

**DETERMINANTS OF FORENSIC SCIENCE APPLICATION IN CRIMINAL
INVESTIGATIONS AT THE DIRECTORATE OF CRIMINAL INVESTIGATIONS,
NAIROBI, KENYA**

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**THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
GOVERNANCE, PEACE AND SECURITY IN THE DEPARTMENT OF PEACE
AND SECURITY STUDIES, SCHOOL OF HUMANITIES AND SOCIAL SCIENCES
OF AFRICA NAZARENE UNIVERSITY**

JUNE 2021

DECLARATION

I declare that this document and the thesis it describes are my original work and it has not been presented in any other university for academic work.



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This research was conducted under our supervision and is submitted for examination with our approvals as University Supervisors.



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DEDICATION

This thesis is dedicated to all forensic investigators who do their work diligently to ensure that justice prevail to everyone. This is also dedicated to all law enforcement officers who work day and night in maintaining law and order.

ACKNOWLEDGEMENT

I am greatly indebted to my Supervisors Dr. Janerose Kibaara and Dr. Duncan Ochieng, for their guidance given during the preparation of this thesis. Secondly, I wish to convey my gratitude to Africa Nazarene University management and teaching staff for providing an enabling and conducive environment of study.

I also acknowledge Mr. George Kinoti, Director of Criminal Investigations, for allowing me to conduct research at DCI Headquarters and to staff of Forensics Department and Training Departments for their overwhelming support during this research. I will not forget all respondents who took their time to answer my questioners and those who participated in the interviews; your contributions are appreciated.

Lastly, I acknowledge my wife Dr. Wilter Cheronos Koske, my son Adriel Kibet Talah and my daughter Angela Chepchumba Kiptalah for support and encouragement during the preparation of this thesis.

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ABSTRACT

This study sought to assess the determinants of forensic science application in criminal investigations at the Directorate of Criminal Investigations (DCI), Nairobi. The objectives of the study were; to establish availability of forensic tools, level of training of forensic investigators, the effect of existing laws and regulations on the application of forensic science, and determine the moderating influence of management support on criminal investigations conducted by DCI. Actor-Network Theory and Human Capital theory guided the study. Descriptive research design was used in the study. A simple random sampling technique was used in selecting participants. Questionnaires and key informant interviews data collection tools were used. Approximately 75% of the selected samples respondents participated in the study. The study found that DCI has well-trained and qualified staff with the lowest level of education as Diploma and for every 10 investigators 7 had a Bachelor's degree and above. Forensic investigators working at the DCI are well skilled and knowledgeable in forensic science, 64% of the investigators are forensic experts. DCI have a well-equipped laboratory with up-to-date database used for the analysis of forensic evidence. However, it was established that DCI does not have adequate forensic field tools used in identification, collection and transportation of evidence from crime scenes to laboratories for analysis, thus hampering the application of forensic science. The study also found that 79.2% of the respondents strongly agree that on-the job training are effective in improving the application of forensic science in investigations. The existing laws and regulations adequately provide guidance on the application of forensic sciences in investigations. However, DCI do not have a well define standard-operating procedures for collection of forensic evidence in the crime scene. The study results indicated that 70.8% of the investigators agreed that Management plays a key role in providing guidance, advice and morale on the application of forensic sciences. It was recommended that for DCI and other investigative agencies to effectively execute their mandate, more funds should be allocated to the institutions to facilitate efficient operations. DCI should improve in providing more forensic tools for collection of evidence in the crime scene and develop elaborate standard operating procedures to guide in the application of forensic sciences. One of the ways DCI can improve the quality of forensic investigation is by regularly training of staff and benchmarking with other agencies and countries conducting forensic investigations.

DEFINITIONS OF TERMS

Criminal Investigation is a Process of collecting evidence used in determining who, how, when, where and why the crime were committed. It is a process of finding evidence used in identification of suspects of crimes and presenting of evidence collected to a court of law.

Forensic Investigation Refers to expert examinations carried out for attesting the authenticity of a claim or event. Therefore, forensically collected evidence has been applied in proving the commission of crimes, identification of suspects of crimes, linking the suspects to a crime scene, corroborating witness's testimonies and establishing how offenses were committed.

Forensic Science This is a scientific discipline that deals with applications of specific scientific areas of expertise in law enforcement, criminal, civil, legal and judicial matters.

Forensic Tools These refer to investigative materials such as vehicles, forensic analysis, and laboratories for forensic investigations.

Training Structured activity aimed at providing information and instructions to increase the recipient's performance or to help him or even her attain a needed level of knowledge or skill.

ABBREVIATIONS AND ACRONYMS

ANT	Actor-Network Theory
ANU	African Nazarene University
CPC	Criminal Procedure Code
DCI	Directorate of Criminal Investigations
DNA	Deoxyribonucleic Acid
ECT	Electronic Communications and Transactions
FBI	Federal Bureau of Investigations
KEBS	Kenya Bureau of Standards
NACOSTI	National Commission for Science Technology and Innovation
NPS	National Police Service
SOP	Standard Operating Procedures
SPSS	Statistical Packages for Social Sciences
USA	United States of America

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter presents the study introduction and background. The chapter's subsections are as follows: study background, the rationale for the study, problem statement, research questions, study objectives, hypothesis, and study scope, the importance of the study, assumptions, study limitations, delimitation, conceptual framework, and theoretical context.

1.2 Background of the study

The continued application of forensic evidence in criminal investigations has proven to be a significant research source for both practitioners and scholars who have conducted rigorous quantitative studies and enthralling qualitative assessments. Among the factors that always stand out in the application of forensic science in investigation is the availability of forensic tools and the level of police training to conduct forensic analysis (Brito et al., 2017).

Among the first studies on the role of physical evidence in investigations was a RAND study, which was conducted in mid 1970s in the USA (Greenwood et al. 2015). The RAND study's general conclusion was that investigation of crimes are not conducted in a way the public was often encouraged to believe. Law enforcers detect most crimes when they arrest the offenders at the crime scene, or from critical information provided by eyewitnesses. If these are absent, there is little chance of detecting crime offenders (Jansson, 2015). A study on burglary investigation in England revealed that 17 percent of the detected cases of burglary was a result of the application of forensic techniques, with

1.2 percent and 1.5 percent of all burglaries offenders identified using fingerprints lifted from at crime scenes (Coupe and Griffiths', 2016).

In the United States of America (USA), forensic sciences have played a significant role in solving complex investigative matters. For example, the Federal Bureau of Investigations (FBI) has developed and maintained a database of fingerprints used in identification and placing the suspects in the scene through comparing the prints collected from a crime scene with those in the database. Bureau of Alcohol, Tobacco, Firearms, and Explosives has also developed a database of markings of firearms, which are readily available for use in comparing with markings of spent ammunitions recovered from scene, thus helping in linking the guns to the crime scene (McEwen, 2014). The recent censuses of crime laboratories in the USA established that there exists a backlog of millions of cases annually submitted to crime laboratories awaiting examination due to the high cost of reagents required to analyze the pieces of evidence and the procedures involved, which derails the justice process.

VanLaerhoven in 2012 expressed a concern that; "a chronic lack of funding is a major barrier to developing the discipline and training of new experts, lack of national standards, reliance on training and accreditation from other countries affects the quality of forensic evidence used in criminal prosecution. Poor/inconsistent legislative and regulatory framework and limited opportunities for limited research opportunities by forensic scientists" (Pollanen et al., 2012).

Israel have advanced in the application of forensic science with more than 250,000 forensic investigation cases conducted every year. Its application rate stands at 83%.

Further, the Israel maintains DNA databases applied in identification of crime perpetrators, (Tal et al, 2015).

Africa is slowly embracing the concept of forensic sciences despite facing many challenges. Nte (2012) noted that while Forensic examination plays a crucial role in settling murders in Nigeria, the nation needs political cooperation in merging aptitudes among the security offices, particularly the Police force. It was discovered that the inadequate or absence of forensic skills and investigation equipment negative affects the police and other security specialists' forensic examination capability. Nte (2012) suggested that it is essential that the Nigerian Police have regular training on the administration and effectiveness of forensics. Thus would possibly be conceivable if the crucial resources are accessible for the security segment in the nation. Ngboawaji (2016) stated that in Nigeria, cases of unsolved crimes were attributed to the Nigerian justice system's reluctance to provide the right forensic evidence. The public has lost confidence in police investigations; they view the police as an institution that does not take serious investigations of murder cases.

Digital forensics in South Africa is underdeveloped, and there is a skill gap in computer and digital forensics. Similarly, there is poor coordination between government agencies, private digital forensics providers, and academia in providing digital forensics services in South Africa. (Irons & Ophoff, 2016). Further, the Country does not have a National Body regulating forensic science (Olckers et al., 2015).

In Kenya, there has been a bitter exchange of words between the judiciary and prosecutions with the judiciary accusing the prosecution of not being able to present

sufficient evidence in court to sustain convictions of criminals. On September 20, 2016, it was reported in the Daily Nation Newspapers that the Attorney General's office, faulted and criticized police investigators stating that they lack the essential lawful skill to defend cases in court. In their response, the senior police officers said the absence of legal skills and gear is considered to blame for the chaos making a significant blow to the nation's criminal equity framework. One officer from the Directorate of Criminal Investigations (DCI) who was anonymously quoted was reported to have said: "We are frustrated because our department does not have up-to-date equipment that can help us conduct proper investigations" (Pollanen et al., 2012).

A study conducted by Mbaya (2016) established that forensic investigations in Kenya is low, for the following reasons; weak framework, absence of a standard system to be followed, and nonappearance of strategies concerning forensic investigations. Most Kenyan Law enforcers and investigators get forensic services from DCI Forensic Laboratories, Government Chemist, Kenya Bureau of Standard (KEBS), and Ministry of Health Laboratories.

1.3 Problem Statement

Inadequate forensic science application in criminal investigations processes contributes to an increase in the number of unresolved crimes cases in many parts of the world (Van Niekrek, 2015). This inadequacy has led to the exoneration of perpetrators of the crimes and prosecution of innocent people who end up suffering in jail for crimes they did not commit. The process has made the justice system to rely on and put weight on false testing and imperfect evidence testing. This has made most victims suffer from injustices

and unresolved murder crimes (Van Niekrek, 2015). It cannot be denied that in the pursuit of justice, the ones responsible for the application of the said justice have sometimes resorted to unmitigated fraud instead of seeking alternatives to place a conviction (Davis, 2015).

The Kenyan Government has invested in forensic science development by putting up forensics infrastructures such as the building of modern forensic laboratories at DCI Headquarters and the recruitment of more forensic experts to work in these laboratories. However, the state of forensic investigations in Kenya is still low (Mbaya, 2016).

Forensic investigations in Kenya have generally marred with challenges from the availability of forensic tools, level of training on the officers conducting investigations, availability of resources such as forensic labs, and inadequate laws and policies governing the application of forensic science in Kenya. Studies have been conducted locally on the forensic investigations which established that the field of forensic science is faced with many challenges such as; existences of skill gaps, limited resources, and infrastructure, and inadequate laws and policies to standardize forensic investigation in Africa (Ladapo, 2011; Nte, 2012; Irons & Ophoff, 2016; Olckers et al., 2015; Mbaya, 2016). However, there are no studies conducted to establish the application of forensic science on criminal investigations conducted by DCI in Kenya. Therefore, this study aims to provide new knowledge and solutions to the application of forensic science in criminal investigations conducted by DCI in Kenya.

1.4 Purpose of the Study

The purpose of this study was to establish the determinants of forensic science applications science in the criminal investigations conducted by DCI in Kenya and of importance is to provide feasible and workable recommendations that are likely to improve the quality of forensic investigations undertaken by DCI in Nairobi Kenya.

1.5 Objectives of the Study

The specific objectives of the study were:

- (i) Assess the availability of forensic tools used when conducting criminal investigations at DCI in Nairobi, Kenya.
- (ii) Establish level of training of investigators on application of forensic science on investigations conducted by DCI in Nairobi, Kenya.
- (iii) Examine how laws and regulations governing applications of forensic science in Kenya affect criminal investigations conducted by DCI in Nairobi, Kenya.

1.6 Research Questions

- i. What is the availability of forensic tools used when conducting criminal investigations at DCI in Nairobi, Kenya?
- ii. What is the level of training of DCI investigators on application forensic science, and how it affects criminal investigations conducted by DCI in Nairobi, Kenya?
- iii. To what extent does the laws and regulations govern application of forensic science in Kenya do affect criminal investigations conducted by DCI in Nairobi, Kenya?

1.7 Significance of the Study

It was expected that the findings of this research would help DCI understand the factors affecting application of forensic science when conducting criminal investigations and provide solutions to the challenges faced by the Forensic investigators in conducting forensic investigations. The study will also provide recommendations on improving the quality of forensic investigations undertaken by DCI, leading to an increase in successful convictions of criminal cases in court, which in turn will be deterrence to other offenders resulting in low crime rates in Kenya.

Policymakers will use the findings of this study when formulating policies related to the application of forensic science.

It will also give new knowledge and source of reference to future researchers interested in research on the application of forensic science in Kenya and other parts of the world.

The findings of this study will also help improve the application of forensic science in Kenya, leading to improved quality of criminal investigations, resulting in justice and fairness by members of the public.

1.8 Scope of the Study

Research studies have limited scopes and cannot cover all the sites of interest (Kothari, 2009). The study was focused in assessing the application of forensic science in investigations; availability of forensic tools, level of training of forensic investigators, laws, and regulations governing the application of forensic science and, the influence by DCI management on the application of forensic science in conducting criminal

investigations. This study was conducted at DCI Headquarters, targeting 32 investigators working at Forensic Investigations Department as respondents.

