilities, potentially influencing superior abilities.

The positive correlation years of service. Notably, 6.1% of participants had a service duration of 5 years and below, while 28.7% fell within the 5-10 years range. A significant proportion, 40%, had accumulated service experience spanning 10-15 years. Furthermore, 20.9% represented officers with a service history of 15-20 years, and 4.3% had been in the police service for over 20 years. The results underscore a correlation between years of service and experience, suggesting that increased tenure enhances

between years of service and experience emphasizes the potential wealth of expertise within the police force. This heightened experience can significantly impact the effective utilization of geospatial techniques, as more seasoned officers may possess superior abilities in adapting and maximizing the benefits of such technologies in crime prevention strategies.

Table 4. 4 Showing level of education

		Frequency	Percent
Valid	O Level	64	55.6
	Diploma	18	15.7
	Bachelors' Degree	30	26.1
	Postgraduate	3	2.6
	Total	115	100.0

As depicted in Table 4.4, the study's results reveal the educational diversity within the respondent pool. Notably, 55.6% of participants reported having no post-secondary school education, while 15.7% possessed a diploma. A significant proportion, 26.1%, held a Bachelor's degree, and an additional 2.6% had pursued postgraduate education. This diversity illustrates the varied educational backgrounds within the sample, reflecting a spectrum of knowledge and qualifications among the participants.

The educational diversity observed suggests that there is a range of expertise within the police force concerning geospatial techniques. While a significant portion may not have post-secondary education, the presence of officers with diplomas, Bachelor's degrees, and postgraduate qualifications indicates a potential pool of individuals with varying levels of analytical and technological acumen. This diversity could influence the successful integration and utilization of geospatial tools, as officers with higher educational backgrounds may contribute distinct perspectives and skills to enhance the effectiveness of crime prevention strategies.

Table 4. 5 Showing the cadre of the respondents

		Frequency	Percent
Valid	Junior Officers	75	64.3
	Mid-Level Management	40	35.7
	Senior level management	20	100

As illustrated in Table 4.5, the study's outcomes indicate that 64.3% of respondents held positions as junior police officers, while 35.7% occupied mid-level managerial roles. Twenty (20) senior

level management officers were interviewed. The distribution across cadres suggests that the application of geospatial technology has permeated various hierarchical levels within the police force, contributing to enhanced efficiency in police response strategies across the organizational spectrum.

The widespread utilization of geospatial technology across both junior officer and mid-level managerial positions suggests a democratization of technological access and proficiency within the police force. This indicates that the benefits and effectiveness of geospatial tools are not confined to specific ranks but are accessible and applicable across diverse cadres. The findings underscore the potential for a holistic integration of geospatial techniques, fostering a collaborative and informed approach to crime prevention that involves personnel at all levels of the police hierarchy.

4.2.3. Assessment of Components of geospatial techniques for crime prevention

This was the first objective of the study. Under this objective, the respondents were asked to identify and evaluate the identified components of geospatial techniques being applied by the Kenya police service in crime prevention. The researcher aimed to find out which components of geospatial techniques were being utilized by the police service in Nairobi City County and how they have helped to improve efficiency in their response to reduce crime incidents.

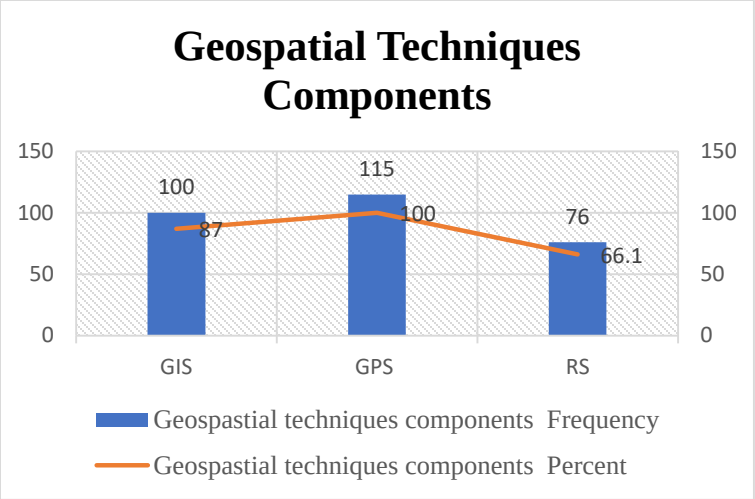

Figure 4: 1 Showing the identified components of Geospatial techniques

As presented in figure 4.1, the study revealed that 87.0 % of respondents identified GIS as one of the components being used by the Kenya Police Service. While only 66.1% of the respondents were aware of Remote sensing, all the respondents identified GPS as a geospatial technique being applied by the Kenya Police Service.

Several studies have recorded various components of geospatial techniques applied in crime prevention. Most of the studies recognize GIS, GPS, and RS as the most commonly used technologies in the detection and prevention of crime. Daglar and Argun 2016; Akpan *et al.* (2018); Ferreira *et al.* (2012); Boba (2013); Fakir (2013); Jaishankar (2009) and Kinney (2022) are in full support of the study findings as they identified GIS, GPS and RS being the main components of geospatial techniques useful in crime prevention. Since the question on the geospatial technology components was left open for a qualitative response, each of the respondents stated any or all of the three components. The findings reveal the study participants' confidence in stating the three geospatial components having interacted with them in their law enforcement duties.

4.2.3.1. Geographic Information Systems

Although GIS was defined by Clarke (1990) as an automated system for gathering, storing, retrieving, analyzing displaying geospatial data, Ayinde & Agwu (2016) suggested that it is a

visual depiction of multiple geographically localized data sources and crime events. The main application of GIS is in enhancing decision-making. Mahender (2020) on the other hand praises the usefulness of GIS in crime detection and prevention due effectiveness in crime analysis. The results of this study show that there is a strong link between utilization of GIS in the management of crime data. This implies that application of GIS by police in crime prevention through their response strategies.

Table 4. 6 Rate the Usefulness of GIS in the detection of crime

		Frequency	Percent
Valid	Very Good	28	24.3
	Good	72	62.6
	Neutral	9	7.9
	Poor	4	3.5
	Very Poor	2	1.7
	Total	115	100.0

As presented in Table 4.6, the study reveals that 24.3% of respondents perceived GIS as "very good" in detecting crime, with a majority of 62.6% considering them "good." A smaller portion, 7.9%, expressed neutrality, while 3.5% believed these technologies were "poor," and 1.7% deemed them "very poor." In alignment with Deneef's (2014) perspective, most respondents (86.9%) recognized GIS's crucial role in handling spatial data, with advancements in computational power and web-based systems enabling real-time data collection, integration, visualization, and analysis for crime detection and prevention. The findings suggest a generally positive perception among respondents regarding the effectiveness of geospatial techniques in crime detection. The study implies that the application of GIS was well-received and considered valuable by the majority of police officers, indicating a positive impact on crime detection and prevention strategies.

Davenport (2021) highlights the role of modern technologies in enhancing the identification and collection of crime data. Geospatial technology, particularly GIS, is widely used for efficient automated analysis of bulk data, facilitating faster law enforcement and crime detection. 86.9% of respondents agree that these techniques are widely applied in crime prevention by police.

4.2.3.2. Global positioning system

According to Shehu (2022), a GPS receiver can receive geolocation and time data from this global navigation satellite system from any position on or close to Earth. While there are significant societal and legal issues that have been brought up by the growing reliance on GPS technology, some people argue that society is made safer by the use of this technology by law enforcement agencies to track automotive movements. (Fakir,2013; Jaishankar,2009: and Kinney, 2022) underscored the significant role of GPS in crime detection, highlighting its ability to reveal exact crime locations, real-time positioning, and efficient data collection compared to visual surveillance methods like electronic tracking and telephonic monitoring. These notable benefits of GPS technology were also revealed by the findings of this study.

Rate the usefulness of GPS in the investigation of crimes

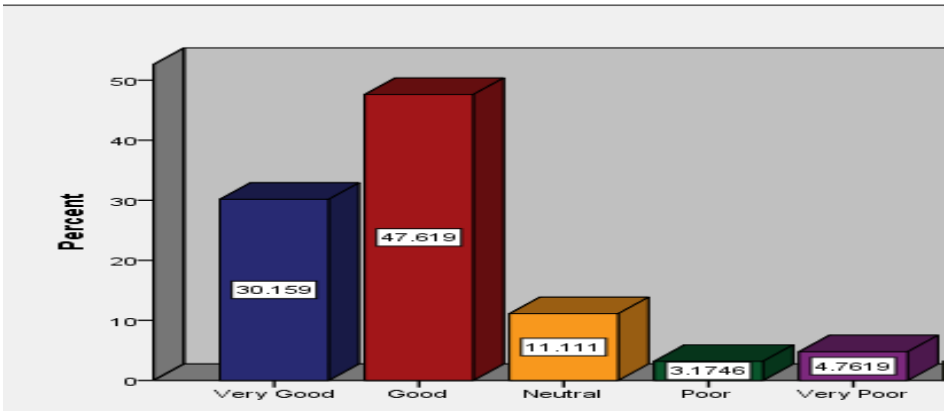

Figure 4: 2 GPS in the investigation of crime

On application of geospatial techniques in the investigation of crime. As shown in figure 4.2, an overwhelmingly 77.78 % of the respondents indicated that the application of GPS has not only

improved the outcomes in the investigation of crime but also the quality of evidence adduced in courts. In a study conducted by Shamblin (2004), the results showed a similar pattern, emphasizing the usefulness of GPS and GIS to the investigators.

