INFORMATION TECHNOLOGY AUDIT AND FRAUD PREVENTION AMONG COMMERCIAL BANKS IN KENYA

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DECLARATION

This research project is my original work and has not been presented for an award in any other University.

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DEDICATION

I dedicate this project to my entire family and my supervisor for their hard work and encouragement through the entire project.

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LIST OF ABBREVIATIONS

ACL-	Audit Command Language
ATMs-	Automated Teller Machines
BFIU-	Banking Fraud Investigation Unit
CAATs-	Computer Aided Audit Techniques
CBK-	Central Bank of Kenya
CPA-	Certified Public Accountant
DMZ-	Demilitarized Zone
EFTs-	Electronic Funds Transfers
FTP-	File Transfer Protocol
GECS-	Global Economic Crime Survey
ICPAK-	Institute of Certified Public Accountants of Kenya
ICT-	Information, Communication and Technology
IDEA-	Interactive Data Extraction and Analysis
IDS-	Intrusion Detection System
IP-	Internet Protocol
IPS-	Intrusion Prevention System
IS-	Information Systems
ISA-	International Standards on Auditing
ISACA-	Information Systems Audit and Control Association
ISGA-	Information Standards and Guidelines on Auditing
ISO-	International Standards Organization
IT-	Information Technology
ITGI-	Information Technology Governance Institute
INTOSAI-	International Organization of Supreme Audit Institutions
KBA-	Kenya Bankers Association

Kes-	Kenya Shillings
KRA-	Kenya Revenue Authority
KRAAC-	Kenya Revenue Authority Anti-fraud and Corruption Policy
POS-	Point of Sale
RBI-	Reserve Bank of India
RMG-	Risk Management Guidelines
SMTP-	Simple Mail Transfer Protocol
STAR-	Statistical Techniques for Analytical Review
TAM-	Technology Acceptance Model
VoIP-	Voice over Internet Protocol
VPN-	Virtual Private Network

ABSTRACT

The study focused on commercial banks in Kenya, as they are dependent on technology in carrying out their banking operations. The reliance on technology has resulted to numerous challenges such as multiplicity and complexity of systems, insider security threats, as well as more exposure to fraud risks. Thus, the need for this study arose, and it aimed to find ways of curbing the various types of IT-related risks and challenges. The study sought to determine the extent of IT related fraud in Kenyan commercial banks, to establish the challenges faced during IT auditing by the IS auditor, to establish the countermeasures implemented in preventing fraud through IT auditing and to determine the relationship between IT auditing and fraud prevention. The study made use of the descriptive survey design. Questionnaires were used to gather data from IS auditors of various commercial banks in Kenya. Statistical methods such as mean, standard deviation, factor analysis and regression analysis were utilized to analyze the data collected from the respondents. From the findings, it was evident that banks had encountered IT-related fraud. As a result, IS auditors utilize different IT audit approaches and mitigation strategies in the detection and prevention of fraud and most of the respondents concurred, to a great extent, that there is a relationship between IT audit and fraud prevention. It was however noted that most IS auditors did not possess the right tools to perform effective IT audits. This largely inhibited the effectiveness of detecting fraud early. In this regard, it is imperative that banks put in place mitigation strategies to help reduce the prevalent fraud risk. Banks should also ensure that IS auditors are well equipped with tools to effectively perform their duties. Further, IS auditors should perform appropriate risk assessments when planning for IT-audits on areas that may be affected by frauds.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

In the last decade, environmental factors such as high competition and technological development, have led to the diversification of banking operations from the traditional brick and mortar branches to branchless banking (Perspective Magazine, 2009). There is now a greater dependency on technology in carrying out banking operations. Banks are encouraging their customers to embrace newer service delivery platforms like the use of Automated Teller Machines (ATMs), electronic funds transfers (EFTs), mobile banking, internet banking and agency banking (RBI, 2011). These channels have enabled the faster moving of funds in the economy, resulting to enhanced efficiency and cost-savings.

The technological-dependency has however resulted in innumerable challenges and risks. For instance, different types of controls are now required for different computer systems, there is more multiplicity and complexity of systems, there is more dependency on vendors due to outsourced IT services, there is an increase in threats from computer-related fraud and there is need for governance processes to adequately manage technology and information security (RBI, 2011). Consequently, banks are now more vulnerable to computer-related fraud since fraudsters are using the computers as tools through which fraud is perpetrated.

As defined by the KRA Anti-fraud and Corruption Policy (2006), computer fraud occurs where IT equipment is used to manipulate programs or data dishonestly. Manipulation occurs where the programs or data are altered, substituted or destroyed. It also occurs where the use of an IT system becomes a substantial factor in the perpetration of the fraud and theft of fraudulent use of computer time and resources, including unauthorized personal browsing on the internet (KRAAC Policy, 2006).