1.9 Delimitations of the Study

Delimitations are limits that the survey has regarding the subjects of interest. Delimitations involve areas not be covered by the Study (Kothari, 2009). This study was confined to DCI Headquarters, Forensic Investigations Department in Nairobi. The study was limited to tools, training levels of investigators, and laws. The study did not cover the prosecution of cases where forensic sciences were utilized due to limited resources and human resource.

1.10 Limitations of the Study

Limitations are considered as the constraints to the research, which the researcher has no control. Non-cooperation by the respondent in giving information during the study was foreseen because most of the information maintained by DCI is confidential and might be touching on National Security matters. This challenge was overcome by clearly explaining to the respondent that the information provided will only be used for this study and not for any other purpose. Further confidentiality of the respondents was achieved by not disclosing their identities. Respondents were asked not to include their personal details like names in the research instrument. At the same time, approvals to conduct the Study at DCI Headquarters were sought from management, who informed the respondent to cooperate.

The study was conducted during the period when the spread of the COVID-19 pandemic was on the rise. Therefore, respondents were un-willing to fill in physical

questioners and participate in the interviews because of the fear of contracting the virus. This was mitigated by using google forms questionnaires, which were shared with the respondents electronically, who also responded to the questionnaires online. Further virtual interviews was conducted to key informants.

1.11 Assumptions of the Study

Leedy and Ormrod (2010) posit that assumptions are so elementary that, minus them, the research problem itself could not be existent. This study was based on the following assumptions; a representative sample of the target population from the Forensic Investigations Department at DCI Headquarters was knowledgeable and represented the correct position of the department, respondents gave an honest response to the research questions to the best of their knowledge. It was assumed that the research instrument collected accurate information. The study further assumed that availability of forensic tools, training of investigators on forensics, and the existing laws and regulations governing forensic investigations affect the application of forensic science in a criminal investigation conducted by the DCI.

1.12 Theoretical Framework

This section presents the theories that provide the meaning, nature, and challenges associated with this Study (Kothari, 2009). The study was guided by; the Actor-Network Theory and Human Capital Theory.

1.12.1 Actor-Network Theory

Actor-Network Theory (ANT) applies scientific discipline to explain the way technological artifacts are created in society. The ANT is associated with John Law, Bruno

Latiur, and Michael Callon, who used the term to describe their popular approach to technical and scientific innovation (Dwiartama & Rosin, 2014). ANT developed from the interdisciplinary field of science and innovation studies, as impacted by social variables. The proponents postulate that that science and innovation are neither straight nor aggregate procedure, which is autonomous of social powers with a direct effect on society (Dwiartama & Rosin, 2014).

In ANT, it is conceivable to consider the two advances and individuals utilizing similar devices when adopted in cases where the social and innovation are implanted in one another. ANT is most profitable because it empowers social and innovation to be studied on an equivalent and dependable balance. As indicated by Sayes (2014), innovation, science, and social investigations are not logical ventures detached from the social world, deciding and commanding perspectives and social relations.

The ANT's relevance in the current study was founded on the overall objective of assessing the influence of specific interventions on forensic science's utilization in DCI investigations. Fundamentally, ANT emphasizes the infrastructure of actor-networks, as well as the formation of such networks in describing the optimal arrangement of human and non-human factors to enhance forensic science's reliability in guiding DCI investigations. Besides, ANT insists on strict empirical analysis to describe social events for subsequent introduction of abstract theoretical concepts (Fondebrider, 2016).

Given that forensic investigations rely on both human and non-human factors, ANT demonstrates the need for infrastructural factors such as laboratories, field tools, social skills through training and laws governing forensic science to conduct forensic

investigations. However, the theory does not emphasize human capital like education level, experience, and number of personnel required for successful forensic investigations. However, the theory does not explain the necessity of training and capacity building as a building block in the successful application of forensic science in forensic investigations. Therefore, human capital theory was used to bring training into perspective.

1.12.2 Human Capital Theory

“The Human Capital Theory has grown quickly since Mincer (1958), Schultz (1961), and Lucas (2015) established their frameworks. Human Capital is the "know-how" of the workforce that expands the efficiency of every specialist. In forensic science, both human and non-human resources are essential in quality forensic processing and analysis. The proponents of the theory argued that organizations could benefit human capital if they invest in training its staff, resulting from increases in performance. The Human Capital Theory depends on neo-old style speculations of work markets, instruction, and financial development. It underestimates that employees are productive assets and endeavors to see if profoundly trained staffs are more productive than other workforce is (Godoy et al. 2005).

The theory emphasizes investing in training of personnel working on an organization leading to an increase in productivity. Therefore, it is applicable in this study as it aimed at establishing the effect of investing in forensic personnel through training and management to improve the application of forensic science in investigations. Forensic investigation has been a matter of concern as many court cases have ended up being thrown out due to weak evidence, in which some quotas in the judicial system were associating

this problem with the lack of appropriate training on investigators on the investigation skills (Olumbe, 2000).

1.13 Conceptual Framework

The conceptual framework is a blueprint of the interactions between independent and dependent variables in a graphical format (Mugenda & Mugenda, 2003). From the conceptual framework, this study was set to establish how the availability of forensic tools at the DCI, training of investigators on forensic investigations, and the existing laws and regulations affect the application of forensic science in criminal investigations conducted by the DCI. The study assessed whether the DCI has well-equipped laboratories to conduct all the forensic investigations, whether the availability of databases affects the application of forensic science in conducting criminal investigations, and lastly, whether the officers have adequate resources and field equipment to conduct quality forensic investigations.

The study also looked at the skills possessed by forensic investigators and whether there is training needed to bridge the skill gap. The study assessed the basic training, on-the-job training offered to investigators, and whether there is a government exchange programs and how it affects the applications of forensic science in investigations.

The study reviewed the existing laws, regulations, and standard operating procedures regarding forensic science and its effects on the applications of forensic science in criminal investigations. The study finally looked at the moderating influence of management support through the provision of resources required. Providing guidance and advice on the applications of forensic sciences and improving the welfare of forensic investigators affects the application of forensic investigations conducted by DCI.

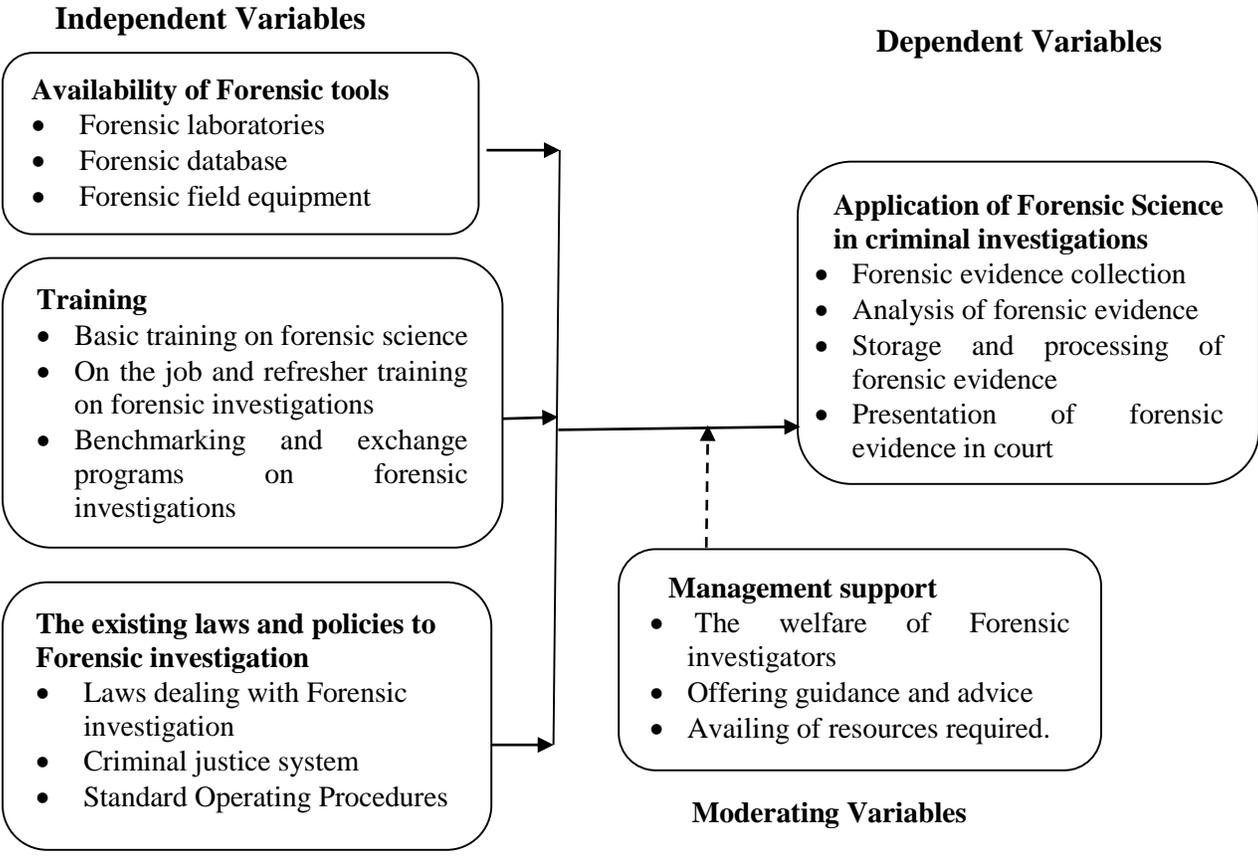


Figure 1. 1: Conceptual Framework.
Source: Researcher (2021)

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section is organized to cover an overview of forensic sciences, the objectives of the study provided in chapter one, include the effect of availability of forensic tools, the effect of training, and existing laws on the application of forensic science in investigations. The study also reviewed the research gaps and a summary of the literature review.

2.2 Empirical Literature Review

This section reviews the literature on the effect of the availability of forensic tools, training, and existing laws and regulations on the application of forensic science in investigations.

2.2.1 Availability of forensic tools in crime investigations

A substantial number of study papers employed empirical evidence to examine the current state of forensic science in crime detection. It highlighted the hurdles that affect the various aspects of forensic science investigations. A statistical paper conducted by Dezfoli and his colleagues in 2015 explores the trends of different aspects of forensic science. The scholars suggest some factors that digital forensic investigations need to consider adapting to novel challenges in the forensic science field. Irons and Lallie's (2014) study showed an annual increment of forensic investigations, data amount under investigation, and the volume of data being scrutinized in a case, utilizing the yearly data, which the FBI published between 2007 and 2011. The scholars established that there is a remarkable increment of digital crimes each year.

There is a need to improve the available forensic investigation resources, as the literature implies, as it is necessary to enhance the current forensics tools. Every procedure encompasses different obstacles such as anti-forensics, legal issues, heterogeneous data sources, digital data volume, and preservation of efficient standards of divisions. Various divisions have employed various solutions in countering the challenges. They include triage, using random samples, an introduction of features in commercial instruments, improved previewing, visualizing information, distribution, utilization of data mining tools in the analysis (Roy, 2014; James, 2014; Shaw & Browne, 2015; Roussev & Golden, 2004; Nirghi, Dharaskar, & Thakre, 2012).

Forensic tools are a critical aspect of the implementation of various objectives within various organizations and institutions. Resources are both human and non-human needed in the application of different aspects. The availability of resources is an indication that there are resources required for the organization's specified goals. The available resources are provided in line with the issues that have to be accomplished (Zietkiewicz et al., 2012). The authors explore the resources available for the identification of disaster victims through genetic profiling. The advancement in DNA profiling provides crucial information, which affects the application of forensics during the criminal investigation.

Within the security sector, there is a need to have resources for the security officers to conduct their roles effectively. Resources within the security sectors include; personnel, facilities, and tools necessary for the implementation of the various security measures that are needed by the society, such as conducting forensic science activities (Brito, Martins, Braz, Chaves, Braga & Pimentel, 2017). The study gives an overview of the prevailing

trends in forensic science that affect its application in the criminal investigation. Conducting forensic analysis requires an analyst to pay heed to the trends as they provide further understanding into resource availability.

On the off chance that the offices and apparatuses utilized by specialists are not sufficient to deal with the typical cases and scenes satisfactory, at that point, there are a few bits of proof, which are left at the scene because of the absence of legitimate equipment and instruments of work. If the field officers neglect to gather all the necessary proof at the scene, the investigator will overlook what is important and might pursue an inappropriate path (Zietkiewicz et al., 2012). The sufficiency of hardware is indispensable, as stressed by the instructional booklet utilized by American criminological specialists. Thus, the availability of equipment for collecting evidence in crime scenes affects forensic science in the criminal investigation. Establishing the available and necessary evidence collection tools determines how forensic scientists conduct their work effectively.

In most African countries, the tools used in forensic investigations are insufficient, and they don't meet the minimum threshold as spelled out in the manual for the apparatuses that all field specialists ought to have. Apparatuses and the innovation utilized by the criminological researcher rely upon the sort of proof gathered and the sort of lab. Bowen (2016) explores ethics that apply to the forensic science field. Ethics provides guidelines for conducting professional activities. The guidelines determine how forensic tools are application in a particular case, affecting how criminal investigations are conducted.

The absence of the necessary resources needed is one of the reasons for the many cases that are not concluded promptly, leading to injustice to the victims. It has been

indicated that most countries experiencing extrajudicial killings lack forensic tools to be applied by the oversight bodies in investigating such cases. This makes it hard for the compilation of evidence (Nte, 2012). Forensic investigations encounter challenges, which impede the solving of criminal cases. Finding ways of mitigating the problems is essential in doing the work of forensic analysts to be more productive and facilitate successful criminal investigations.