Shamblin (2004) and Boba (2013) highlighted the use of GPS technology in providing geographic data, enabling mobile phone operators to trace calls to specific locations. This data, integrated into the GIS platform, can significantly unravel victims' movements and aid in criminal investigations of serial offenders. The ability to show crime patterns can aid in correlating the modus operandi and evidence gathered from occurrences to apprehend a criminal.

During the in-depth interview, a respondent answering the question of how GPS has assisted in improving the quality of evidence confirming the prominence of GPS technology in the investigation of crime said: *"Here at DCI we have a gadget that helps track the mobile number of the accused person from which we can now obtain other details. If it places the suspect at the scene of crime then it beefs up the evidence. As you know an offender will always leave traces of evidence behind. Forensic experts will take a keen interest in obtaining the samples for DNA to match with what was corrected at the scene. This helps in corroborating other evidence.*

The findings of this study are consistent with other previous studies that suggested that GPS technology was an important component in the investigation of crime.

4.2.3.3. Remote sensing (RS)

According to Jensen and Cowen (1999), several fields have historically used remote sensing technologies to gather physical environment features. These methods have increased our awareness of the relationships between crime and physical surroundings, as well as our understanding of the location and spatial perspectives of crime. The results of this study further contribute to the scant literature on the application of Remote sensing in crime prevention through

police response strategies. Moreover, remote sensing helps detect crime that occurs in hidden locations thus minimizing dark figures in crime data management (Kelly & Kelly, 2017).

Table 4. 7 Rate the usefulness Video based surveillance cameras in the apprehension of offenders

		Frequency	Percent
Valid	Very Helpful	44	38.3
	Helpful	62	53.9
	Neutral	6	5.2
	Slightly Helpful	2	1.7
	Not Helpful	1	0.9
	Total	115	100.0

As presented in Table 4.7, the study has revealed that 38.3% and 53.9% of respondents acknowledged the significance of data obtained from video-based surveillance cameras considering it "very helpful" and "helpful," respectively, in the apprehension of offenders. A smaller proportion, 5.2%, expressed uncertainty about the utility of the data, while 1.7% perceived it as "slightly helpful," and 0.9% believed the data was "of no help."

The majority of respondents recognizing the value of video-based surveillance data in apprehending offenders underscores the instrumental role of surveillance technology in law enforcement. The data suggests a positive reception among the police force regarding the effectiveness of video-based surveillance in contributing to the identification and capture of perpetrators. The varying responses also highlight the need for continued evaluation and optimization of video-based surveillance systems to address concerns and uncertainties among a minority of respondents, ensuring that this technology remains a valuable tool in contemporary crime prevention strategies.

In support of these findings a respondent during the in-depth interview when asked if the video-based surveillance cameras placed along various roads within Nairobi City County are assisting

the police officers during their investigations responded in affirmative as follows: "*If there is a project that was well thought with a view of addressing the security situation in the city of Nairobi is the safe cities project. These surveillance cameras that are strategically placed along various roads are fitted with automatic number recognition cameras that pick up runaway motor vehicles that are suspected to have been involved in crime. We have managed to apprehend suspects having been taken up by these cameras.*

Document reviews were instrumental in gathering information on the components of geospatial techniques applied in crime prevention within Nairobi City County. A comprehensive examination of existing literature, including academic papers, reports, and policy documents, revealed that Geographic Information Systems (GIS), remote sensing, and GPS were widely utilized by law enforcement agencies. The reviews illuminated the technological landscape, providing a foundation for understanding the various components involved in geospatial crime prevention.

Focus group discussions complemented document reviews by offering qualitative insights into the practical application of geospatial techniques. Police officers deployed at Crime Research and Intelligence Bureau at DCI and Crime and intelligence Section at Police HQS with a help from a geospatial expert engaged in discussions that delved into their experiences and perspectives on the use of GIS, remote sensing, and other spatial tools. Key findings from these discussions included the challenges faced in implementing geospatial techniques, the level of training required, and the perceived effectiveness of these technologies in actual crime prevention scenarios.

The observational component involved first-hand observations of law enforcement activities and the utilization of geospatial tools. This included observing officers working with GIS software, participating in training sessions, and witnessing the integration of geospatial data into daily policing practices. The observation revealed the practical challenges faced by law enforcement in

implementing geospatial techniques and provided context to the document review and focus group discussion findings.

The results of this study indicate that there is application of geospatial techniques by police for crime prevention in Nairobi City County. These findings are consistent with previous studies that have shown that application of geospatial techniques by law enforcement agencies have improved on their efficiency in responding to crime incidents.

4.2.4. Influence of Geospatial techniques in crime prevention through Police response strategies

This was the second research objective. During the study, respondents were asked if geospatial techniques had any influence on crime prevention through police response strategies. The study revealed that the application of geospatial techniques in police operations has a positive influence on police response strategies. The current study identified key areas of crime prevention that have experience significant influence after the application of geospatial technology by the police service in Nairobi City County. These areas include crime hotspot identification, the deployment of police patrols, identification of crime patterns and trends, computer-aided dispatch, and tracking offenders. This technology has also created a paradigm shift in the mapping of crime and the effectiveness of the Integrated Command and Control Centre (IC3) in the dissemination of information to and from the tactical teams.

4.2.4.1. The influence of Geographic information systems in crime prevention through police response strategies

Burrough (1998) describes GIS as a powerful set of tools for capturing, storing, and retrieving geographical data for specific goals. According to Ahmed & Salihu (2016) its applications in operations, decision-making, criminal investigations, community problem-oriented policing, crime prevention programs, cross-jurisdictional analysis, and improved cooperation with courts

and corrections. GIS allows police officers to map event locations based on specific attributes, making it a valuable tool for law enforcement.

The examination of existing documents elucidated the historical evolution of geospatial techniques in police response strategies. Reviews of official reports and academic studies showcased the impact of GIS and related tools in identifying crime hotspots, optimizing resource allocation, and enhancing the overall effectiveness of police response strategies. The documented cases provided valuable insights into the tangible outcomes achieved through the application of geospatial techniques in policing operations.

Rate the effectiveness of GIS in identification of crime hotspots

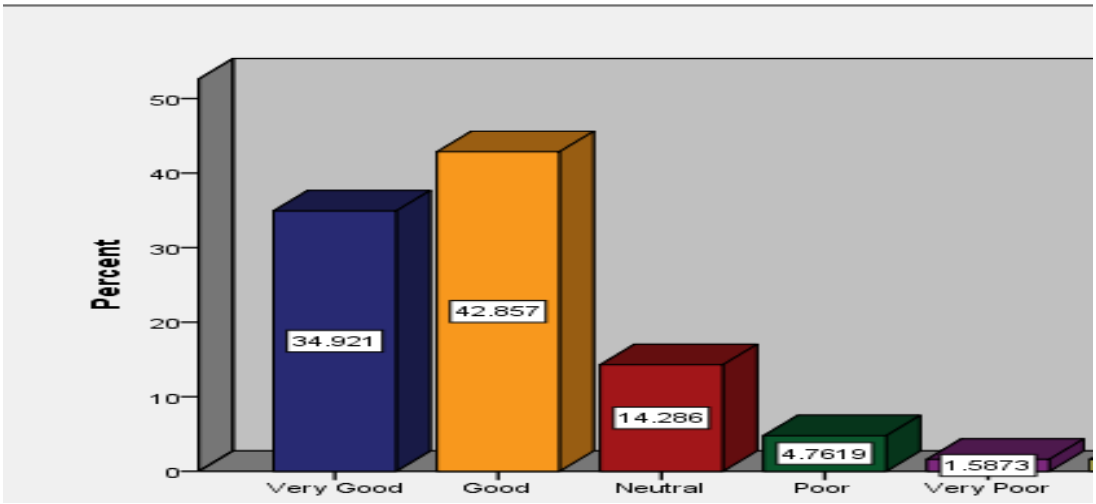

Figure 4: 3 GIS in identification of crime hotspots

From the findings of the study as shown in figure 4.3, it was revealed by a majority 76 percent of respondents GIS is very useful in the identification of crime hotspots. Various studies have supported this view, Geographic analysis of crime based on data obtained from police records is used to identify the micro-places where crime is most prevalent to effectively target police resources such as deployment of patrols (Braga *et al.* 2018; Curtin *et al.*,2010; Weisdud,2005).