From a global fraud study carried out in 2010, it was established that banking and financial services industry had the most cases of fraud as compared to other industries (www.acfe.org). The amount of money stolen from commercial banks in Kenya in the year 2012 according to BFIU, was Kes 1.12B, out of which Kes 393M was recovered. A BFIU report on trends of fraud cases in the Kenyan banking industry, covering the period April to June 2013, indicated that electronic crimes continue to be widespread compared to other types of frauds. Because of these worrying trends, CBK revised the RMG and gave a recommendation that banks should ensure that an effective internal audit of IT risks is carried out. The RMG require the IS auditor to identify IT risks by determining all kinds of threats and exposures present in the ICT system configuration. The auditor is also expected to review all IT components such as networks, hardware, software, applications, systems interfaces, operations and human elements.

1.1.1 Information Technology Audit

Information technology (IT) audit involves the collection and evaluation of audit evidence by the Information Systems (IS) auditor, to determine whether a computer system is designed to preserve data integrity and safeguard organization's assets by allowing effective achievement of organizational goals and efficient use of organization's resources (INTOSAI 2008). The IS auditor examines and evaluates an organization's information systems, internal controls and procedures so as to ensure that the records are accurate and information controls are in place (www.ISACA.org). She is responsible for assessing the risk of irregularities or illegal acts occurring by evaluating the impact of identified deviations (ISGA No. 9). The auditor performs an audit review by gathering evidence, which is used in the evaluation of how well an audit criteria has been met. An IT audit must be objective, impartial and independent and the audit process must be both systematic and documented (ISO 19011:2011).

When carrying out an IT audit, the IS auditor is expected to design appropriate procedures to detect illegal acts or irregularities based on the assessed level of risk that they could occur. She is required to have certain skills to enable her carry out an effective assessment, which include an understanding of general computer controls, data analytics,

basic knowledge of the system infrastructure and risk assessment acumen (www.theiia.org).

The next step for the IS auditor is to execute the designed procedures and identify the risks. She is then expected to put in countermeasures to seal loopholes in order to prevent fraud. Countermeasures can be defined as actions taken in response to an event or occurrence in order to negate the preliminary action, and are most often a defensive response (www.businessdictionary.com).

While carrying out her duties, the IS auditor may experience some challenges that may hinder the effectiveness of the audit. These challenges include inadequate time allocation for an audit, failure to understand the business processes and systems properly and inadequate aptitude and skills to perform IT audit work (Chakrabarty, 2013). She should therefore come up with measures to deal with such challenges such as continuous learning to enhance her skills and competencies, proper planning prior to the commencement of an audit and continuous review of the plan during the audit (RBI, 2011). In view of the foregoing, the IS auditor must always keep herself abreast with new advancements in technology as well as possess the essential IT audit skills, for her to be effective in her work.

1.1.2 Detection and Prevention of Fraud

Brink and Witt (1982), as cited by Oyinlola (2010), notes that fraud is an ever-present threat that hampers effective utilization of an organization's resources. Early detection and prevention of fraud is therefore becoming an increasingly important subject to auditors, management, the public and regulators (Albrecht and Albrecht, 2002).

In this regard, ISGA No. 9 stipulates that, management and those charged with governance have the primary responsibility of preventing and detecting fraud. The standard however emphasizes that IT auditors should exercise professional skepticism while performing their work. Although, this is not their primary responsibility, IT

auditors are required to identify any fraud risks that may result in material misstatement of the organization's reports.

According to Albrecht and Albrecht (2002), the identification of fraud risks requires the IT auditor to follow an 8-step strategic method, which consists having an understanding of the process/ business; identification of possible frauds that could exist; identification of possible fraud symptoms; use of technology to gather data on the identified symptoms; analysis and refinement of results; investigation of the symptoms; follow up and iteration of the cycle; and finally the automation of detection procedures. Mukinda (2011) further denotes that understanding and knowing past frauds is a springboard to combating new ones, since current frauds are simply old recurring fraud schemes, sometimes with a twist.

Welch et al (1986), as quoted by Muslimat and Hamid (2012), asserts that there is a significant relationship between auditing and fraud detection and prevention. The study indicated that organizations that had an internal audit function presence were more effective in detecting fraud when compared with those without the audit function. It was also revealed that, the procedures and tools used must be effective and efficient for the auditor to detect fraud. Further, a fraud survey conducted by KPMG in 2003 shows that 65% of the frauds were detected by the internal audit while 12% were discovered by external audit. Coram et al (2006) concurred that there was a positive relationship between an organization having an internal audit and the number of frauds uncovered by the audit function.

1.1.3 Commercial Banks in Kenya

Commercial banks in Kenya represent a vibrant link in the flow of funds and the facilitation of trade and investments. Banks act as financial intermediaries by mobilizing deposits from the public and investing the funds through lending and other types of investments. They play an important role in the safeguarding and helping grow

customers' resources, while extending credit facilities for customers' economic benefit (www.kba.co.ke).