Furthermore, in a study conducted by Dror et al. (2012), most of the countries in the developing world are not adequately equipped with the forensic investigation resources, which have led to the dismissal of most cases in court due to the lack of evidence on the side of the prosecution. This has mainly affected sexual offenses and related cases. For example, it might be difficult to prove a case of rape if forensic examinations are not conducted to prove penetration into the genital organs. An expert can only use forensic tools, which may include extraction and analysis of DNA samples to give an accurate expert opinion. Hence, such resources must be available to aid the investigation. Pollanen et al. (2012) discuss forensic science's effect on criminal investigations. They postulate that the application of forensic analysis in a criminal investigation is limited to the availability of resources. However, the study does not provide an insight into the ethical practice of forensic science.

Financial support is an essential part of forensic investigations. The lack of finance is one of the issues that have been able to cripple most of the investigations that application forensic science. According to Salfati, Horning, Sorochinski and Labuschagne (2015), forensic science in most developed countries has been successful due to the financial

support that the investigators received from the state and the departments that they were attached. If the management does not believe in the investigations conducted, there will be limited funds that will be allocated. Hence, the required finance should be offered as part of the management's support (Salfati, Horning, Sorochinski & Labuschagne, 2015). The gaps explicit the authors' work includes their failure to expound on the significance of effective leadership in criminal investigations and the limitations existing in forensic analysis.

Lee et al. (2015) investigated the relationship between forensic investigation resources' reliability and the capability of police officers handling them. The study established that investigators of crime scenes need individuals that are highly educated with a forensic science background, the criminal justice system and natural sciences. Expert technicians holding degrees in crime scene investigation look for clues and help in solving the puzzle of whatever took place at a crime scene. Technological advancements provide techniques and tools to figure out who committed murder. A lacking in protocols in evidence handling and a lack of training in the right use of equipment hamper current forensic investigators. The study has focused on the educational background and the reliability of forensic investigation equipment. However, there exist some gaps in the conduct of the study. The study has provided no sampling. Besides, the study has not given how the data was presented and how the conclusions arrived. Lambert et al. (2015) did study on police expertise and contributions to forensic investigation equipment. The study utilized a cross-sectional survey research design. In addition, the study used a target population of 290 graduates in forensic science. Using qualitative analysis, the study

established that education background on forensic investigation equipment is critical in the system of criminal justice because there is the incorporation of the application of the analyzing of evidence scientifically in the courtroom. In addition, the participants of the study supported the forensic education to be included so that law enforcement practitioners are well informed on how to use forensic investigation equipment. The predicted the benefits of the disciplines' integration accurately to analyze an equitable justice system. Forensic evidence. Be sides then collected and presented in a way that ensures its integrity is maintained.

“Hazelwood and Burgess (2012) studied the capability of locating and identifying physical evidence at crime scenes. The study utilized a descriptive research design and a target population of 121 forensic investigation officers. Using descriptive statistics, the study found that the most relevant and important evidence may not be obvious or directly visible to the naked eye but requires high experience in forensic investigation equipment. The study further stated that the physical evidence recognition starts by observation of the crime scene, which is based on initial observations and considering the case's context, the incident's nature, possible scenarios and characteristics of surfaces that might bear potential evidence, a methodologic and flexible search strategy is implemented. This includes using the naked eye and magnifiers to search as well as other hand-held sources of light.

“Dandurand (2014) did a study on forensic investigation qualification and the ability to collect evidence. The study used a survey research design to answer the research question of the study. The target population comprised of 50 junior police officers who were recently recruited in forensic investigation department. Using qualitative analysis, the

study established that capturing the knowledge that underpins a police investigation is a crucial task for an investigator, and it influences his or her performance. Catching criminals cannot happen until an investigator first captures the knowledge provided by forensics, intelligence, and interviewing victims, witnesses, and interrogating suspects. The study further stated that the experience in gathering evidence using forensic investigation equipment is essential in the delivery of concrete evidence. Recovery and recognition of evidence need extensive training and experience. It also needs an understanding of what should be done on different types of physical evidence in forensic labs and the obtained information.

The conducted literature review revealed that only a little research was done on personnel needs in law enforcement, though crime laboratory needs have been deeply examined. Forensic evidence being mostly inadmissible due to the wrong collection techniques is a problem that was addressed in the Michigan study. The analysis revealed that potential material for evidence was left uncollected or trampled underfoot because personnel in law enforcement are inadequately trained in the techniques for processing of crime scenes. Because forensic science involved scientific evidence analysis, it should be vital in the United States criminal justice system.

Many studies have been conducted to establish how the availability of resources affects the operations of activities in institutions, which includes conducting investigations. However, there is no known study, determining the effects of resource availability in the application of forensic sciences in conducting criminal investigations. Therefore, besides acknowledging the scarcity of monetary and other resources for establishing robust

forensic science operations in Kenya, this study strives to establish the optimal resource allocation for instituting credible forensic investigations. These objectives are accomplished through concentrated researches to gather critical data, thereby ascertaining the suitable resource utilization for attaining reliable forensics in the Kenyan. Fondebrider (2016) conducted a study on the application of forensic science in solving crimes relating to political violence in South Africa. The study is relevant in the research as Kenya has encountered political violence cases in the past, for instance, after 2007 post elections violence. The author explores how a country's level of development determines its capability to conduct forensic analyses in solving criminal cases.

2.2.2 Level of training of investigators on application of forensic science

A study by Van der Westhuizen (2016) on the skills and the quality of the forensic investigation process utilized descriptive research design and targeted a population of 200 participants from the police training college. The study established that educational background is essential as it determines the quality of training of investigators. The study further established that forensic investigations required high-end qualifications for the investigator to be conversant with the investigation process. Right from respondent number one to the final user of the information, all involved personnel should have enough understanding of scientific disciplines, forensic procedures, and specialized services.

Training and education should be aimed at equipping police personnel with advanced forensic skills that will enable investigators to manage methods facilitating the treatment of complex forensic trade data for investigative and intelligence purpose. For instance, criminal intelligence analysts processes crime data in a structured way. Their

methods can be used to integrate information conveyed by traces in the right data structures and models. It also guide on the reasonable steps, and facilitate interpretation with various visualization tools and methods. The key aspects for the implementation of such methodology are that forensic case data analysts should have an influential culture in forensics, or be paired with forensic scientists rather than having to report in a vacuum without regards to producing the evidence.

Gardner (2015) did a study on forensic investigation and the skills of the investigation officers. The target population was 125 police officers who were requested to indicate a five-point Likert scale of how the skills influence the forensic investigation process. Using qualitative survey design, the study established that criminal investigation officers with adequate forensic investigation skills carried out investigations with ease compared to those with little expertise. The research further established that crime scene investigation involved in identification collection of physical evidence potentially relevant to the solution of the case. Thus, it is necessary for the officers involved always to have the required skills to ensure success of the process.

Capsambelis (2012) finds very little evidence in the research that addresses the criminal investigators' needs but shows that an effort has been spent to determine the educational needs of forensic science students. Capsambelis noted that a small number of academic programs existed because previously, crime scene personnel got their skills on the job and knowledge. The best situation is to have forensic evidence processed by senior scientists at crime scenes. This approach may be impractical and not feasible. Levinson and Almog's (2015) recommended specific indicators on the necessity to ensure those

responsible for the crime scene processing and the collection of evidence have specialists' training. The pool of unqualified forensic scientists is huge, therefore leading to a shortage of qualified ones. This may be attributed to colleges offering degrees having no uniform curriculum indicting basic science courses necessary for the occupation. Currently, the educational programs available are hampered by a lacking of protocols to handle evidence and lack of training in the right use of scientific equipment.

Forensic science is a field that largely depends on the expertise of individuals who are allowed to practice it within various countries. Courts using forensic science as evidence have noted forensic scientists need to be trained on the court procedures. The formal training given to individuals who study forensic is supposed to make them have a better opportunity to gain more experience in the field of study, making them experts. Balding (2015) evaluates the application of low-template, mixed-source, DNA profiles in forensic science. Training criminal investigators on such forensic analysis tools improves their efficiency. Balding's (2015) study focuses on DNA profiling analysis, leaving out other types of evaluations such as ballistic forensics.

In Kenya, forensic researchers were enrolled from the positions of college graduates in chemistry or biology. Practically no trainings provides in forensic sciences; all the legal stuff was learned at work. Hardly any state-funded colleges offers forensic trainings. The prevalence of forensics has caused a blast in the forensic oriented program, and students keen on legal professions in many third world nations. Previously, a large number of these projects offered a frail educational plan, little science, and had no

personnel with lawful experience (Dror, 2015). There is a need to have particular courses in-state colleges on forensic science, as it would ease criminal investigations significantly.

Few individuals have been trained as a forensic scientist. This is attributed to the stringent requirements that universities placed for admission of a forensic science student. However, the few individuals who are available in forensic science practice have been able to do significant works because they have strived to ensure forensic evidence are applied in administrative justice. Baechler and Margot (2016) focused on the application of forensic science in identification of forensic identification documents. Therefore, it provides an insight into a single area of forensic science.

According to Milliet, Delémont, and Margot (2014), demonstrate that if an investigator is well trained it will increase proficiency in performances of duty. From the studies, it was evident that experience causes one to be sure and have significant interaction with the apparatus. The more you go to the comparable scenes, the more you get the experience to deal with them gallantly and with a specific goal. Likewise, the more you have been in the field, the more you learn and enhance your aptitudes. However, Milliet, Delémont, and Margot (2014) do not explore the necessity of funding in criminal investigation and stakes from different quarters.

Dandurand (2014) did a study on forensic investigation qualifications and the ability to collect evidence. The study used a survey research design to answer the research question of the study. The target population comprised of 50 junior police officers who were recently recruited in forensic investigation department. Using qualitative analysis, the study established that getting hold of the information that supports a police investigator is

a crucial errand for an agent, and it influences their performance. Getting criminals cannot occur until an agent first gets the information gave by forensics sciences, insight, and interviewing casualties, witnesses, and grilling suspects. The study further stated that the experience in gathering evidence using forensic investigation equipment is important in the delivery of concrete evidence. Recovery and recognition of evidence need extensive training and experience. It also needs to understand what should be done on different types of physical evidence in forensic labs and to obtained information.

Analysis of studies conducted has shown that training is essential in having a professional workforce within an organization to perform their work professionally and that their opinions as experts are accepted in courts. Despite the significance of the training aspect in developing forensic experts, the existing forensic science curricula are generic; therefore, they do not meet the clarity and applicability standards to guide practical training for the local professionals. In that sense, this study endeavors to explore the critical factors underlying the active development of forensic investigators locally (Gordon & Steyn, 2012). This is accomplished through a focused exploration of the relevant data, and actual discussions and analyses of data for the subsequent establishment of appropriate training curricula. Training influences the application of forensic science in criminal investigations. Personnel equipped with the relevant training of forensic science possess the capability of solving criminal cases more effectively.

2.2.3 Laws and Regulations on Forensic Science

The question of how to address forensic investigations is a significant challenge. In 2002, the Houston Police Department Crime Laboratory and Property Room went under

investigation, given the scope of value worries that made "significant questions about the uprightness of substantial parts of the criminal equity framework. Issues raised include poor documentation, genuine systematic and interpretive blunders, the nonattendance of value confirmation programs, deficiently prepared staff, incorrect revealing, the utilization of wrong and deceiving measurements, and even the contamination of logical outcomes. Most of the guidelines and best practices in criminological science practice depend on the deliberate support of certain individuals from the scientific science network working tenaciously to improve general quality (Pollanen et al., 2012). The gaps existing in the forensic analyses according to the studies is the need for the standard course, which can streamline the field of study accordingly.

Despite significant development in actualizing quality control in the scientific science disciplines, absence of a uniform, and required laws and guidelines in regards to the quality affirmation systems, joined with some profoundly advertised issues including large wrongdoing, research centers have prompted increased consideration to cure lopsided quality among labs through the burden of norms and best practices. The American Bar Association suggested that "Crime laboratories and medical examiner officers should be accredited, examiners should be certified, and procedures should be standardized and published to ensure the validity, reliability, and timely analysis of forensic evidence" (MacCrehan, 2007).

In the case of *Daubert v. Merrell Dow Pharmaceuticals*, the Supreme Court referred to as an important factor in surveying expert testimony the presence and upkeep of norms controlling the strategy's activity. Principles and best practices make an expert domain that

permits organizations and professions to make quality frameworks, strategies, and techniques and keep up self-rule from personal stake gatherings. Standards guarantee alluring attributes of administrations and procedures, for example, quality, reliability, proficiency, and consistency among experts (National Research Council, 2009). Ordinarily, principles are upheld through accreditation and confirmation frameworks, wherein free analysts and examiners test and review the exhibition, approaches, and methodology of the two labs and specialist co-ops. What's more, prerequisites for quality control can be forced on elements accepting government assets. Expert gatherings can create codes of morals and direct to fill in as measures against which execution can be evaluated.

In Africa, various investigations have been conducted on the application of forensic science. Irons and Ophoff (2016) did a study on aspects of digital forensics in South Africa. The investigation evaluated computer forensics (predominately forensics concentrated on personal computers and laptops) and computerized forensics (forensics from digital artifacts, including cell phones, tablets, Global Positioning System (GPS) gadgets, implanted frameworks) condition in South Africa. The investigation explored that the nation had enactment on the most proficient method to deal with cybercrime. This has permitted compelling investigations of cybercrimes, a valid example being the meaning of 'digital overseers' by the Electronic Communications and Transactions (ECT) Act (2002). Nonetheless, the examination suggested that a comprehensive and reliable methodology over the African landmass is required, creating enactment which applies broadly and globally.