Accurate detection of spatial crime concentrations and timely mapping of crime locations aid in identifying where crimes concentrate in space and time, providing critical information for law enforcement operations to reduce crime. (Zhou *et al*., 2014).

Rate the effectiveness of GIS and computer aided dispatch

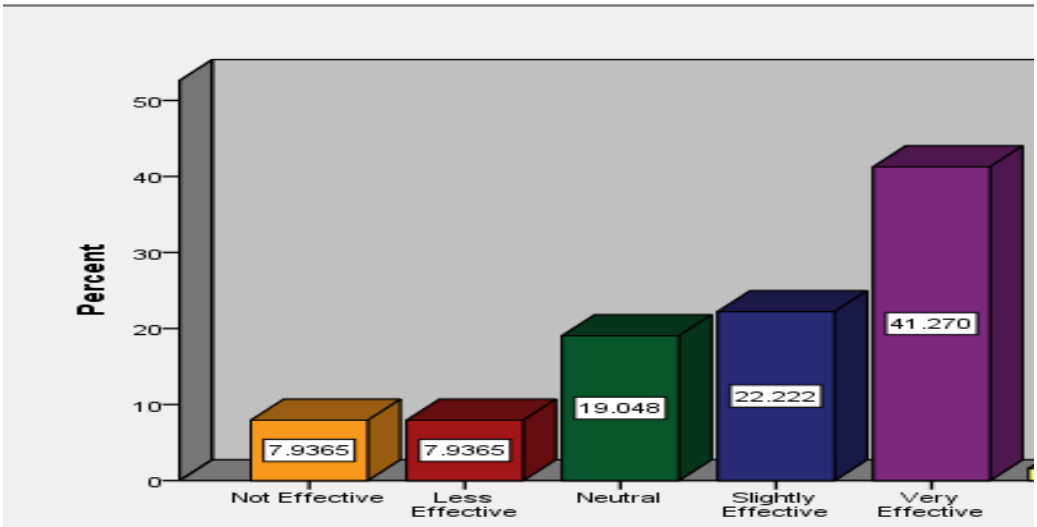

Figure 4: 4 Effectiveness of Computer-Aided Dispatch

As shown in figure 4.3, 63 % of the respondents indicated that Computer-aided dispatch (CAD) systems were effective as a response strategy that was used by the Kenya Police Service to prevent crime. This followed the incorporation of Integrated communication, a command centre popularly known as IC3 into policing work in Kenya, which has seen a quick response to calls of service made through 112, 911, or 999. The officer at the command centre raises the patrol team near the point of distress call. According to McEwen *et al*., (2004), CAD systems supported police agencies in assisting residents with fast responses to calls to service and therefore decreasing crimes.

A respondent in one of the in-depth interviews provided the following response on how computer-aided dispatch contributed to crime prevention: " *At the Integrated communication, command centre popularly known as IC3 whenever a distress call is made through 911 or 999 the officer at*

the centre sends something we call computer-aided dispatch (CAD) raising the patrol team near the vicinity and the same time the station commander on whose jurisdiction the incident is happening for them to respond and for follow-up. This is possible because the computer aided dispatch software is linked with GIS that plays crucial role in pinpointing the exact locations of the units in the field allowing for strategic deployment and response. We have seen a hastened response as a result of this technology as opposed to what used to happen some years back." Mr Francis Gachina the Director IC3 in Nairobi asserts dated 1st July 2021.

Rate the utilization of GIS in deployment of patrols.

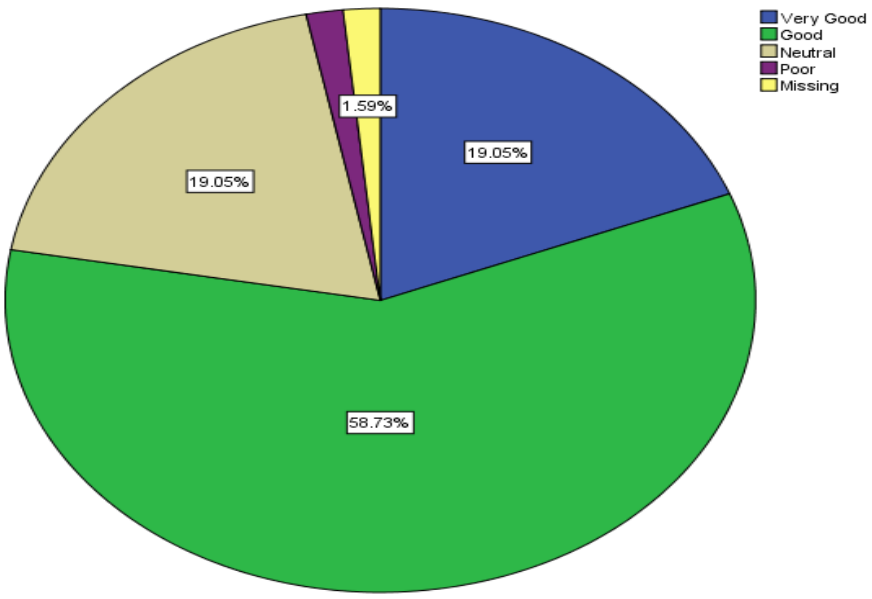

Figure 4: 5 Use of GIS in the deployment of patrols

A majority (77.8%) of respondents as revealed in figure 4.5 were of the view that the quality of deployment of Police patrols has improved with the application of GIS in police operations. This viewpoint is reinforced by other previously conducted studies by (Weisdud ,2005; Chainey *et al.*, 2008) found that hotspot mapping is important for police in anticipating crime based on past crime data. This method aids in the identification of crime hotspots, the most effective policing strategy,

and crime-reduction initiatives. According to Eck *et al.* (2005), police make decisions on how to deploy scarce resources based in part on where police demand is highest and lowest. According to Eck et al., problem-oriented policing encourages police officers to identify concentrations of crime or criminal activity, establish what causes these concentrations, and then adopt remedies to reduce them. Curtin *et al.* (2005) used an optimal covering model to determine the most successful police patrol zones.

The findings of the study show that GIS was being used for planning deployment of police officers for patrols. The police commanders can tell the location of their patrol teams. Fahui (2012) supports this view, he argues that the utilization of geographic information systems (GIS) can help law enforcement agencies better manage their personnel. GIS is utilized for organizing field visits for overall supervision, conducting crime investigations, optimizing routes, tracking the movement of relevant officers, scheduling work, tracking police vehicles, real-time monitoring of the force's location, managing attendance, HRM, managing assets, generating reports, and more.

4.2.4.2. The influence of Global Positioning System in crime prevention through police response strategies.

GPS technology has significantly improved efficiency in law enforcement operations worldwide. The integration of GPS technology has led to increased officer safety, situational awareness, and more efficient investigations and resource allocation. This integration of GPS technology has transformed the field of law enforcement, paving the way for a new era of efficiency and effectiveness. As GPS technology continues to evolve, law enforcement organizations can leverage its benefits to enhance their operations (Seeworld,2023).

Table 4. 8 Rate the usefulness of GPS in tracking of offenders

		Frequency	Percent
Valid	Very Good	44	38.3
	Good	62	53.9
	Neutral	6	5.2
	Poor	2	1.7
	Very Poor	1	0.9
	Total	115	100.0

As shown in Table 4.8 above 38.3 % of the respondents indicated that GPS was very good in tracking offenders while 53.9 % thought it was good. 1.7 % and 0.9 % of the respondents felt that it was GPS was poor and Very Poor in helping them track the offenders. 5.2% of the respondents were neutral.

Mr Paul Mumo officer incharge Crime Research and Intelligence bureau during the indepth interview on the question whether the use of geospatial technology has been of any influence to criminal investigations, replied as follows: *while still here I can tell you that there are several notable cases where Geo locater has helped us to track and arrest key suspects. An example is the case about the alleged murder of Mr. Tob cohen. In this case we analyzed the mobile phones of the three suspects. Using the geolocator we were able to trace the third suspect. The other two were linked through their communication and their phones could be located at the scene on the material day of the alleged disappearance of the man until he was discovered dead. This is one of the cases among many.*