Mbaya (2016) examined the state of forensic investigation in Kenya. In explicit terms, the study tried to depict forensic examination procedures, set up the specialists' degree of training, analyze frameworks set up for watching human rights and codes of morals. The difficulties looked by forensic agents in the nation. The study discovered that the department had not accomplished maximum capacity due to the breakdown in the subsystems, rendering it moderate and in some way or another wasteful. It was also settled that the institution did not have precise examination techniques and guidelines trailed by all actors to decrease rubbing and moderate administration conveyance. The study deduced that forensic examination in Kenya is deficient because of the absence of a standard method to be followed, and nonappearance of approaches as far as scientific examination, weak foundation and apparatuses, and deficiency of particular specialists to deal with the scenes. In this way, the study suggested engaging the specialists through training, improvement of offices, and presentation of new advancements, appropriate subsidizing, and unmistakably laid out strategies and implicit rules. The current study seeks to establish whether the DCI has any improvement in their infrastructure, the experts' training, and the new laws and regulations in handling forensic evidence.

2.2.4 Influence of DCI management Support on Application of Forensic Science in Criminal Investigation

The support of the management is crucial when it comes to those who are subordinate. It plays a significant role in how the junior employees perform their duties. Hence, the management needs to have a favorable view of their employees. This is the

valuable aspect of the management support when it comes to the subordinates' effectiveness in executing their duties (Rossy et al., 2015).

In forensic science and investigations, the support of management is critical in ensuring that there are positive results that are yielded by the officers and the investigators. This is one reason some countries have proper management within its investigative agencies; there are always results that are realized positively. Management is imperative in conducting criminal investigations through forensics. The effectiveness of leadership in criminal investigations determines whether there is adequate incorporation of forensics.

Management support can be in forms of provision of resources needed in investigations. In situations where there are few or limited resources that might hinder the forensic investigators' performance, it is the management's role to ensure that resources are adequately available (Rossy et al., 2015). Management support is linked to the training of the investigators within the field of forensic science. Forensic science is based on the application of technology that keeps on changing regularly, and this demands the routine training of the investigators to be able to be in line with the current requirements. Any management that is keen on having a positive result will ensure that there is support for the investigators in the latest skills (Rossy et al., 2015).

Financial support is an essential part of forensic investigations. The lack of finance is one of the issues that has been able to cripple most of the investigations that application forensic science. According to Salfati, Horning, Sorochinski, and Labuschagne, forensic science in most developed countries has been successful due to the financial support that the investigators received from the state and from the departments that they are attached.

Management will not allocate adequate resources to forensic science if they do not believe in forensic investigations. Therefore, the required finances should be part of the management's support (Salfati et al., 2015).

2.3 Summary of Literature Review and Research Gaps

The available literature on forensics highlights areas that various scholars have focused on and the research gap in their works. Some studies explore the prevailing regulations in forensic science, while others focus on ethics (. From the literature, it is evident that management and leadership are vital aspects of deploying forensics in criminal investigations.

According to Salfati, Horning, Sorochinski and Labuschagne (2015), forensic science in most developed countries has been successful due to the financial support that the investigators received from the state and the departments that they are attached. The findings from this study cannot be applied in developing countries such as Kenya, whose financial footing is limited. This is confirmed in a study by Dror et al. (2012) that most of the countries in the developing world are not adequately equipped with the forensic investigation resources, which have led to the dismissal of most cases in court due to the lack of evidence on the side of the prosecution. This has mainly affected sexual offenses and related cases; for example, it might be. However, Dror's (2012) study is old, and there is a need for new literature on the availability of forensic tools for forensic investigations, which this study sought to fill.

The training of forensic investigators was another factor reviewed in the literature. From the studies, Lee et al. (2015) established that investigation of crime scenes needs

individuals highly educated with a forensic science background, the criminal justice system, and natural sciences. Hazelwood and Burgess (2012), on the other hand, Dandurand (2014) did a study on forensic investigation qualification and the ability to collect evidence. The study used a qualitative approach to deduce that the experience in gathering evidence using forensic investigation equipment is essential in the delivery of concrete evidence. The current study used both qualitative and quantitative approaches to be in control of the study and, at the same time, get in-depth information concerning the research questions. Additionally, Gardner (2015) established that criminal investigation officers with adequate forensic investigation skills tended to carry out investigations with ease compared to those with little expertise. The study only focused on the investigators' level of training in handling forensic investigations leaving essential factors investigators to require conducting forensic investigations successfully. This study incorporated the availability of forensic tools, existing laws and policies, and the level of training in forensic investigations.

Numerous laws and policies have been adopted worldwide, as reviewed in the literature. Irons and Ophoff (2016) explored that South Africa had enactment on the most proficient method to deal with cybercrime. In Kenya, Mbaya (2016) sought to analyze frameworks set up for watching human rights and codes of morals and the difficulties looked by forensic agents in the nation. The study discovered that the department had not accomplished maximum capacity due to the breakdown in the subsystems, rendering it moderate and in some way or another wasteful. Having conducted the study in 2016, a lot has changed in terms of infrastructural development, funding, and training facilities for

investigators in the Country. Mbaya's study was conducted at the County level and was limited by the fact that it only focused on investigators at the scenes of crime at the Sub-County level. To avoid such, the current study concentrated on all investigators involved in forensic investigations at the DCI, Headquarter.

In summary, the research gaps evident in the reviewed literature include differences in forensics practice between developing and developed nations and the standardized forensics courses in state educational institutions. Among the factors, which affect the application of forensic analysis during, include resource availability, laws, and regulations, prevailing trends, and management.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The study design demonstrates the flow of the research, whereas the methodology manifests how the scholar collects data and the necessary information required for completing the study entirely. This work's primary aim was to determine the application of forensic science in conducting criminal investigations at the Directorate of Criminal Investigation (DCI). Fundamentally, the study focused on the effect of availability of forensic tools, investigators' training, and the existing regulations and laws on utilizing forensic tools in investing crimes at the DCI. The chapter explores the study's design, research site, sample size, target population, sampling process, data collection methodologies, study tools, data analysis and processing, instrument reliability and validity, and ethical and legal issues.

3.2 Research Design

The research design contains the selected plans to be used in the collection of data (Sileyew, 2019). It helps with handling the collected data to come up with specific information that is desired for review. A descriptive research design was used in this study to depict the study respondents accurately. Information was collected by filling questionnaires and interviewing key informants.

The methodology is ideal in collecting data on opinions, attitudes, and perceptions, which people have on various issues. A descriptive design recapitulates the current or past

state of an issue by describing attitudes, achievements, behaviors, and other traits of the subjects' group (McMillan & Schumacher, 2006).

3.3 Research Site

The research site is a selected location for conducting the study; it should have all the characteristics that can ensure the success of the study (Mugenda, 2003). The study was conducted at the DCI Headquarters located along Kiambu road within Nairobi City County (Appendix 6). The DCI, Headquarters, was chosen because it is a semiautonomous department of the NPS mandated with conducting forensic analysis, maintenances of criminal records, undertaking criminal investigations, among other functions (National Police Service. Therefore, the choice of DCI Headquarters is essential, as it is the major police department charged with carrying out forensic analysis in the Country. It is the central coordination point used by the police on matters of forensic investigations. It is also, where forensic laboratories used by the police during their forensic investigations are located.

3.4 Target Population

A research population is an entire group of people whose research is focused on, events, or things of interest that the researcher wishes to investigate. According to Mugenda and Mugenda (2003), the population consists of individuals, objects, and events with the same observable characteristics. This study-targeted population of 320 individuals working as forensic investigators within DCI because they are knowledgeable and have experience in application of forensic science in criminal investigations at DCI. The population was stratified as follows (Table 3.1).

Table 3. 1: Target Population

Police Unit	Target Population
Ballistics unit	21
Crime Scene Support Services unit	47
Forensic Document Examinations unit	18
Computer Forensics unit	23
Forensic Biology unit	17
Forensic Chemistry unit	18
Criminal Registry Office (Fingerprints)	154
Bomb Disposal Unit	22
Total	320

Source: DCI registry (2020).

3.5 Study Sample

3.5.1 Study Sample Size

Sample sizes represent portions of the target population, which scholars have an interest in studying. Sampling is selecting a participant sample for research within a target population (Leary, 2004). A researcher can employ a sample size of 10%-30% of the targeted population (Mugenda & Mugenda, 2003). As a rule of thumb, a sample of 10% is sufficient to represent the entire population (Blanche et al., 2008). A sample of 32 respondents was randomly selected to represent the target population of 320 investigators (Table 3.2).

Table 3. 2: Sample Size

Unit	Target Population	Proportion	Sample Size
Ballistics unit	21	10%	2
Crime Scene Support Services Unit	47	10%	5
Forensic Document Examinations Unit	18	10%	2
Computer Forensic Unit	23	10%	2
Forensic Biology Unit	17	10%	2
Forensic Chemistry Unit	18	10%	2
Criminal Registry Office (Finger Prints)	154	10%	15
Bomb Disposal Unit	22	10%	2
Total	320	10%	32

Source: Researcher (2021)

3.5.2 Sampling Procedure

The researcher settled on assumptions that the sample best represented the target population. The sampling process is an activity that was done to decide on an appropriate number that can be used as a representative of the targeted community. The simple random sampling procedure was utilized to select the sample for the study from the target population. Simple random sampling is a technique used to ensure that all the members of the population each have an equal opportunity to be selected. Using simple random

sampling, the email addresses of the respondents were arranged in alphabetical order and numbers from 1 to 320. The researcher then selected the every tenth email in the list to participate in the study. The study used a purposive sampling method to select the Heads of different units to respond to the study.

3.6 Data Collection

The researcher used the questionnaire and key informant interviews to collect data from the respondents. Due to the existence of the COVID -19 pandemic in the Country, the physical data collection method was not possible. The researcher resorted to using google forms to collect information from the respondents. Key interviews were conducted on the Heads of units and a persecutor from the Office of Directorate of Public Prosecution as the key informants to corroborate the questionnaires' findings.

3.6.1 Research Instruments

The researcher used primary data collected through questionnaires (Appendix 5) and key informant interviews guide (Appendix 6). Questionnaire were designed for officers from ballistics unit, crime scene support services unit, forensic document examinations unit, computer forensic unit, forensic biology unit, forensic chemistry unit, criminal registry office (finger prints), and bomb disposal unit while key informant interview guide were for the heads of units and a persecutor from the Office of Directorate of Public Prosecution. The Google forms questionnaires were designed based on the research questions, which were structured and unstructured to ensure that there is maximum collection of the intended information. The survey was in two parts, that is the background information and the research questions.

The Google forms questionnaire was used because it was safe and reduced chances of spreading COVID – 19, apart from saving time as it allows for a faster collection of data. The questionnaire provides a simple way of testing reliability and validity during pilot testing. Further, questionnaires allowed analysis of data using SPSS statistical tool.

Each of the broad questionnaire themes integrates relevant data needs, including the requirement to ascertain the presence of an influencing factor. It also includes the extent of the operational effects that each broad questionnaire themes integrate relevant data needs. Primarily, the choice of the questionnaire instrument was justified by the tendency of the data collection method to safeguard against subjective responses. (Fondebrider, 2016).

3.6.2 Pilot Testing of Research Instruments

The pilot study was conducted at Nairobi County Police Headquarters. The station was selected since it used forensic science in conducting its investigations with almost similar characteristics with DCI Headquarters. The pilot study was used in determining the validity and reliability of the research instruments. Four (12.5%) respondents were used for piloting to test the reliability of the research instrument.

3.6.3 Instrument Validity

Validity refers to the ability of a tool to accurately measure what is supposed to be determined based on the content of the application (Kombo & Tromp, 2006). A pilot study was conducted to determine the validity of the questioners that were used in conducting the study after the piloting ambiguous questions were addressed so to ensure that the final questioners produce valid results.

To test for validity, the researcher employed the content validity approach, which refers to measuring the collected data, by a specific instrument, representing a given domain (Cohen, Manion & Morrison, 2015). Additionally, the instrument was submitted for expert scrutiny from the supervisor to identify any possible gaps.

3.6.4 Instrument Reliability

Reliability is a measure of the consistency of study results. (Kombo & Tromp, 2006). The internal consistency method was employed in determining the reliability of the research instrument. The reliability measures were done using Cronbach's alpha coefficient in measuring the questionnaire's internal consistency. Table 3.3 below shows that the research instrument is reliable if Cronbach's alpha is above 0.7.

Table 3. 3: Reliability Measure

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Source: Kombo & Tromp, 2006

3.7 Data Analysis

Analysis of data is the synthesis process where the collected data are used, including a variety of approaches to arrive at meaningful conclusions for generalizability

(Henseler, 2017). For both qualitative and quantitative data, a different approach was employed. The qualitative data collected were analyzed using SPSS, and the results of the study were generated. Data were processed to generate the percentages and the frequencies of the findings for quantitative data.

Essentially, data coding assigns numerical codes to the diverse responses for weighing the items' variances from the predetermined validity and reliability scales. Subsequently, through the SPSS computer application, final data was generated for interpretation and analysis. The qualitative data were coded into themes and findings presented in verbatim to corroborate the findings from the questionnaires. Descriptive statistics and measures of central tendencies, frequencies, graphs, charts, and tables were used to represent quantitative data. On the other hand, qualitative data were analyzed using the content analysis technique and presented in narrative form and quantitative data.

3.8 Legal and Ethical Considerations

There are various legal and ethical considerations to take into account in conducting the study. Ethical issues of the research include protecting the identity of participants and guaranteeing the integrity of study outcomes. Confidentiality was realized by requesting the respondents from refraining from including personal data on the study instruments. Respondents were informed that participation in the study was purely voluntary, and they can choose to withdraw at any phase of the study with no consequences.

A formal request to research DCI Headquarters was sought; permit to conduct research (Appendix 3) sought from National Commission for Science Technology and Innovation (NACOSTI) and an introduction letter form postgraduate school obtained

(Appendix 2). An introduction letter (Appendix 1) was attached to the study questionnaires to help explain the scope of the research to the respondents. Questionnaires had unique numbers for identification that ensured the protection of participants' identities.

CHAPTER FOUR

RESULTS AND INTERPRETATION

4.1 Introduction

The purpose of the study was to establish the determinants of forensic science application in criminal investigations conducted by DCI in Nairobi Kenya and of importance is to provide feasible and workable recommendations that are likely to improve quality of forensic investigations undertaken by DCI in Nairobi Kenya. The specific objectives of the study were to assess the availability of forensic tools used when conducting criminal investigations, establish the level of training for investigators on forensic science and how it affects criminal investigations and examine how the laws and regulations governing the application of forensic science in Kenya affect criminal investigations conducted by the DCI in Nairobi Kenya. The moderating variable in the study was management support. This chapter presents the findings of the results of the study. The results have been analyzed, interpreted and presented based on the specific objectives to answer the research questions.

4.2 Demographics of the Respondents

4.2.1 Response Rate

The researcher targeted a sample size of 32 respondents. The overall response rate for the respondents and interviewees was 24 respondent representing 75% of the total respondent that was targeted samples as indicated in Figure 4.1. Mugenda and Mugenda (2003) pointed out that a response rate of 50% is good and a response rate of 70% and

above is excellent for generalization of the findings. Therefore, the response rate in this study is credible.

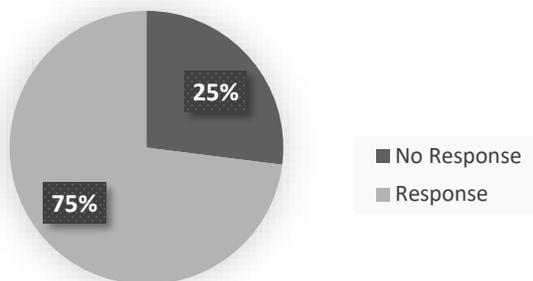


Figure 4.1: Response Rate

Source: Field Data (2020)

4.2.1 Gender of Respondents

Approximately 79% of the respondents were male, while 21% were female as indicated in Figure 4.2. This is an indication that there is gender balance in the distribution of forensic investigators at DCI. This could be attributed to the fact that forensic investigators need to have studied science course, a subject that is not one of the favourite courses to most ladies in school.

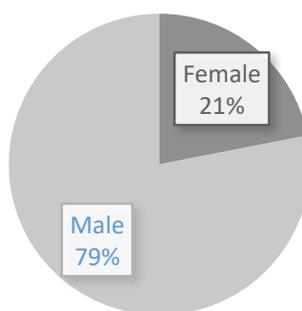


Figure 4.2: Gender

Source: Field Data (2020).

4.2.2 Highest Level of Education of Respondents

It was observed majority (75%) of the respondent have attained an undergraduate level of education with the lowest possessing Diploma and 25% of the respondents had attained postgraduate studies (Masters and above) (Figure 4.3). The findings revealed that all the respondents had at least a college level of education on forensic science. This shows that DCI has qualified forensic investigators with adequate knowledge and understanding of the field of forensic science. Therefore, data collected from the sample was relevant and provide reliable information.

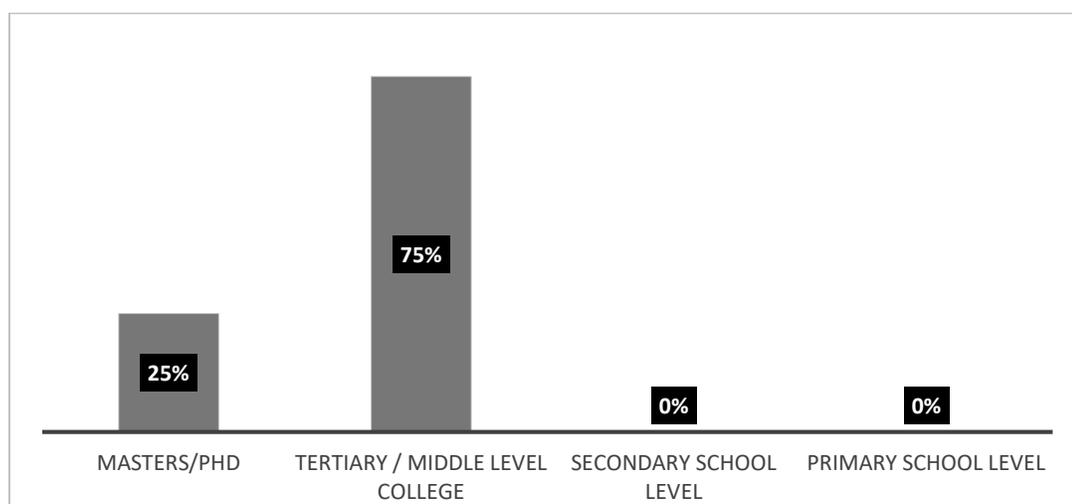


Figure 4. 3: Highest Level of Education

Source: Field Data (2020)

4.2.3 Level of Understanding and Knowledge of Respondents on Forensic Science

From the study, it was established that all the respondents had an understanding and knowledge on forensic sciences with 64% of the respondents being experts, 23% of the respondents having intermediate understanding and knowledge while 13% have basic knowledge and understanding on forensic science (Figure 4.4). Therefore, the respondents

were correctly sampled and they provide relevant data ensuring reliability and validity of the results.

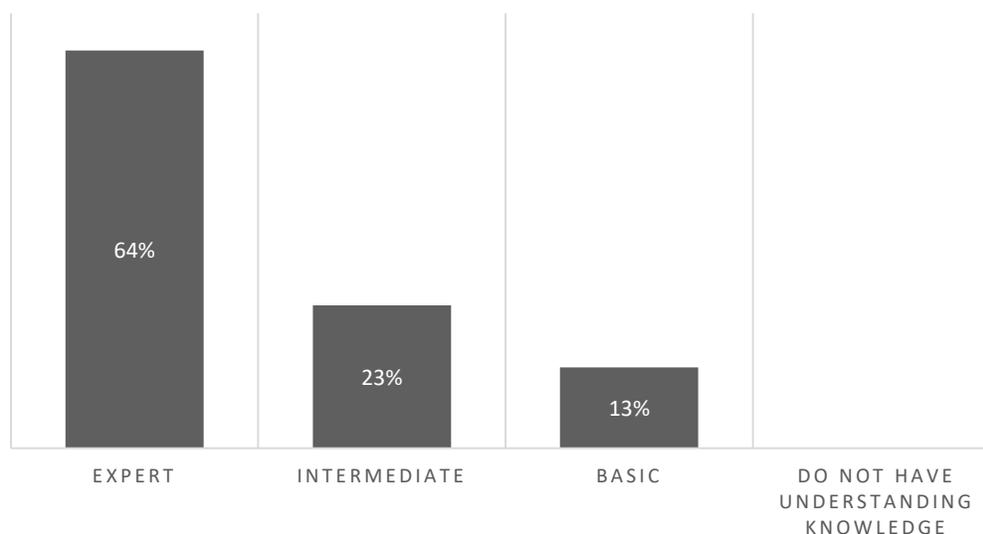


Figure 4. 4: Level of Understanding

Source: Field Data (2020)

4.2.4 Respondent's Years of Experience in Conducting Forensic Investigations

Figure 4.5 depicts the respondent's years of experience in conducting forensic investigations. It was noted that 47% of the respondents had 1 to 10 years of experience, 37.5 % of the respondents had 10 to 20 years of experience, and 15.5% of respondents had 20 to 30 years of experience. None of the respondents had over 30 years' experience. The table analytically shows that the respondents of the study have relevant experience in the field of forensic science. This means that the data collected were authentic. Further, the data was collected from different respondents with low and high experience in forensic investigations making it balance hence avoiding one-tailed data.

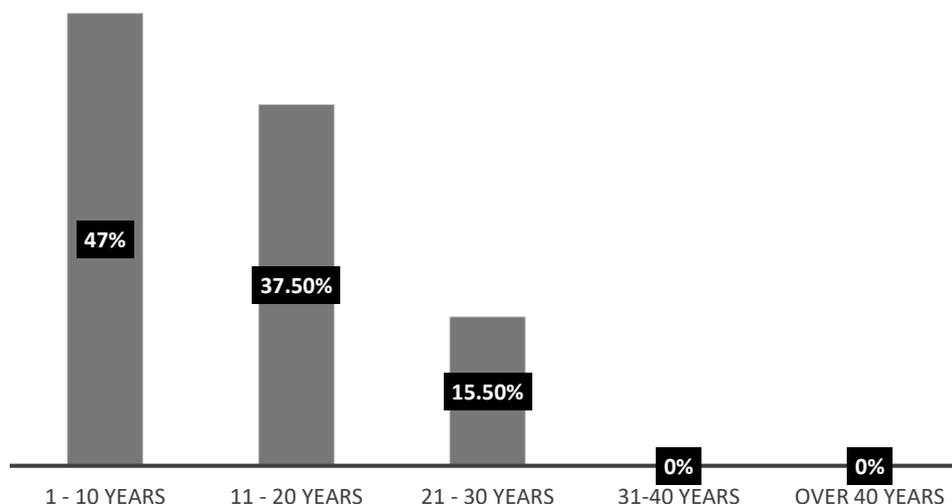


Figure 4.5: Experience in Forensic Investigations

Source: Field Data (2020)

4.3 Data Analysis and Interpretation

This section presents the findings on the availability of forensic investigation tools, level of training of investigators, how laws and regulations governing and how DCI management on the application of forensic science affect criminal investigations.

4.3.1 Availability of forensic tools used in crime investigations

The first specific objective of the study sought to establish whether DCI has adequate forensic tools for the collection of evidence in the field and how it affects criminal investigations conducted by DCI.

Table 4.1 shows the investigators equipped with forensic field tools to be used in collections, preservation and transportation of forensic evidence to forensic laboratories for analysis. The said Table 4.1 shows that 62.5% of the respondents thought that investigators are inadequately equipped, 25% felt that they are adequately equipped, while

12.5% thought they are not provided. The response to this question reveals that the investigators are ill-equipped with the necessary tools required in collections, preservation, and transportation of forensic evidence to forensic laboratories for analysis.

Table 4. 1: Availability of Forensic Field Tools

Availability of Forensic Fields Tools to Investigators	Frequency	Percentage
Inadequately equipped	15	62.5
Adequately equipped	6	25
Not Equipped	3	12.5
Well Equipped	0	0
Total	24	100

Source: Field Data (2020)

Table 4.2 depicts level in which DCI Laboratories are equipped with forensic tools necessary in conducting forensic analysis of evidence and come up with an expert opinion as a forensic expert. It was found that 50% of the respondents indicated that the DCI laboratories are adequately equipped, 33% of respondents stated that the laboratories are inadequately equipped, while 17% respondents did not answer this question. A large percentage of the staff believe that the DCI laboratories are well equipped with forensic investigation tools to carry out forensic analysis effectively. Despite the findings that the DCI laboratories are adequately equipped, the respondents were clear that they do not have adequate field forensic tools to undertake fieldwork activities like collection of evidence, preservation of the evidence for a watertight prosecution.

Table 4. 2: Availability of Equipped forensic laboratories

Availability of equip forensic Laboratories	Frequency	Percentage
Adequately equipped	12	50
Inadequately equipped	8	33
Well equipped	0	0
Not Equipped	4	17
Total	24	100

Source: Field Data (2020)

Table 4.3 captures the responses against the question of whether DCI has an up-to-date forensic database (Eg DNA, Fingerprints, Ballistics databases) to help in the analysis and interpretation of forensic evidence. The said table showed that 25% of the respondents are of the view that DCI has inadequate up to date database, 50% of the respondents believe that DCI has adequately updated database, and 16.7% respondents are of the view that DCI has a well-updated database. 8.3% also indicated that the DCI does not maintain any database of forensically analyzed data. It was discovered that majority of the respondents indicated that DCI has an up-to-date forensic database. However, it was further, noted that the DCI only have fingerprint and ballistic databases, but it does not have a DNA database. This is of key concern as lack of DNA database limits the ability of the agency to conduct criminal investigations with samples such as hair, body fluids, or blood especially on the case of sexual offences and homicide.

Table 4. 3: Forensic Databases

Up To Date Forensic Databases of DCI	Frequency	Percentage
Have inadequately updated database	6	25
Have adequately updated	12	50
Have a well-updated database	4	16.7
Do not have a database	2	8.3
Total	24	100

Source: Field Data (2020)

The study went further to seek the respondent's opinion on what they think should be done to encourage investigators to utilize forensic tools and other forensic resources when conducting investigations.

Several suggestions were given with one of the respondents suggesting that;

Access to most of the necessary forensic tools is only available at the headquarters. This has made it difficult to conduct investigations in remote areas of the country (DCI staff 12).

Another respondent also indicated that;

There is little budgeting for field forensic investigation tools which makes the work of the department very difficult (DCI staff 3).

Another respondent also reiterated that

Our country allocates a handsome budget to the ministry of internal coordination of the country, from which a significant portion is allocated to

outside security, the remaining budget is for internal defence, and a low budget comes to the forensic department.

We are weak in two major steps of forensic investigations that are the preservation of data and examination of data because of the technological gap between our country and the international community (DCI staff 5).

To add more information on non-availability of tools, another respondent pointed out that;

Non-availability of investigative tools is problematic, but the use of available tools and resources up to their optimal level is one of the essentials that should not be lacked in forensic science.