Rate the efficiency of IC3 in dissemination of information

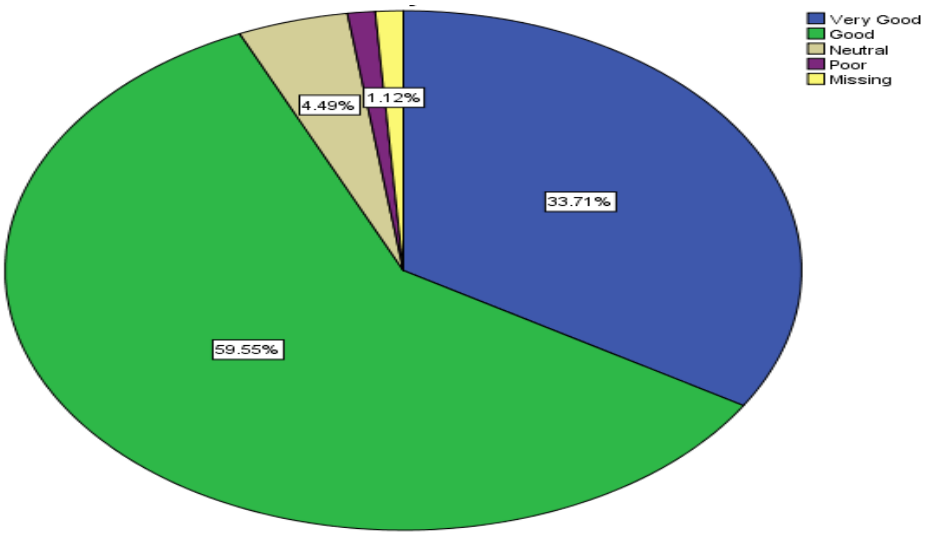

Figure 4: 6 Efficiency of IC3 in dissemination of information

As shown in Figure **4.6,** 93%of respondents believed that the dissemination of information from the Command Centre had become more efficient with the introduction of the Integrated Command and Control Centre (IC3). The Centre uses geospatial technology to advance policing agenda in the country. These results are consistent with previous studies on this topic. Afzaal & Masood (2019) argue that GIS has a quick turnaround in the analysis and dissemination of actionable intelligence; thus, making the technology efficient in combating crime. GIS also assists law enforcement officers in making effective decisions in the event of a crime, or when mapping areas at risk of experiencing criminal activities (Butorac, 2017; Khushi *et al.*, 2022).

4.2.4.3. The influence of Remote Sensing in Crime Prevention through police response strategies

The application of remote sensing technology has fundamentally changed how the police approaches public safety, response to crimes, and crime prevention. This technology makes monitoring, surveillance, and search and rescue operations more precise and effective. High-

resolution photography from remote sensing aids in reconstructing events, corroborating witness accounts, and presenting evidence in court.

Rate the usefulness of video-based surveillance in detection of crime

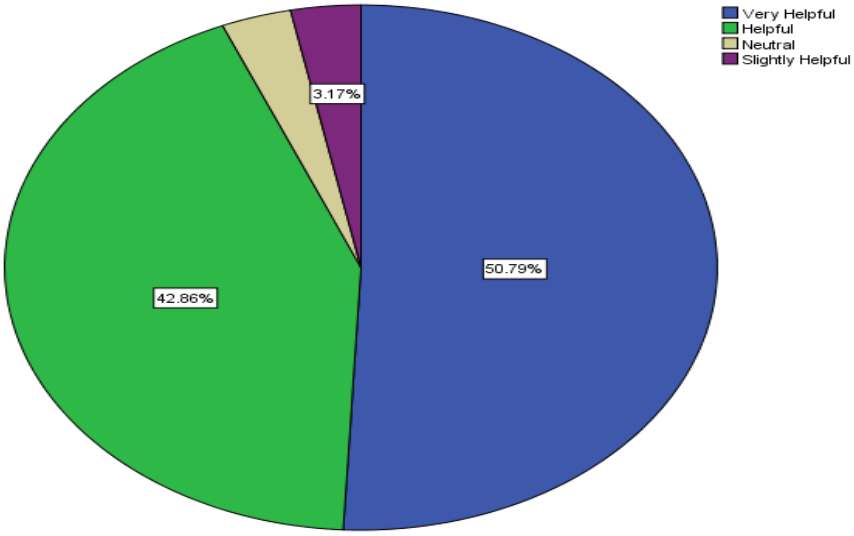

Figure 4: 7 Use of video-based surveillance in detection of crime

The findings of the study revealed that 93.7% of the respondents held that data obtained from video base surveillance in Nairobi City county was helpful in crime detection. Based on Routine Activity Theory, crime prevention strategies target the three components of crime (target, offender, and responsible guardian). The knowledge that there is an extra eye watching you becomes a deterrence to some people who would have ordinarily committed a crime and if the crime is committed video video-based surveillance cameras assist in the identification of offenders and therefore corroborating other pieces of evidence.

During the in-depth interviews on the question of the usefulness of video-based surveillance data in the detection of crime and therefore its prevention. One respondent replied: *"The knowledge that there is an extra eye watching you becomes a deterrence to some people who would have ordinarily committed a crime. In a clearer picture let me put it like this, since the installation of*

the surveillance cameras along various roads in the city, it has become easy to track runaway vehicles that are suspected to have committed crimes". Another one said, "*In many instances where individuals have installed good* video-based surveillance *cameras in their premises, in case there happens a crime, our investigators will run through the videos and piece evidence that in many instances have helped us nab the offenders and prosecute them."*

Geospatial techniques have significantly influenced the detection and prevention of crime in modern society. Various studies support the current research findings, which credit the positive impacts of geospatial techniques on law enforcement and crime prevention. The use of geospatial techniques for crime detection and crime-related data analysis is one of the greatest achievements the technology presents law enforcement officers with (Mathiu 2021). Other studies, including Afzaal& Masood (2019); Butorac (2017); ESRI (2012); Khushi *et al.* (2022); Newton &Felson (2015); Curtin *et al.* (2010); Nemeth *et al.* (2014); Hutt *et al.* (2021); Walton (2001); Schwarck (2018); Davenport (2021); Ratcliffe (2011); Camacho-Collados *et al.* (2015); Silva *et al*. (2015); Figueiredo & Mota (2016) and Jaishankar (2009) all points to the positive influence, in the analysis crime data.

Observational findings were crucial in validating the claims made during focus group discussions. By witnessing the actual utilization of geospatial tools in police response scenarios, the study corroborated the reported impacts. Observation also allowed for an exploration of unintended consequences or challenges faced by law enforcement officers, providing a holistic understanding of the practical implications of incorporating geospatial techniques in daily policing activities.

Rate the usefulness of GIS in enhancing the decision-making process

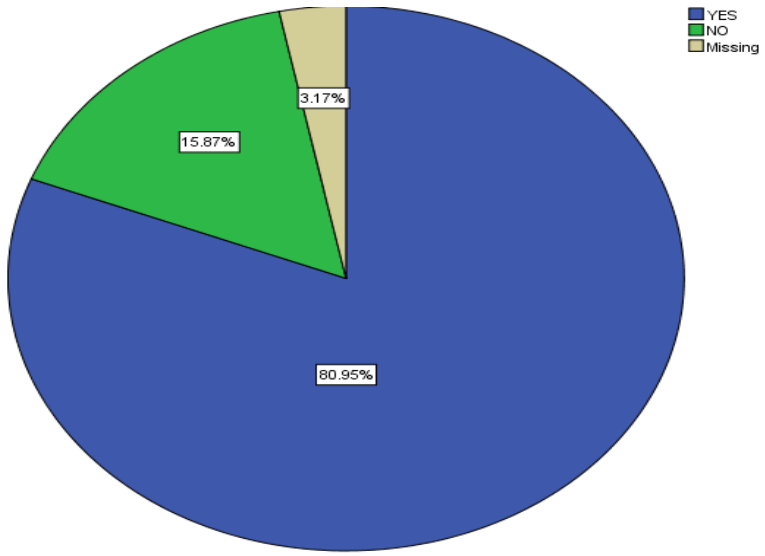

Figure 4: 8 GIS for decision-making in Police operations

As shown in Figure 4.8 above, findings 80% of the respondents pointed out that the decision-making process during operations was highly improved by the use of GIS. A review of major studies in this area confirmed that GIS is a potent analytical tool that helps in decision making when it comes to prevention of crime. Suryavanshi (2001) and Wang (2005) argue that GIS is a powerful analytical tool that aids in decision-making in crime prevention and law enforcement. It aids in analyzing and visualizing crime and planning data, enabling objective decisions in policing and planning. GIS helps create safer communities by examining the relationship between variables influencing city growth and future, such as land use and crime opportunities.

Focus group discussions delved into the perceived influence of geospatial techniques on police response strategies. Participants shared their perspectives on how these tools contributed to proactive policing, improved situational awareness, and facilitated data-driven decision-making. The discussions uncovered nuances in the integration process, highlighting areas of success and potential areas for improvement in leveraging geospatial techniques for crime prevention.

4.2.5. Extent of application of Geospatial techniques in crime prevention through police response strategies

This was the study's third objective, in which the researcher aimed to determine the extent of the application of geospatial techniques in crime prevention through police response strategies. The results of the study revealed that geospatial techniques have been applied in all spheres of crime prevention. Geospatial technology was being used to capture, analyze, map and store spatially referenced crime data.

Document reviews contributed to understanding the broader policy and strategic frameworks guiding the integration of geospatial techniques in police response. Official documents, guidelines, and policies related to law enforcement practices shed light on the institutional commitment to incorporating GIS and spatial analysis into crime prevention strategies. The reviews outlined the parameters set by governing bodies and the level of standardization in the use of geospatial tools.