The careless behavior of investigators, as well as lack of sense of responsibility, leads to delay in investigations, in some cases, it harms the investigations in different possible ways (DCI staff 18).

The study sought to establish how the availability of forensic tools and resources affects the application of forensic science in criminal investigations conducted by DCI. The respondents aired the following opinions;

There should be convenient accessibility to forensic tools and resources to enable investigators to use forensic science at a relatively high rate (DCI staff 1).

Availability of forensic resources and tools does not affect how the DCI uses forensic science during investigations (DCI staff 9).

Despite the availability of forensic resources and tools, the DCI uses forensic science in conducting investigations at low levels (DCI staff 13)

Based on the responses, first, it is very important to stimulate a sense of responsibility by investigators on the criticality of their work as it directly or indirectly affects the administration of justices.

4.3.2 Training on the application of forensic science in Criminal Investigations

The second specific objective aimed to establish the level of training of investigation officers, and on whether the training is relevant to the success of criminal investigations.

Table 4.4 depicts the training which should one possess before deployment to conduct forensic investigations. 16.7% of the respondents had basic certificate training before deployment, 20.8% had intermediate training on forensic science, and 62.5% view that one should have an advance level of training in forensic science before joining forensic investigations field. From the findings, it shows that all the respondents believe that one must be trained in forensic science before deployment to the forensic department.

Table 4. 4: Training Possessed

Training Posses before Deployment	Frequency	Percentage
Basic Training (Certificate)	4	16.7
Intermediate Training (Diploma)	5	20.8
Advance Training (Degree)	15	62.5
Do not Require any training	0	0
Total	24	100

Source: Field Data (2020)

Figure 4.6 shows how often forensic investigators should undergo refresher training on forensic science to sharpen their skills. It shows that 87.5% of respondents are of the opinion that investigators should undergo frequent refresher training, and 12.5% are in settle that sometime refresher training would be helpful. It was observed that most respondents are in favor of refresher training and want to sharpen their forensic investigations skills. This a clear indication that refresher training is essential in improving the quality of forensic investigations conducted by DCI.

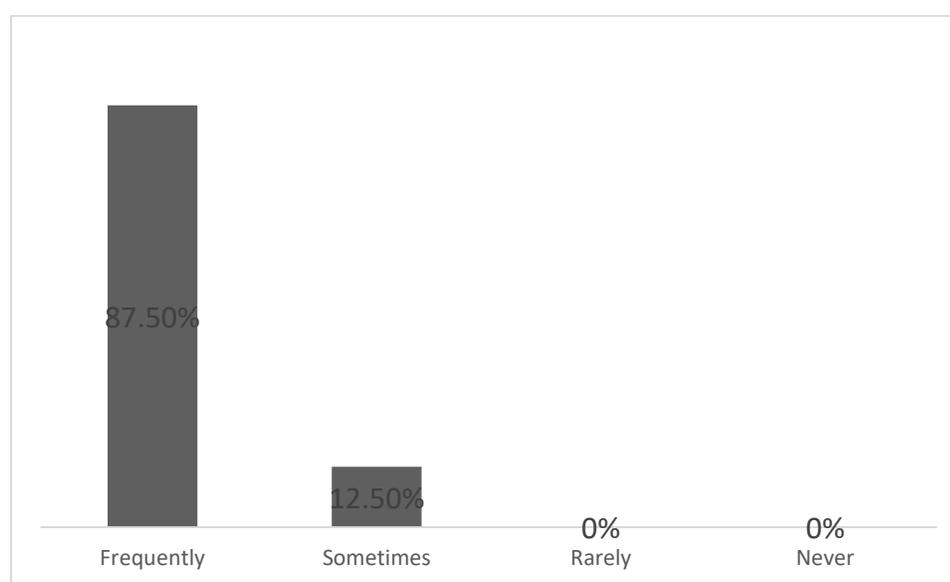


Figure 4.6: Refresher Training

Source: Field Data (2020)

Figure 4.7 depicts the frequency distribution on the view of respondents on the benchmarking and exchange programs for DCI forensic investigators with other agencies/countries to improve the knowledge and application of forensic science in investigations. It was noted that 63% of respondents strongly agree that these programs will enhance the understanding and application of forensic science, while 37% of

respondents only agree with the statement. It was deduced that all the respondents agree that benchmarking and exchange programs help improve the application of forensic science.

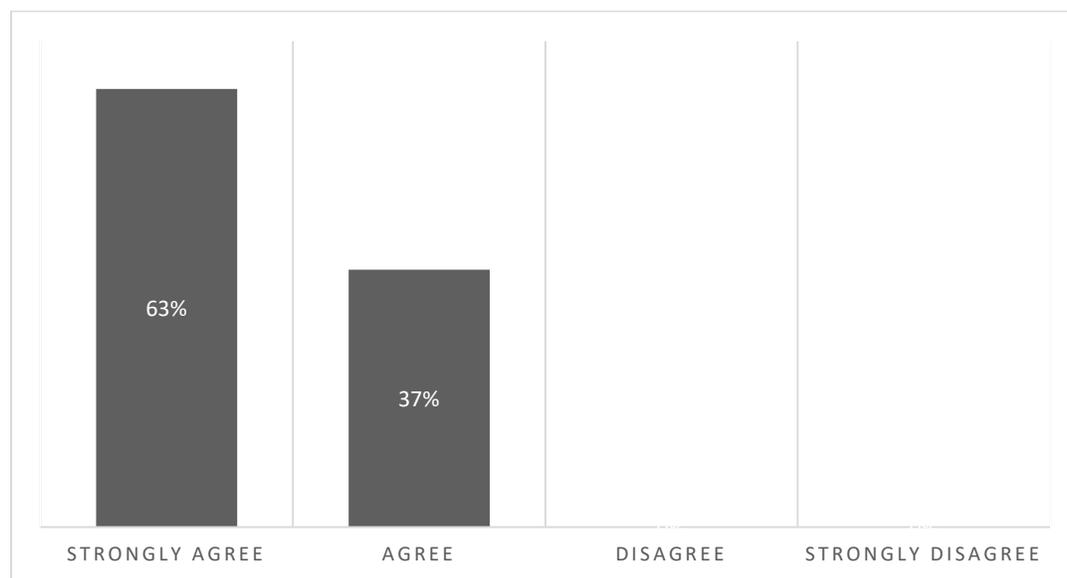


Figure 4. 7: Benchmarking and Exchange Programs

Source: Field Data (2020)

Table 4.5 shows the frequency distribution against the question that either On-Job training improves the skills and knowledge needed in conducting forensic investigations conducted by DCI. In response, 79.2% of respondents strongly agree that on-job training is helpful to enhance the skills and expertise of investigators, while 20.8% agrees with this statement. It was noted that all the respondents believe that on the job training develops the skills and knowledge of forensic science, increasing the application of forensic sciences when conducting investigations by DCI investigators.

Table 4. 5: On-Job Training

On-Job Trainings Improves Skills and Knowledge	Frequency	Percentage
Strongly agree	19	79.2
Agree	5	20.8
Disagree	0	0
Strongly disagree	0	0
Total	24	100

Source: Field Data (2020)

The study sought to establish other means in which the DCI can enhance the skills of the investigators to ensure that they use forensic science to conduct investigations. Some of the respondents reported that;

Investigators who use forensic science during investigations should be recognized and awarded to motivate them and encourage others to apply forensic science during investigations.

DCI should also create a conducive working environment to allow full utilization of forensic science (DCI staff 11).

The study went further, to investigate challenges that the investigators face when performing forensic investigation, which is related to training. The respondents mentioned the following problems;

There is the unavailability of training resources, which hinders the expansion of knowledge with regards to forensic investigations. This has also made it a challenge for the department to conduct refresher courses to the investigators regularly (DCI staff 6).

The department is faced with a challenge of developing standards for forensic science training (DCI staff 4).

Lack of standardized curriculum for the training of forensic sciences affects its application. The Government should endeavour to develop a uniform curriculum for the training of forensic experts (DCI staff 1).

The study went further to seek if the forensic department has any mechanisms put in place to address investigators knowledge gaps. It was reiterated that;

The department identifies the knowledge gaps and includes them in forensic science training modules, which is part of professional training developments coordinated by the department (DCI staff 20).

There is a promotion of research in forensic science by investigators through making such projects part of the training program for investigators. Skills training for the investigators is crucial in this context (DCI staff 15).

There is a program, which involves exchanging good practice between investigation agencies to help in closing the prevalent knowledge gaps. Investigators are trained on the need of taking a collaborative stance in their work through team training (DCI staff 5).

4.3.3 Law and regulations guiding the application of forensic science

The third specific objective of the study was to examine how the laws and regulations governing the application of forensic science in Kenya do affect criminal investigations conducted by the DCI in Nairobi, Kenya. The study findings are presented in the following sub-headings.

Table 4.6 depicts how the respondents view on how Law such as; Evidence Act, Criminal Procedure Code (CPC) and other Acts and regulations affects forensic investigations. 67% of respondents indicated that existing laws provide adequate guidelines to the application of forensic science, and 33% thought that they offer more than sufficient instructions. From this finding, it is evident that existing laws such as the Evidence Act, the Criminal Procedure Code (CPC), etc. are providing adequate guidelines to forensic science.

Table 4. 6: Adequacy of existing laws and regulations of guidelines

Law and Provision of Guidelines	Frequency	Percentage
Provide more than adequate guidelines	8	33
Provide adequate guidelines	16	67
Provide inadequate guidelines	0	0
Do not provide any guidelines	0	0
Total	24	100

Source: Field Data (2020)

As depicted in Table 4.7. 62.5% of the respondents indicated that Kenya Criminal Justice System had not achieved full application of forensic science in conducting a

criminal investigation, 25% respondents agree with the statement, and 12.5 per cent are disagreeing. It was revealed that two-thirds of respondents believe that Kenya Criminal Justice System has not achieved full utilization of forensic science in conducting a criminal investigation and requires its full application.

Table 4.7: Kenya Criminal Justice System and Its Application

Level of agreement	Frequency	Percentage
Strongly agree	15	62.5
Agree	6	25
Disagree	3	12.5
Strongly disagree	0	0
Total	24	100

Source: Field Data (2020)

It was observed that 66.7% of respondents believe that DCI does not have elaborate Standard Operating Procedure (SOP) that guides the process of forensic evidence collection, preservation, storage, analysis and presentation. 25% thought that SOP is fairly elaborated, while 8.3% believed that SOP is not adequately elaborated as shown in Table 4.8. Consequently, the majority of respondents are not satisfied with the current Standard Operating Procedure (SOP).

Table 4. 8: Standard operating procedure and guidance to forensic evidence

SOP and Guidance to Forensic Evidence	Frequency	Percentage
No SOP	16	66.7
SOP is fairly elaborate	6	25
SOP is not adequately elaborate	2	8.3
SOP is well elaborated	0	0
Total	24	100

Source: Field Data (2020)

The respondents were asked to give their opinion on how effective the existing laws are in addressing forensic investigations. Some of the respondents reiterated that;

Evidence Act provides how forensic evidence should be able to handle for it to be admissible in court. Further Criminal Procedure Code provides on how forensic evidence should be adduced in court; for example, forensic experts need to be gazette as experts (DCI staff 10).

Current laws provide stringent procedures to be followed when; collecting, analyzing and presentation of digital evidence for them to be admissible in the court of law. (DCI staff 13)

The researcher sought to ascertain if there are any gaps in the existing laws and policies that may be impeding the application of forensic science. Some of the respondents are presented that;

Coroners Act interprets that pathologist as experts that will determine the cause of death in cases of murder. In some parts of the country, there is no pathologist, and any medical practitioners have been conducting an autopsy. This can be challenged by the defence, resulting in acquittal of accused persons,

not because they did commit the offence but because of technical provisions of the Law. (DCI staff 4).

Digital forensics standards have gaps that require action. Investigators sometimes lack legal protection. The policies do not promote the exchange of good practices (DCI staff 8).

4.3.4 Management support and application of forensic science in conducting criminal investigations

It was noted in Table 4.9 that 12.5% of the respondents strongly agreed with the statement that management support leads to improved application of forensic science in conducting criminal investigations, 70.8% of the respondents have agreed, while 16.7% disagreed. Consequently, management support is essential if the Government or institute wants to improve the application of forensic science in conducting criminal investigations.

Table 4. 9: Management Support to DCI

Management Support Leads to Improve the Application of forensic science in Conducting Criminal Investigations.	Frequency	Percentage
Strongly agree	3	12.5
Agree	17	70.8
Disagree	4	16.7
Strongly disagree	0	0
Total	24	100

Source: Field Data (2020)

Table 4.10 shows the frequency distribution against the welfare of forensic investigators and the performance of forensic investigators. The said table shows that 46% of the respondents are firmly in agreement with the statement that the welfare of forensic investigators increases the performance of forensic investigators; 33% of the respondents agree. In comparison, 21% of the respondents disagree with the statement. Therefore, the majority of respondents have a point of view that the welfare of forensic investigators plays an essential role in improving their performances.

Table 4. 10: Welfare and Performance of Investigators

Level of Agreement	Frequency	Percentage
Strongly agree	11	46
Strongly disagree	5	21
Agree	8	33
Disagree	0	0
Total	24	100

Source: Field Data (2020)

As indicated in Table 4.11, approximately 2% of the respondents strongly agreed that guidance and advice from the higher authorities improve the accomplishments of forensic investigators, 54% of respondents only agreed, and 25% strongly disagreed. This implies that guidance and advice from management plays a vital role in encouraging the application of forensic science.