Use of Geospatial Tools Crime Data Collection

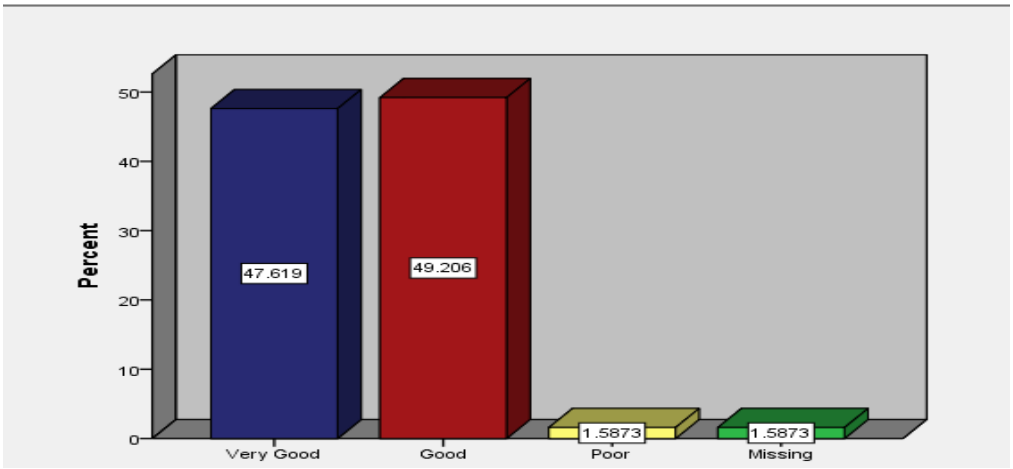

Figure 4: 9 Geospatial tools in data collection

According to Figure 4.9 above, 96.82% of the respondents hold the view that the quality of crime data has improved with the application of technologies like GIS and GPS. While 1.59% of the respondents felt that the quality is poor a similar number did not respond to the question.

Chi-Square Tests

	Value	df	Asymp. Sig (2 – sided)
Pearson Chi – square	47.070[a]	9	.000
Likelihood Ratio	25.889	9	.002
N of Valid Cases	115		

a. 12 cells (75.0%) have an expected count of less than 5. The minimum expected count is .03.

The output above shows a Pearson chi-square statistic of 47.07 and a p-value is 0.000. Since the p-value is less than our chosen significance level α = 0.05, we can conclude that there is an association between GIS and collection of crime data.

Asked if the quality of crime data being collected has improved, a respondent during the in-depth interview replied: *"From my observation, there is a massive improvement. For instance, each police officer is supplied with a tablet that has the digital Occurrence book. The GPS coordinates are already captured when the report is being made and this is a departure from the past where every report had to be entered manually into an OB stationed at the police station and the details of the place were in most cases captured generally.*

Another respondent posed a hypothetical question *"How many crimes do you think would have gone unnoticed were it not for these surveillance cameras? Your guess is as good as mine".*

Table 4. 9 Rate the usefulness GIS in Crime Data storage

		Frequency	Percent
Valid	Very Good	24	20.9
	Good	73	63.5
	Neutral	10	8.7
	Poor	6	5.2
	Very Poor	2	1.7
	Total	115	100.0

As shown in Table 4.9 above, 20.9% and 63.5% of respondents indicated that GIS is very good and good at storing crime data, respectively. While 8.7% of respondents were unsure whether this had improved or not, 5.2% thought GIS was poor. 1.7% said GIS was inadequate for storing crime data.

During one of the in-depth interviews, a respondent in replying to the question of whether GIS has improved the storage of crime data responded as follows: "*There have been instances where there is disappearance of case files as well as other information from our police records. What digitization of the occurrence book has done is to safeguard against these losses. Once a report has been made it cannot be deleted and therefore its retrieval for future usage is very easy. Bear in mind that the occurrence book is linked to GIS technology. This has also made it very easy to share the information whenever required and it has also made it possible to preserve crucial data without fear of loss."*

Chi-Square Tests

	Value	df	Asymp. Sig (2 − sided)
Pearson Chi − square	88.573[a]	16	.000
Likelihood Ratio	29.430	16	.021
N of Valid Cases	115		

a. 21 cells (84.0%) have an expected count of less than 5. The minimum expected count is .02.

The output above shows a Pearson chi-square statistic of 88.573 and a significance value that is less than 0.05. This leads us to reject the null hypothesis and indeed suggest that there is an association between the GIS data stored and crime mapping. This might be that one can follow up on past activities of suspects in previous recorded incidents. The crime mappings will help the police in apprehending suspects with more ease.

Table 4. 10 Rate the Usefulness of GIS in crime analysis

		Frequency	Percent
Valid	Very Good	30	26.1
	Good	68	59.1
	Neutral	11	9.6
	Poor	4	3.5
	Very Poor	2	1.7
	Total	115	100.0

According to Table 4.10 above, 26.1% and 59.1% of the respondents thought geospatial techniques were excellent and good for analyzing crime data, respectively. While 3.5% said these methods for analyzing crime were poor, an additional 1.7% thought they were very poor. 9.6% of the survey participants were unsure of the degree of improvement.

On being asked if geospatial techniques improved the analysis of crime, Ci Matu OCS Langata replied as follows "Technology has created a paradigm shift in the manner in which crime data is analyzed. In the past, this process was done manually. From the reported incidences a crime map showing various types crimes of crimes occurring in an area would be portrayed on a wall map using pins of different colours each depicting the types. To generate a tread a clock map would be generated. Now with this technology, it is just a matter click of a button and you have all this."

Chi-Square Tests

	Value	df	Asymp. Sig (2 − sided)
Pearson Chi − square	14.746[a]	10	.142
Likelihood Ratio	12.871	10	.231
N of Valid Cases	115		

a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .03.

The analysis output above gives a Pearson chi-square statistic of 14.746 and a significance value of 0.142 which is more than the assumed p-value of 0.05. This means that even if the GIS helps make the reports, this will not guarantee that it will help in the crime analysis process. This shows that geospatial information systems can be used to prevent crimes through reports and recording the activities of suspects.

The findings of this research are comparable to those of others that had previously been conducted. Kumar & Chandrasekar (2011) emphasizes the importance of Geographic Information Systems (GIS) in crime analysis, citing its enhanced mapping and analysis capabilities, which allow law enforcement officials to plan efficiently, prioritize improvements, analyze historical data, predict future developments, and locate potential locations.

The nexus between crime analysis and crime reduction is only evident when there is an effective policing strategy that utilizes the actionable intelligence from the analysis. The results of this study have confirmed the important role of crime analysis in crime prevention through police response strategies.

According to Boba (2013), geospatial techniques have become integrated in the law enforcement units, especially the police sector since crime analysis enables the police agencies to gain meaningful information that can be used to reveal underlying meanings and patterns of relationships for operational and administrative purposes. The respondents were also alive to the fact that crime analysis is a policing role whose aim is to find solutions to crime problems.

Table 4. 11 GIS in the determination of Crime trends

		Frequency	Percent
Valid	Very Good	28	24.3
	Good	68	59.1
	Neutral	9	7.9
	Poor	7	6.1
	Very Poor	3	2.6
	Total	115	100.0

As shown in Table 4.8 there are a 24.3 % and 59.1% who rated GIS as very good and good respectively in the determination of crime trends. While 7.9 % were not sure if it helped in any way a 6.1% of the respondents thought it was poor and 2.6% indicated it was very poor. The findings have shown that GIS has improved the efficiency of the police service in determining the evolving crime patterns and trends hence being able to plan to prevent crimes. Mafumbabete *et al.,* (2019) in a study conducted at Chivi district in Zimbabwe highlighted the importance of GIS methodologies in crime analysis, citing Mao *et al.'s* (2018) study. LaRue's (2013) study emphasized the role of understanding crime patterns in police jurisdictions, enhancing resource

allocation and effectiveness of intelligence-led policing techniques (Paulsen, 2004; van Sleeuwen *et al.,* 2018).

Rate the effeciency of GIS in the Mapping of Crime

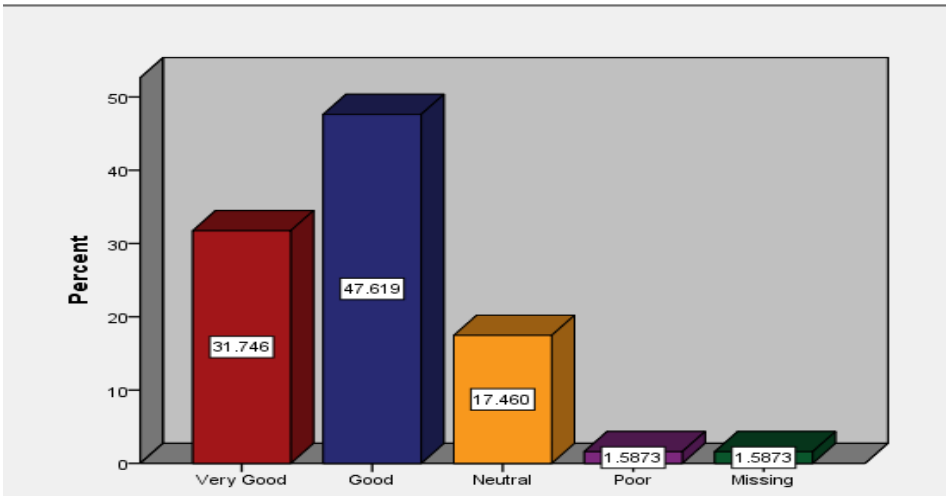

Figure 4: 10 Efficiency of GIS in Mapping of crime

As shown in Figure 4.10 above 79.37% of the respondents indicated that GIS has made the mapping of crime more efficient. In the same question, 17.46% of the respondents did not see any change while 1.59% of them held the view that GIS had made the generation of crime maps poor. The findings of this study are supported by other studies held the same view that GIS methodology was an integral component being utilized by police in mapping of crime. According to Sibanda *et al.*, (2015) Crime mapping focuses on identifying high-crime-density areas. This method aids police in identifying high-crime areas, crime types, and response methods. Zhang *et al.,* (2015) argue that crime is concentrated in small geographic locations. The importance of this knowledge is to help the police agencies in distributing finite resources effectively (Eck *et al.,*2005). Kumar & Chandrasekar (2011) argue that GIS enables police to create more adaptable electronic maps by merging accident scene databases with digitized community maps. This technology offers new opportunities for accident control and prevention initiatives, enabling officers to create effective emergency plans, prioritize remedial actions, analyze past incidents, and predict future events. It

also aids investigators in determining likely crime locations and relationships between crime and physical environment.

Chi-Square Tests

	Value	df	Asymp. Sig (2 − sided)
Pearson Chi − square	88.573 [a]	16	.000
Likelihood Ratio	29.430	16	.021
N of Valid Cases	101		

a. 21 cells (84.0%) have expected count of less than 5. The minimum expected count is .02.

The analysis output above gives a Pearson chi-square statistic of 88.573 and a significance value of 0.000 which is less than the assumed p-value of 0.05. Since the p-value is less than our chosen significance level α = 0.05, we can reject the null hypothesis, and conclude that there is an association between application of GIS and whether or not it improves mapping of crime.

Gupta (2012) study on crime analysis in India highlights the importance of GIS in compiling crime maps. GIS allows for the visualization and analysis of crime hotspots, trends, and patterns. It is a critical component of crime analysis and police strategy, integrating large amounts of location-based data via geography and computer-generated maps. GIS helps police personnel organize emergency responses, identify mitigation priorities, analyze previous events, and forecast future events. Chaturvedi (2019) suggests GIS as the primary method Chaturvedi (2019) for production of briefing maps for beat-level patrol officers.

Insights from focus group discussions elucidated the challenges and successes in integrating geospatial techniques into daily policing activities. Law enforcement officers, policymakers, and technology experts shared their perspectives on the extent to which these tools were ingrained in

response strategies. Key findings highlighted variations in adoption rates, training needs, and the role of leadership in fostering a culture of geospatial awareness within law enforcement agencies. Observational data provided a real-time assessment of the extent to which geospatial techniques were seamlessly integrated into police response strategies. By observing the day-to-day activities of law enforcement personnel, the study captured the practical realities of utilizing GIS and related tools. This included the level of proficiency among officers, the accessibility of technology in the field, and the overall organizational embrace of geospatial strategies in crime prevention.

The results of this study support Boba's (2004) assertion that tactical crime analysis involves the analysis of characteristics such as how, when, and where current crime incidents and potential criminal activity occur to aid problem solving through the formation of pattern trends and the identification of investigative leads. This is supported by Chaturvedi (2019), who claims that violent crime in Baltimore and Los Angeles had decreased with incorporation of CompStat into law enforcement. CompStat delivers real-time insights into emerging crime trends by leveraging geographic information systems (GIS) as a common operating platform. To help law enforcement agencies reduce crime, reliable spatial detection of crime concentration and timely crime scene mapping are critical (Zhou *et al*,.2014).

Overall Synthesis of Results

The document reviews, focus group discussions, and observation collectively yielded a rich tapestry of findings that illuminated the application of geospatial techniques in crime prevention within Nairobi City County. The key issues identified under each objective served as focal points for synthesizing the results:

The study evaluated the use of Geospatial Techniques in Crime Prevention through police response strategies. GIS, GPS, and Remote Sensing were identified as being extensively utilized. Document

reviews offered a theoretical foundation while Focused group discussions provided qualitative insights. Theoretical and qualitative findings were validated through observation.

The study also delved into the application of Geospatial techniques in crime prevention through Police Response Strategies. The results revealed that this technology had a significant impact on crime prevention by helping the identification of crime hotspots, efficiently deploying personnel for patrols, identifying crime trends and patterns, investigating crimes, tracking offenders for crime, and allocating resources as efficiently as possible. A review of documents highlights historical impacts and documented cases and Focused group discussions provide nuanced perspectives on perceived influences. Observation validates reported impacts and explores practical implications.

The third objective was to examine the extent of the application of Geospatial Techniques in crime prevention through Police Response Strategies. The findings of the study revealed that geospatial techniques were being applied in all spheres of crime prevention. Institutional commitment is reflected in official documents and policies that outline governing parameters and standardization. Focused group discussions revealed variations in adoption rates and training needs while the Observation assessed the application of geospatial tools in daily policing.

Triangulation of data from document reviews, focus group discussions, and observations strengthened the robustness and credibility of study findings. By combining quantitative and qualitative insights, the research provided a comprehensive understanding of the complexities and nuances associated with the application of geospatial techniques in crime prevention through police strategies in Nairobi City County.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

5.1. Introduction

This chapter provides a summary, a conclusion, the study's contributions to knowledge suggestions for future research.

5.2. Summary of the findings

The study sought to assess the application of geospatial techniques in crime prevention through police response strategies. The study was carried out among police officers drawn from NPS (KPS and DCI) in Nairobi City County. Data was collected utilizing semi-structured questionnaires and in-depth interviews, focus group discussions, document reviews, and observations. The data collected was analyzed utilizing descriptive statistics. The findings were presented through descriptive methods such as tables and charts.

On the first objective, the findings of the study revealed that the aspects of geospatial techniques namely remote sensing, geographical positioning systems, and geographical information systems have been applied to prevent and reduce crime. The findings revealed that geospatial techniques were used by the Police service to improve investigation, decision-making, and personnel management.

The results of the study have also revealed that geospatial techniques played a critical role in influencing the identification of crime trends and hotspots, identification of crime patterns and trends, and designing the deployment of patrols. The effectiveness of IC3 in the dissemination of information to and from the tactical teams as well as the computer-aided dispatch was also tested and great improvement was noted.

Furthermore, the findings also revealed that the application of geospatial techniques in police operations with a view of preventing crime has enhanced the capability of the police service in the collection and storage of spatially referenced crime data, crime analysis, and eventual generation of crime maps. The impact of improved efficiency in the mapping of crime has a bearing on effective police response strategies and consequently reduction of crime.

5.3. Conclusions

According to the study's findings, geospatial approaches have significantly enhanced the nature of policing in Nairobi City County. The study indicated that geospatial techniques are essential technological tools that the police agency has adopted in their response strategies leading to the prevention and reduction of crime. According to the findings, many crimes would have occurred and gone unnoticed, while others, even if caught, would have resulted in the culprits going unidentified. The study therefore concluded that geographically referenced data is a significant component of crime prevention.

Geospatial approaches have improved police response strategies in Nairobi City County, according to the research findings. The findings revealed that the importance of the integrated command and control centre in preventing crime and disseminating crucial crime information from police command and tactical teams cannot be underestimated. It can therefore be concluded that GIS and GPS have changed the way decisions are made and how police officers are deployed for patrols. Thanks to geospatial technology, police officers are now more accountable for their activities in the fight against crime. It was clear that police officers' response time to a call for service has greatly improved with a GIS-enabled computer-aided dispatch system.

The application of geospatial technology in police work has improved the collection and preservation of crime data, according to the study's conclusions. The GIS-enabled tablets that

police officers use to record incidents prevent the loss of vital information. Furthermore, crime mapping has vastly improved because of the usage of GIS. The use of this technology, which overlays other factors on a crime map, allows law enforcement authorities to discover factors that contribute to crime and, as a result, respond early to prevent or minimize crime.