Table 4. 11: Guidance, Advice, and performance of Forensic Investigations

Level of Agreement	Frequency	Percentage
Strongly agree	5	21
Agree	13	54
Strongly disagree	6	25
Disagree	0	0
Total	24	100

Source: Field Data (2020)

The study sought to establish whether some other factors are impeding the application of forensic investigations by the DCI. The respondents stated the below listed as application of forensic science in criminal investigations;

The poor motivation of the investigators collecting evidence and those were conducting forensic analysis. (DCI staff 23)

Weakness in documentations of crime scene and negligence of forensic investigators when performing their duties.

Lack of political goodwill, especially from the political class in policymaking position in Government.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND COMMENDATIONS

5.1 Introduction

The section encompasses deliberations, inferences and recommendations, which scholars can focus on for further research. Conclusions and outcomes of the study are presented in the discussions while the inferences section seeks to solve the problem of study. Recommendations highlight the areas, which the research has not covered fully and gives suggestions for future studies on the topic.

5.2 Discussion of Findings

5.2.1 The availability of forensic tools used when conducting criminal investigations at the Directorate of Criminal Investigations

The study sought to determine if there are adequate forensic equipment used by investigators in the collection of evidence in a crime scene. The outcomes show that 62.5 per cent of the respondents stated that the DCI is inadequately equipped, and 25 per cent stated that the investigators adequately equipped, whereas 12.5 per cent stated that they are not equipped. The results of the query indicate that DCI does not have adequately forensic tools for tracing and collection of evidence forensically from a crime scene leading to investigators failure to effectively apply forensic sciences when conducting investigations.

Resources within the security sectors include; personnel, facilities and tools that are necessary for the implementation of the various security measures that are needed by the society such as conducting forensic science activities (Brito, Martins, Braz, Chaves, Braga & Pimentel, 2017). Additionally, forensic field tools are resources that investigators can

utilize effectively to enhance the capability of the DCI in solving criminal cases in Kenya. Gathering all the necessary information and analyzing is paramount. Hence, field officers should collect all the crucial information at scenes of crime so that they do not overlook essential evidence and veer off the correct path of solving a case (Zietkiewicz et al., 2012).

The opinions made by forensic experts have to be accurate for them to be credible. However, the accuracy of the results depends on the availability of forensic equipment for the collection of evidence in crime scenes. There is need for DCI personnel to have the requisite tools and competence to collect evidence at the scenes of crimes, as well as storing and transporting the information in a way that preserves its integrity. The DCI is inadequately equipped with field forensic tools, which negatively affects the application of forensic science in conducting investigations. Therefore, there is a need for the Government to deploy more resources to the department to enable procurement of the much-needed field equipment. Lack of forensic tools makes it hard for investigators to compile evidence (Nte, 2012). From the findings, we established that Kenya is among the many African countries with insufficient forensic investigations apparatuses.

The study established whether forensic laboratories are well equipped for use in analyzing data found at crime scenes. Among the respondents, 50% of them indicated that the DCI laboratories are adequately equipped, 33% of respondents stated that the laboratories are inadequately equipped, while 17% of respondents have not answered this question. A larger percentage (53%) of the respondents indicated that the DCI laboratories are equipped with forensic investigation tools to carry out forensic analysis effectively. Despite the findings showing that the DCI laboratories are adequately equipped, the

respondents were clear that they do not have adequate forensic field tools for effective collection of evidence in the crime scenes.

Having equipped forensic laboratories for conducting forensic analysis and lacking necessary equipment for the collection of evidence in crime scenes is counterproductive, and it negatively affects performance and application of forensic science in investigations. The investigators could be well trained, and that the ability to collect, storing and transporting forensic information, but they need laboratories for further analysis such as ballistic and DNA evaluation. Dror et al. (2012) found that the majority of developing countries lack adequate forensic investigation resources that have led to the dismissal of many court cases because of insufficient evidence. Equipping forensic laboratories is a question of serving justice to people because criminal cases have to be backed with sufficient evidence in courts of law. Forensic science has a profound impact on criminal investigations as Pollanen et al. (2012) postulate in their study. The scholars assert that criminal investigation depends on forensic science and the availability of forensic tools and resources for analysis of evidence.

Majority of the respondents are of the option that that DCI has a database for use in forensic analysis with, 16.7% of the respondents stating that DCI has a well up-to-date forensic database and 50% believe that the available database. It was further noted that DCI only have fingerprint and ballistic databases with no DNA database. It is of crucial concern as lack of DNA database limits the ability of the agency to conduct criminal investigations with samples such as hair, body fluids, or blood. Facial recognition database may also be

helpful to the DCI to not only investigate crime more effectively but also prevent crimes. People could be wary of having their facial data stored by the Government.

5.2.2 The level of training of investigators on forensic science and its effect on criminal investigations conducted by DCI

Forensic science training equips law enforcers and investigators with crucial investigation capabilities. The study found that 16.7% of the respondents acquire basic training before deployment, while 22% have intermediate training, and 64 % have advanced skill levels. The findings show that the majority (>80%) of the respondents have at least Diploma level of training in forensic science which indicates that the staff has the capability of conducting conclusive forensic investigations. Education background of investigators is essential in determining how they perform their work and training quality (VanderWesthuizen, 2016). Forensic investigators should have top-rate qualifications for them to be conversant and efficient in the investigation process. Adequate insight into specialized laboratory services, forensic processes and scientific disciplines is essential for all investigating personnel.

The outcomes of the study indicate that DCI personnel are qualified with the minimum level of training being the diploma. At least 62.5% of the respondents possess advanced training on forensics; this means that the DCI have qualified human resource to conduct forensic investigations. Competence of investigators is crucial as it determines the quality of the evidence collection in crime scenes, transportation of evidence to forensic laboratories for analysis and useful forensic analysis. Gardner (2015) argued that where criminal investigation officers possess adequate competencies in conducting forensic

investigations carried out their work with relative ease. The scholar further found that investigating crime scenes involves the recognition and collection of all tangible evidence that helps solve a case hence officers must be well trained. From the outcomes of the study, the DCI personnel can conduct recognize, collect and analyze the evidence from crime scenes with relative ease. However, they also need the essential tools and resources for collecting, storing, transporting and evaluating evidence from crime scenes. The collaboration of the investigators with data analysts and forensic scientists can augment the application of forensic tools in investigators by the DCI through increasing collective efforts to curb crime.

The refresher training of forensic investigators to sharpen their skills is crucial in improving the application of forensic science by the DCI. 87.5% of the respondents prefer frequent refresher training, while 12.5% are in favors of having regular refresher training. Generally, the investigators support having refresher training as it would help in sharpening their skills in forensic science, resulting in having more investigators that are competent. Several training programs exist which equip investigators with the requisite skills they need (Capsambelis, 2012).

The efficiency, accuracy, credibility and timeliness of forensic investigation rests in the hands of investigators at the crime scene, and those conducting analysis on the evidence collected forensically. With the least DCI investigators, possessing Diploma, it means that the forensic investigators have the right academic qualifications; further, the investigators have at least basic training on forensic science. Therefore, investigators working at the Forensic Department of DCI are qualified and competent in the field of

forensic sciences. It was also noted that there is need to have investigators undergo refresher training on forensic science, as this will sharpen their skills in conducting forensic investigations increasing the application of forensic sciences by DCI. Formal training equips detectives with specialized skills such as DNA profiling (Balding, 2015). Offering forensic science in Kenyan institutions of higher learning can change the course for forensic investigation at the DCI. In the past, the training programs for investigators included dismal science in a frail education plan and lacking in authoritative training personnel (Dror, 2015). Having specific courses in government colleges delving in forensic science can enhance criminal investigations substantially.

The research found that 47% of the respondents had 1 - 10 years of experience, 37.5% have 10-20 years of experience, while 15.5 per cent respondents have 20-30 years of experience. The upper limit for expertise in the work is thirty years. The investigators have substantial experience levels; thus; they can collect data effectively. The ability to collect evidence and forensic investigation competency is essential as accessing supportive information is vital, and it affects the performance of police investigators (Dandurand, 2014). The scholar asserted that experience in collecting evidence from crime scenes using forensic tools is crucial in delivering concrete supportive information regarding a crime. Extensive knowledge and training are essential to recovering and recognizing evidence. From the study findings, the DCI officers have substantial experience, and they undergo training, making them competent in collecting and understanding evidence from crime scenes.

A proportion of 63% respondents of the strongly agree that training programs will enhance their knowledge and application of forensic science, and 37 per cent respondents were only in agreement with the statement. It was deduced that all the respondents are in favor of benchmarking and exchange programs, which are helpful to forensic investigations. Further, 79.2% of the respondents strongly agree that on-job training in playing a pivotal role in improving the skills and knowledge of investigators and 20.8% agree with this statement. It was noted that all the respondents are willing to get on-job training that will enhance their skills and competencies.

5.2.3 How the laws and regulations governing the application of forensic science in Kenya affect criminal investigations conducted by DCI

Rules and laws guide how the DCI conducts forensic investigations. There are various laws applicable to the field, which includes the Criminal Procedure Code (CPC) Evidence Act, along with other acts that collectively guide investigators in their work. The study discovered that 68% of respondents perceive that existing regulations present sufficient guidelines to the forensic department. A proportion of 32% thought that the rules provide adequate instructions. The results of the study show that all the respondents agree that the existing law and regulations such as the Criminal Procedure Code (CPC), Evidence Act, provides necessary guidelines to forensic science. Thus, the DCI is positively affected by the existing laws and regulations while conducting the forensic investigation on criminal cases. Rules establish standards for procedures and administrations such as reliability, quality, consistency and proficiency among forensic scientists (National Research Council, 2009).

Forensic investigation has a substantial contribution to the justice system in a country. The availability of credible and reliable evidence on criminal cases is necessary for courts of law for conviction of offenders. The level of application of forensic science in the justice system plays a crucial role in the administration of justice to citizens. Forensic science can uncover crimes that could not be possible even without having eyewitnesses. Forensic evidence is treated as primary evidence in court. A proportion of 62.5% of the respondents specified that Kenya Criminal Justice System had not achieved full application of forensic science in conducting a criminal investigation. In comparison, 25% of the respondents are in agreement with the statement, and 12.5 % in disagreement. The responses reveal that the Criminal Justice System of Kenya is yet to attain full utilization of forensic science in steering criminal investigations to ensure citizens justice.

The respondents of the study gave their responses regarding the existence of elaborate standard operation procedure at the DCI. A proportion of 67% respondents thought that DCI lacks an elaborate Standard Operating Procedure (SOP) for guiding the process of forensic evidence gathering, maintenance, storage, evaluation and presentation; while a proportion of 26 % indicated that the SOP is somewhat elaborated, and 7% thought that SOP is inadequately elaborated. Thus, the majority of respondents are discontent with the Standard Operating Procedure (SOP) in place at DCI. Therefore, DCI should endeavor to develop well elaborate Standard Operating procedures to guide forensic investigations.

The state of forensic investigation in Kenya is low, as stated by Mbaya (2016) in his study on the state of forensic investigations in Kenya. The DCI has been unable to attain its full capacity due to inconsistencies in the subsystems. The scholar further deduces that

the investigation institution lacks a discrete examination procedure and principles. Thus, it has been not effectively applied to forensic science. The deductions of the scholar are consistent with the finding of this study that DCI lacks adequate Standard Operating Procedure. Further, Mbaya (2016) asserts that forensic examination has been shallow in Kenya due to the absence of standard methods for procedures, inadequate framework and inefficient approaches in conducting criminal investigations. There is a need to address the inadequacies in forensic examinations at the DCI through improving offices, specialist training, implicit regulations and clear strategies while also incorporating new advancements.

There are general rules that govern the forensic science field. There are various areas in the field, including ballistic and computer forensics. A study conducted by Irons and Ophoff (2016) focuses on computer forensics' aspects and digital forensics. The study had permitted compelling investigations of cybercrimes; a valid example is the meaning of 'digital overseers' by the Electronic Communications and Transactions (ECT) Act (2002). However, the examination suggested that a comprehensive and reliable methodology over the African landmass is required, creating enactment which applies broadly and globally. Studies in forensic science in Kenya and beyond help in setting regulatory precedents in conducting investigations at the Directorate of Criminal Investigation. The study establishes that regulations and laws affect the operations of forensic investigators. However, there is a need for the DCI to adopt Standard Operating Procedures that are more elaborate to guide in forensic investigations.

5.2.4 Influence of DCI manages the application of forensic science in conducting criminal investigations

Management support is essential for efficiency in organizations as it determines how leaders relate to their followers. Leadership influences the efficiency of junior workers (Rossy et al., 2015). Thus, DCI management has an impact on the uptake of forensic science within the institution. The support of the leadership of forensic investigations and science is crucial in producing positive outcomes at the DCI. The results of the study indicated that 12.5% of the respondents strongly agreed with the statement that management support leads to promote the application of forensic science in conducting criminal investigations, 70.8% respondents agreed, and 16.7% have differed. In total, more 80% of the respondents considered that management support is essential if the Government or institute wants to enhance the application of forensic science in conducting criminal investigations.

The welfare of investigating officers affects the application of forensic science in solving criminal cases. A proportion of 46% of the respondents concurred with the statement that the welfare of forensic investigators enhances the effectiveness of forensic investigators, 46% of respondents sharply differ. In comparison, 33% of the respondents agree with the statement. Thus, the majority of respondents perceive that the welfare of investigators is not a primary factor for the success of the criminal forensic investigation. However, it is paramount to focus on the welfare of the investigators as a secondary measure for enhancing their effectiveness.

Leaders have the obligation of guiding junior officers, as a majority of respondents indicated during the study. Twenty-one per cent of the respondents have strongly agreed with the statement that advice and guidance from the manager's result into an enhancement in performance of forensic investigators, and 54% respondents only agreed, while 25% strongly disagreed. Hence, 56% of the respondents thought continuous guidance from the higher authority leads to the improvement of forensic investigators. There is a positive relationship between management support and training for forensic investigators.