5.4. Recommendations

The current study focused on the application of geospatial techniques in crime prevention through police crime response procedures in Kenya's Nairobi City County. The findings of the study revealed that GIS, GPS, and Remote Sensing were the main components of geospatial technology that are being utilized by the police in Nairobi City County for crime prevention in their response strategies. The study acknowledges the significant role played by geospatial techniques in crime prevention through police response strategies and has recommended as following:

i. Geospatial techniques to be integrated into policing operations in major cities and towns in Kenya of police work in Kenya. This will enhance information sharing that will subsequently improve crime prevention in the majority of the country.
ii. By utilizing geospatial techniques, the police service has advanced crime detection, identification, and offender tracking, transforming data into valuable intelligence for criminal investigations. To shift the paradigm of crime management, the government should provide more resources to adequately integrate geospatial tools into police crime response strategies.
iii. The findings of the study revealed that utilizing geospatial technology in police work enhances crime data collecting, preservation, analysis, and mapping. However, the increasing rate of invention produces a technological imbalance, with fewer people

wielding more influence due to the difficulty of comprehending and applying technology. Therefore, continuous training is necessary for police officers.

iv. The application of geospatial tools by the police service has improved crime detection, identification and tracking of offenders, and transformation of the data into actionable intelligence in criminal investigations.

5.5. Areas of further research

Since the researcher could not conduct a study that would exhaustively cover all aspects of Geospatial techniques in the prevention and reduction of crime, it is prudent to recommend the following:

1. The only other county that is connected to the integrated command and control centre is Mombasa. One, future scholar should conduct a study on dependability of the Integrated Command and Control centre in crime prevention.
2. In the recent past there have been several road traffic accidents in Nairobi that have been reported in Nairobi. A study should be conducted on the use of Geospatial technology to identify the accident hotspots.

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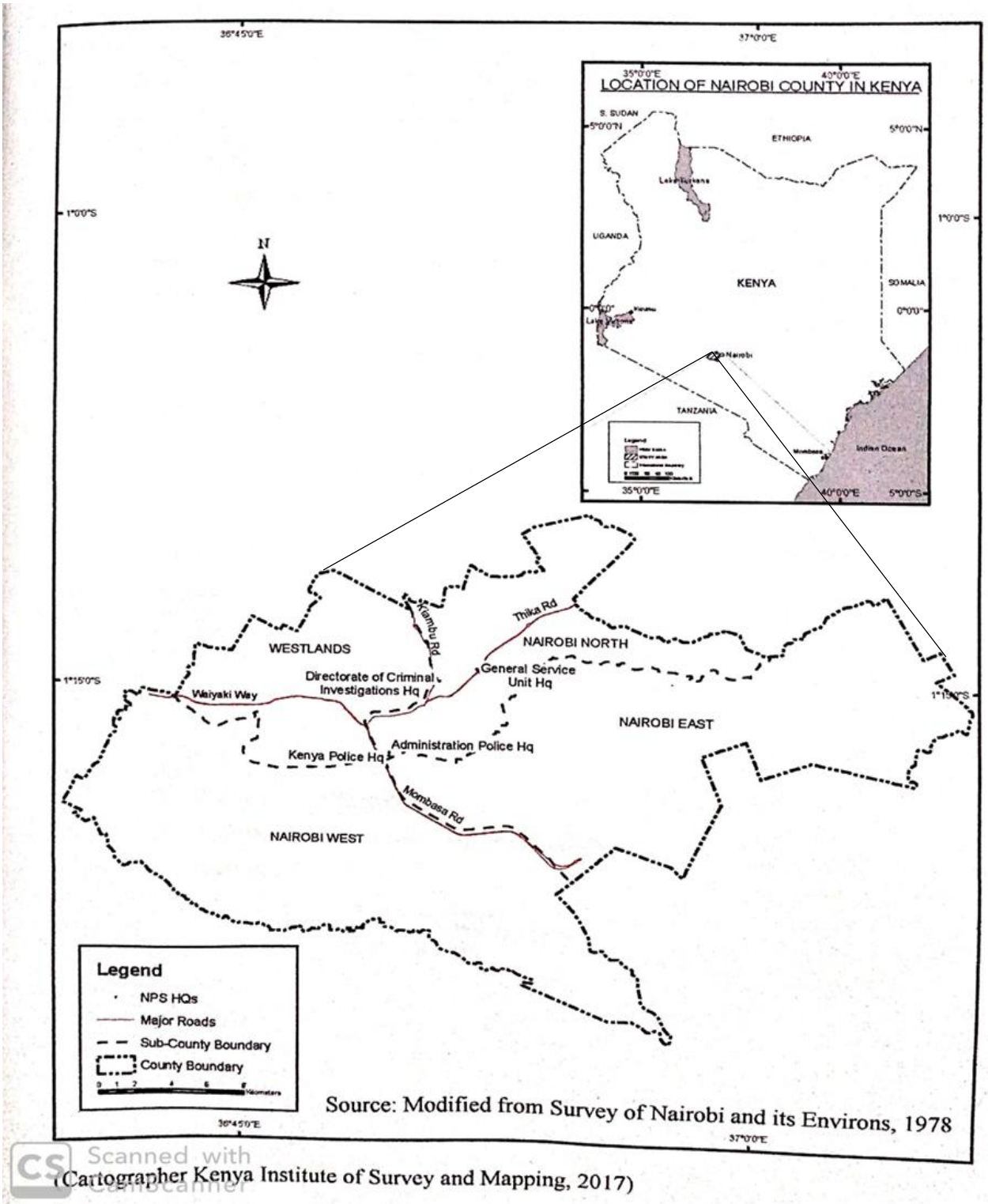
APPENDICES

Appendix i: Map showing the study location



Appendix ii : Google Map showing the location of study

Google Maps September, 2022

Appendix iii: Introductory letter

John Gichohi
P.O. BOX 107042-00400
NAIROBI.
0720 772562

Dear Respondent,

RE: REQUEST FOR PARTICIPATION IN A RESEARCH

I am Master's student in Security Management and Police Studies at Kenyatta University. I am taking research on "APPLICATION OF GEOSPATIAL TECHNIQUES IN CRIME PREVENTION THROUGH POLICE CRIME RESPONSE STRATEGIES IN NAIROBI CITY COUNTY, KENYA."

I will be thankful for your response. The information provided is for academic use only and your identity will be privacy.

Thank you.

Yours faithfully,
John Gichohi.

Appendix iv: Questionnaire

Part A: Demographic Information

1. Your age bracket

Under 25 yrs [ ] 25 – 30 yrs [ ] 31 – 35 yrs [ ] 36 – 40 yrs [ ]
41 – 45 yrs [ ] 46 – 50 yrs [ ] Over 50 yrs

2. State education level

Secondary Education [ ]

Diploma [ ]

Bachelor's Degree [ ]

Postgraduate Degree [ ]

Others-specify……

3. For how long have you been in the service

Less than 1 yr [ ] 2 – 5 yrs [ ] 6 – 10 yrs [ ] Above 10 yrs [ ]

4. In which cadre are you

Junior officer [ ] mid-level management [ ] senior level management [ ]

Components of geospatial techniques used for crime prevention

5. Is there technology being used by the Kenya police service for crime prevention?
   Yes [ ] No [ ]

6. If yes, please tick on the types
   Geographic Information Systems [ ]
   Global Positioning System [ ]
   Remote Sensing and imagery [ ]

7. The National police service has employed technology to prevent crime. Using Likert scale of 1-5 where 5 =very good, 4= Good, 3= Neutral, 2= poor, and 1 = very poor, rate the following geospatial techniques in the collection of crime data

Type of geospatial technique	5	4	3	2	1
Geographic Information System					
Global Positioning System					
Remote sensing (video-based surveillance cameras)					

Influence of application of Geospatial techniques by police in crime prevention.

10. Quick decision-making plays a key role in addressing a crime situation. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate GIS in this process?

    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

12. Police operations require quick decision-making. Has GIS improved this process at your station?

    Yes [ ] No [ ]

13. On a Likert scale of 1-5 whereby 5=very good and 1=very poor. How do you rate the efficiency of GIS software in the determination of crime trends in your station?

    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

14. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate the use of GPS software in tracking offenders?
    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

15. A clear, relevant, operating picture is very necessary in law enforcement operations because it enhances efficiency. On a Likert scale of 1-5 where 5 is very effective and 1 is not effective, rate the effectiveness of the computer-aided dispatch

    Not effective [ ] less effective [ ] Neutral [ ] slightly effective [ ] Very effective [ ]

    The National Police Service established the integrated command, control and command centre popularly known as IC3 centre. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate the effectiveness of the centre in the dissemination of crime intelligence to the tactical teams?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

16. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate the adoption of GIS in the Identification of crime Hot spots by Police service in Nairobi city county?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

17. On a Likert scale of 1-5 whereby 5=very good and 1=very poor is very poor, how do you rate geospatial techniques in the designing of police patrols deployment?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

Extent of application of geospatial techniques in policing

18. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate the use of GIS in the collection of crime data at your station?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

19. The National police service has digitized the police records. On a Likert scale of 1-5 where 5 is very efficient and 1 is not efficient indicate how you rate data collection using the digital platform

Very efficient [ ] efficient [ ] Neutral [ ] less Efficient [ ] Not Efficient [ ]

20. The government has invested in the installation of security cameras along various roads within Nairobi City County. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate use the usefulness of data obtained from this technology?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

21. Crime data should be preserved over some time. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate GIS in the storage of crime data in the police service?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

22. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate GIS in crime analysis, in the police service?

Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

23. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate GIS in the mapping of crime?
    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

24. Crime mapping is a key element in policing. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate GIS in mapping of crime at your station?

    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

25. How would you compare the manual methods and GIS in the generation of a crime map?
    .....
26. Using a Likert scale of 1-5 where 5 =very good, 4= Good, 3= Neutral, 2= poor, and 1 = very poor, rate the following types of geospatial techniques in the investigation of crime

Type of geospatial technique	5	4	3	2	1
Geographic Information System					
Global Positioning System					
Remote sensing (video-based surveillance cameras))					

Issues that may affect the application of geospatial techniques

27. On a Likert scale of 1-5 where 5 is very difficult and 1 is not easy, how do you rate the ease of use of the GIS in recording crime data?

    Very easy [ ] Easy [ ] Neutral [ ] Difficult [ ] Very difficult [ ]

28. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate the availability of power source for the GIS-enabled gadgets?

    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

29. On a Likert scale of 1-5 whereby 5=very good and 1=very poor, how do you rate the efficiency of the internet that powers the GIS software?

    Very good[ ] Good[ ] Neutral[ ] Poor[ ] Very poor[ ]

Appendix v: Interview guide

John Gichohi
P.O. BOX 107042-00400
NAIROBI.
0720 772562

Dear Respondent,

RE: REQUEST FOR PARTAKING IN A RESEARCH

I am Master's student in Security Management and Police Studies at Kenyatta University. I am conducting research on "APPLICATION OF GEOSPATIAL TECHNIQUES IN CRIME PREVENTION THROUGH POLICE CRIME RESPONSE STRATEGIES IN NAIROBI CITY COUNTY, KENYA."

I will be thankful for your response. The information provided is for academic use only and your identity will be privacy.

Thank you.

Yours faithfully,
John Gichohi.

Interview guide

1. What are the geospatial technology components being used by the Kenya police service in the prevention of crime?
2. How is Kenya police service using geospatial techniques in the collection of crime data in Nairobi City County?
3. How would you compare geospatial technology and traditional policing methods in the collection of crime data?
4. What is the role of geospatial technology in as far as dealing with crime hotspots?
5. The government has installed video-based surveillance cameras at strategic points within the city county. Have they been of any help to crime prevention?
6. Crime analysis plays a critical role in the designing of crime prevention strategies. How would you compare crime analysis with the application of GIS and traditional crime analysis methods?
7. Police in Kenya have been accused of loss of crucial documents. How is geospatial technology assisting you in addressing these concerns?
8. Police operations are aimed at preventing or apprehension of offenders. It therefore requires meticulous planning. How does this geospatial technology help police commanders in this endeavor? Has your decision-making process been improved by the application of GIS?
9. The police patrols are planned based on geographical jurisdictions. How are the geospatial techniques being used in the planning of police deployment in those jurisdictions?
10. To secure a conviction the investigator is required to prove his case beyond reasonable doubt by providing quality evidence. Do you think geospatial technology has improved the quality of evidence? If Yes how? (a) GIS, (b) GPS (c) Remote Sensing.
11. Mapping crime was conducted even there before all over the world. How would you rate GIS in the mapping of crime?

12. Under the Safer City program, the government installed security cameras along various roads in Nairobi and eventually linked them to the IC3 command center. How has this program contributed to public safety?

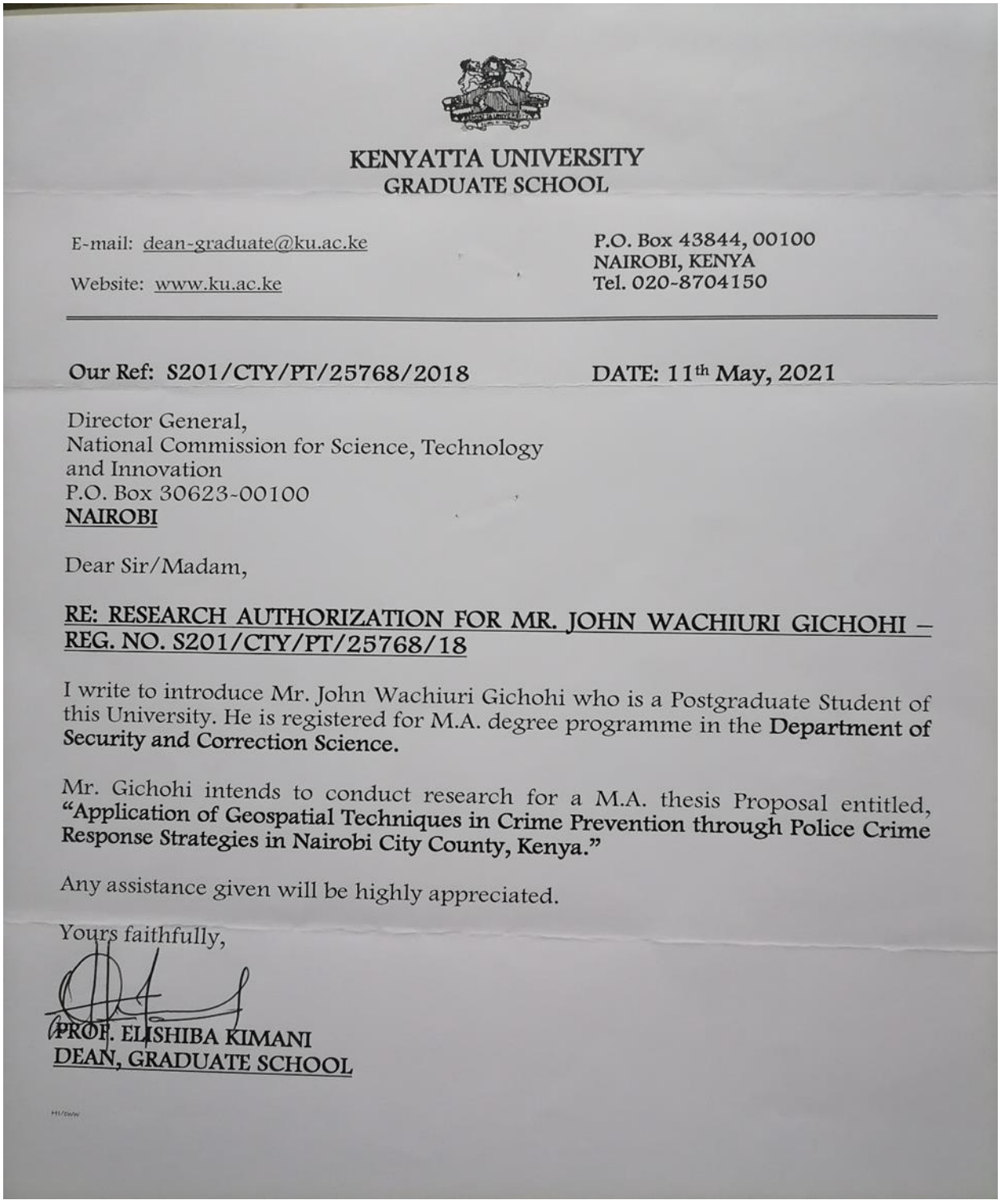
    a) Detection of crime

    b) The output of investigations

    c) Apprehension of offenders

13. The call for service systems has been used as a method to address the security concerns of the citizens. Has the GPS and GIS-enabled computer-aided dispatch been effective? if yes How?
14. Has GIS assisted the police commanders and police service in determining crime patterns and trends to what extent? And how useful is this in planning to prevent crime?

Appendix vi: Authorization letter from Kenyatta University



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

Our Ref: S201/CTY/PT/25768/2018 DATE: 11th May, 2021

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. JOHN WACHIURI GICHOHI – REG. NO. S201/CTY/PT/25768/18

I write to introduce Mr. John Wachiuri Gichohi who is a Postgraduate Student of this University. He is registered for M.A. degree programme in the **Department of Security and Correction Science.**

Mr. Gichohi intends to conduct research for a M.A. thesis Proposal entitled, **"Application of Geospatial Techniques in Crime Prevention through Police Crime Response Strategies in Nairobi City County, Kenya."**

Any assistance given will be highly appreciated.

Yours faithfully,

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

HI/ww

Appendix vii: Nacosti licence

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **302614**

Date of Issue: **31/May/2021**

RESEARCH LICENSE

This is to Certify that Mr.. JOHN Wachiuri GICHOHI of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: APPLICATION OF GEOSPATIAL TECHNIQUES IN CRIME PREVENTION THROUGH POLICE CRIME RESPONSE STRATEGIES IN NAIROBI CITY COUNTY,KENYA for the period ending : 31/May/2022.

License No: **NACOSTI/P/21/10979**

302614

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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