Technology is crucial in the field of forensic science; hence, leaders should promote the adoption of new approaches for conducting a criminal investigation. Rossy (2015) postulates the role of management in criminal investigations and the need for forensics scientists to use technology in their work. The basis of forensic science is the technological application. Technology changes rapidly and there is a need for regular training to keep up with new tools and current requirements in the field. Management ensures that investigators undergo the latest training to impact field personnel positively. For instance, the leadership accords the staff study leaves or ensure that at times that they attain government sponsorship for undertaking training.

Financial support is another crucial element that has a profound influence on the success of forensic investigations. Generally, all investigations require resources, while criminal forensic investigations require more tools and expertise. The management of the DCI should liaise with the necessary government bodies to push for adequate funding of their operations. Training, technological tools, laboratory equipment is among the resources that are necessary for conducting criminal forensic investigations. Salfati, et al.

(2015) highlight finances is part of management's support and that the success of forensic science requires adequate financial support. Investigation officers need various resources in their work for effects such as forensic tools, frequent training, management guidance, investigators' welfare and financial support. Forensic science is a broad field that is changing very rapidly, and there is a need to keep up with the new knowledge coming up every day.

5.3 Summary of Discussion

5.3.1 The availability of forensic tools used when conducting criminal investigations at Directorate of Criminal Investigations

The application of forensic science in criminal investigations is a multifaceted endeavor. The availability of forensic tools for conducting criminal investigations at Directorate of Criminal Investigations is a crucial aspect one has to consider when studying the utilization of forensic science. The study found out that investigators do not have adequate forensic tools for use in the collection of evidence in the field. Thus, it negatively affects the quality of forensic investigations undertaken by DCI. Therefore, there is a need to promote the extensive application of forensic tools in the collection of forensic evidence in the crime scene.

5.3.2 The level of training of investigators on forensic science and its effect on criminal investigations conducted by DCI

The level of training of investigators on forensic science affects criminal investigations conducted by DCI. A well-trained staff is competent to use forensic tools in collection, preservation, transportation and analyzing evidence from crime scenes. It is not

feasible to deploy forensic specialists to conduct fieldwork, and it is crucial to equip all the investigators with the requisite skills and equipment for the forensic collection of evidence. The study found that the DCI personnel have minimum education qualification as Diploma. Thus, the investigators have the capability of attaining forensic science skills to use in their work, and regular training is necessary.

5.3.3 How the laws and regulations governing the application of forensic science in Kenya affects criminal investigations conducted by DCI

Laws and regulations governing the application of forensic science in Kenya affect how DCI conducts criminal investigations. The institution does not operate in a void, and it interacts with other bodies within the criminal justice system and other government agencies. Provision of credible and adequate evidence enables courts of law to conduct their mandate more effectively and ensure every one-access justice. Various Acts govern the work of the Directorate of Criminal Investigation body.

5.3.4 Influence on how the DCI manages the application of forensic science in conducting criminal investigations

Various factors influence how the DCI manages the application of forensic science in conducting criminal investigations. Leadership is one aspect, which has a profound impact on how operations are run in an organization. The results of the study indicated that the investigators prefer receiving guidance from the management. Leaders should also ensure that the organization receive adequate funding for its operations, such as frequent training and the acquisition of forensic tools.

5.4 Conclusions

The Directorate of Criminal Investigations can enhance efficiency by utilizing forensic science more adequately. DCI have adequately equip forensic laboratories with up-to-date forensic database useful in analysis of forensic evidence and coming up forensic expert's opinion. However, DCI do not have adequate forensic tools for collection of forensic evidence in crime scene this negatively affects the application of forensic sciences in investigations. Fondebrider, (2016) insisted that ANT allows empirical analysis to describe social events for subsequent introduction of abstract theoretical concepts. Therefore, this study conformed to the Actor Network Theory (ANT) as it allowed studying interaction between availability of forensic tools and equipment's on the application of forensic science in investigations.

All the respondents have an excellent academic background with the least level being diploma and a majority having postgraduate qualifications, indicating they can learn to use forensic tools with ease after receiving the requisite training resulting in improve application of forensic science in investigations at the DCI. The findings of this study is in agreement with Human Capital Theory, which emphasizes investing in training of personnel working on an organization leading to an increase in productivity.

From the findings, it is also evident that laws and regulations govern the application of forensic science in Kenya affects how the DCI conducts its activities in various ways. The guidelines, contributes to streamlining the field of forensic science. Therefore, the DCI should develop standard operating procedures that conforms to the laws

and regulations in the application of forensic science and of more importance is to ensure that evidence s collected and analyzed are admissible in court.

5.5 Recommendations

The study found that investigators do not have adequate forensic tools for use in the collection of evidence in the field. Thus, it negatively affected investigations undertaken by DCI. Therefore, there is a need to promote the extensive application of forensic tools in the collection of forensic evidence in the crime scene. The government being the main financier of the DCI, the government should increase its budget allocation to the DCI to enable them to afford the necessary resources for forensic investigations effectively.

The study found that the DCI personnel have minimum education qualification as Diploma. Thus, the investigators have the capability of attaining forensic science skills to use in their work, and regular training is necessary. To further empower the staff, the role of leadership should be emphasized within the DCI to equip the staff with the necessary guidance. The staff working at the DCI should receive regular training to keep up with the changes occurring within the forensic science field. The leadership of DCI should participate in benchmarking activities in countries that have efficient investigative institutions.

The study found that existing regulations present sufficient guidelines to the forensic department. Existing laws and regulations such as the Criminal Procedure Code (CPC), and Evidence Act, provides necessary guidelines to forensic science. Thus, the DCI is positively affected by the existing laws and regulations while conducting the forensic

investigation on criminal cases. There is a need for the policymakers to address the inadequacies in forensic examinations at the DCI through improving offices, specialist training, implicit regulations and clear strategies while also incorporating new advancements.

5.6. Subjects for Future Research

- i. Given that the current study focused on factors affecting the application of forensic science in criminal investigations at DCI Headquarters Nairobi, a wider study involving other DCI Regional and County offices is hereby recommended. This will facilitate a broader comparison and generalization of the study findings.
- ii. Another study should be conducted to investigate the influence of existing laws on forensic investigations by the directorate of criminal investigations.

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APPENDICES

Appendix 1: Introduction Letter

Dear respondent,

RE: FACTORS AFFECTING USE FORENSIC SCIENCE IN CRIMINAL INVESTIGATIONS CONDUCTED BY DIRECTORATE OF CRIMINALS INVESTIGATIONS

Dear respondent,

My name is Kirui Vincent Kipngetich, a student at Africa Nazarene University, Kenya, pursuing a Master's of Science in Governance, Peace, and Security. As a requirement for partial fulfilment of the course, I am required to conduct thesis research. This requirement has prompted me to contact you as one of the respondents in the study.

By this letter, I am asking you to accept my request to be one of the respondents in this study by participating in the filling of this questionnaire. Be assured that the information you will provide will be treated with confidentiality and will only be used for this study.

Thanks.

Appendix 2: Approval Letter from Africa Nazarene



11th June 2020

RE: TO WHOM IT MAY CONCERN

Kirui Vincent Kipngetch (16J03DMGP037) is a bonafide student at Africa Nazarene University. He has finished his course work and has defended his thesis proposal entitled: - *"Factors Affecting the Use of Forensic Science in Criminal Investigations at The Directorate Criminal Investigations, Kenya"*.

Any assistance accorded to him to facilitate data collection and finish his thesis is highly welcomed.

A handwritten signature in black ink, appearing to read 'Rodney Reed'.

Rodney Reed, PhD.

DVC Academic & Student Affairs

Appendix 4: Request letter to DCI

Kirui Vincent Kipngetich,
16J03DMGP037
Africa Nazarene University,
Nairobi.
0733813338
Vincent.kirui@kra.go.ke or keyruiv@gmail.com
30th June 2020

The Director,
Directorate of Criminal Investigations (DCI),
DCI Headquarters,
Nairobi.

Dear Sir,

RE: REQUEST TO CONDUCT RESEARCH AT DCI HEADQUARTERS

I am a student at Africa Nazarene University, Nairobi Campus, pursuing Masters of Science in Governance, Peace and Security. Currently I am an investigator working for Kenya Revenue Authority (KRA), Intelligence and Strategic Operations Department (I&SO). Previously I was working at the Directorate of Criminal Investigations (DCI), Forensic Department, Photographic and Imaging Section where I developed interest in Forensic investigations.

As a requirement for partial fulfilment of the course I am required to conduct research. My proposed research thesis title is "*Factors Affecting the Use of Forensic Science in Criminal Investigations at the Directorate of Criminal Investigations, Nairobi, Kenya*".

The purpose of this letter is to kindly request for your permission to conduct the research at DCI Headquarters, Forensics Department. The research findings will be shared with your office at the end of my research.

Attached are copies of; Africa Nazarene University introductory letter, National Commission for Science, Technology, and Innovation (NACOSTI) research permit and my KRA staff identification card.

Looking forward for your positive consideration.

Yours faithfully.

Kirui Vincent Kipngetich
16J03DMGP037

Appendix 5: Questionnaire

For officers from ballistics unit, crime scene support services unit, forensic document examinations unit, computer forensic unit, forensic biology unit, forensic chemistry unit, criminal registry office (finger prints), and bomb disposal unit.

Section A: Details of the Respondents

1. Gender

Male

Female

2. Indicate your highest level of education.

None Primary

Secondary Level Tertiary / Middle Level College

University Degree Masters/PhD

3. Indicate your level of understanding/knowledge on forensic science

Expert Intermediate

Basics Do not have understating / knowledge

4. Indicate years of experience in conducting criminal investigations.

1 - 5 years

5 – 10 years

More than 10 years

5. Indicate the number of years you have worked at DCI

0-5 years

6-10 years

More than 10 years

Section B: Availability of Forensic Tools on the application of forensic science in Criminal Investigations Conducted by DCI

1. How are investigators equipped with forensic field tools to be used in collections, preservation and transportation of forensic evidence to forensic laboratories for analysis?

Not equipped Inadequately equipped

Adequately equipped Well equipped

2. How are DCI laboratories equipped with forensic analysis tools, equipment or reagents for use in conducting forensic analysis?

Not equipped Inadequately equipped

Adequately equipped Well equipped

3. Does DCI have an up-to-date forensic database (E.g. DNA, Fingerprints, Ballistics databases) to help in the analysis and interpretation of forensic evidence?

Not equipped Inadequately equipped

Adequately equipped Well equipped

4. What do you suggest should be done to encourage investigators to utilize forensic tools and other forensic resources when conducting investigations?.....

.....
.....

5. In what other ways do you think the availability of forensic tools and resources affects the application of forensic science in criminal investigations conducted by DCI?

.....

6. What do you suggest can be done to ensure that investigators use forensic science when conducting investigations in relation to forensic tools and resources?

.....
.....
.....

6. In your opinion, what challenges do you face during forensic investigation in relation to the training of the personnel

.....
.....
.....

7. Are there mechanism put in place to address investigators knowledge gaps, if yes explain how it is being addressed and the kind of training. Kindly explain

.....
.....
.....

8. In your opinion, other than training, how can the DCI enhance the skills of the investigators to ensure they use forensic science to conduct investigations?

.....
.....
.....

Section D: Existing Laws, Policies on the application of forensic science in Criminal Investigations Conducted by DCI

1. Do Laws such as Evidence Act, Criminal Procedure Code (CPC) and other Acts provide guidelines on the application of forensic science in investigations?

Do not provide any guidelines Provide inadequate guidelines
 Provide fairly adequate guidelines Provide adequate guidelines

2. Do you agree that Kenya Criminal Justice System has not achieved full application of forensic science in conducting criminal investigations?

Strongly disagree Disagree
 Agree Strongly agree

3. Does DCI have an elaborate Standard Operating Procedure (SOP) that guides the process of forensic evidence collection, preservation, storage, analysis and presentation in court?

No SOP SOP is not adequately elaborate
 SOP is fairly elaborate SOP is well elaborate

4. How effective are the existing laws in addressing forensic investigations? Kindly explain

.....

5. What are the gaps in the existing laws and policies that impede the application of forensic science in investigations? Kindly explain

.....

6. Management support through availing of required resources has improved the application of forensic science in conducting criminal investigations.

Strongly disagree [] Disagree []

Agree [] Strongly agree []

7. Support from the management by improving the welfare of forensic investigators has played a key role in the improvement of the performance of forensic investigators.

Strongly disagree [] Disagree []

Agree [] Strongly agree []

8. Continuous guidance and advice from management improve the performance of forensic investigators.

Strongly disagree [] Disagree []

Agree [] Strongly agree []

9. What other factors do you think affects the application of forensic science in criminal investigations conducted by the DCI?

.....
.....
.....

Thank You for Your Cooperation

Appendix 6: Key Informant Interview Guide**For Heads of units and a persecutor from the Office of Directorate of Public Prosecution**

- (i) Does Directorate of Criminal Investigations have adequate forensic tools to effectively conduct criminal investigations?
- (ii) Does the level of training of investigators on forensics science affect criminal investigations conducted by Directorate of Criminal Investigations?
- (iii) What laws and regulations govern forensic investigations and how do these laws and regulations affect the application of forensic science in criminal investigations conducted by DCI?
- (iv) How does management support influence the application of forensic science in criminal investigations conducted by DCI?
- (v) What other factors do you think affects the application of forensic science in criminal investigations conducted by the DCI?

Appendix 7: Map of DCI Headquarters