In pursuant to the Banking Act (Cap.488), Kenyan banks are licensed and regulated by the Central Bank of Kenya (CBK). CBK regulates banks by enforcing compliance with the Prudential and Risk Management Guidelines. These guidelines ensure that there is transparency in the banking industry and that identified risks are mitigated. (www.centralbank.go.ke). Currently there are 43 commercial banks in Kenya (www.kba.co.ke).

In the recent years, there has been an increase in technological innovation in Kenyan commercial banks. Significant milestones have been achieved in the industry for example the Cheque Truncation System, the Real Time Gross Settlement Scheme, the Automation of the Clearing House, the sharing of data through Credit Reference Bureaus, and the sharing of Automated Teller Machine (ATM) networks between banks (www.kba.co.ke).

To support the aforementioned innovations, banks must have a robust ICT system configuration. Typically, a bank's IT network infrastructure comprises of firewalls, routers, switches, phone systems, servers, remote access connections, computers and printers (Launius, 2009). The network infrastructure enables the bank to transact and communicate with its branch networks, customers, central bank, other local and international banks, outsourced vendors and telecommunication companies. Using the network, commercial banks are able to perform online transactions with their customers, such as cash withdrawals, cash deposits, remittance of funds, the use of plastic cards through Point of Sale (POS) and customer account updates. Banks are also able to transfer data files to other banks or to transmit statements and advices to their customers (RBI, 2011).

Although the network infrastructure has led to an increase in the speed of transacting and greater efficiencies, these technological innovations have increased the levels of vulnerabilities within the banks and augmented the avenues for exploitation (Mulwa,

2012). Against this backdrop, it is now imperative for the banking industry to be armed with tools to protect its resources and avert the risk of being victims to fraud.

1.2 Statement of the Problem

The banking industry is heavily reliant on technology to carry out its operations. This has resulted in diverse delivery channels that have increased the options offered to customers to carry out their transactions with ease, speed and convenience (RBI, 2011). These developments have however led to various challenges such as dependence on vendors due to outsourced IT services, multiplicity and complexity of systems, insider security threats, as well as more exposure to fraud risks (RBI, 2011).

In December 2010 alone, it was reported that Kenyan commercial banks lost Kes 500 Million through fraud (Mukinda, 2011). Further, Pricewaterhouse Coopers conducted a global economic survey in November 2011 on fraud in the Kenyan market. The report indicated that 34% of the respondents had experienced a computer network related fraud in 2011, a 13% increase since the last survey conducted in 2009 (GECS, 2011). The analysis of the survey indicated that, in Kenya, there was a 9% increase in levels of computer related fraud in 2011 as compared to 2009.

To thwart electronic frauds that are on the increase (BFIU, 2013), there has been a high implementation rate of IT auditing in the Kenyan banking industry because banks are required to comply with the CBK Risk Management Guidelines of January 2013. Other reasons leading to the surge of IT auditing include, automation of most of the banking processes (KBA, 2013); the heightened threat from hacking and information theft (Solms, 2005); and the need to manage fraud, IT systems failures and disruptions (RMG, 2013).

In this context, the IS auditor is faced with different tasks of providing audit assurance on IT systems as well as adding value through early detection and prevention of frauds. The audit tools available combined with deductive reasoning can enable the IS auditor to be more proactive in detecting fraud. The IS auditor should, therefore, prudently assess

fraud risk because of the high costs that are associated with either too little or too much investigation (Albrecht and Albrecht, 2002). There is little economic value where too much investigation is done and no fraud is present, while failure to judiciously investigate where fraud is present results in significantly astronomical costs (Palmrose 1987; Nieschwietz et al, 2000).

There has, however, been much controversy on what is expected from IT auditors in the prevention and detection of fraud. Gay et al (1997) points out that the assertion that the auditor has the responsibility in the prevention and detection of fraud, is a controversial topic and this has been a subject that is most often debated by auditors, regulators and the public. Further, there seem to be discord between the audit profession and the management, on the responsibility of the IS auditor in detecting and preventing fraud. The audit profession guidelines stipulate that the management has the primary responsibility to prevent and detect irregularities and illegal acts (ISGA No. 9; ISA 240). Other studies however, reveal that there is a wide performance-expectation gap since auditors feel that the detection of fraud is management's responsibility, whilst the management disagrees (Alleyne and Howard, 2005; Lee et al, 2009). Literature reviews on the study have further cast reservations on what is expected from auditors and there are varied opinions amongst auditors on the expectation-performance gap (Sherer and Turley, 2007).

Therefore, this study sought to fill in the disparities in the studies, apprehensions and approaches relating to role of the IS auditor in the early detection and prevention of fraud by addressing the following research questions: What is the extent of IT related fraud in commercial banks in Kenya? What challenges are faced in an IT audit? What are the countermeasures implemented by the IS auditor in curbing fraud? Is there a relationship between IT auditing and the fraud prevention?

1.3 Objectives of the Study

The objectives of the study are to:

1. Determine the extent of IT related fraud in Kenyan commercial banks.
2. Establish the challenges faced during IT auditing by the IS auditor in Kenyan commercial banks.
3. Establish the countermeasures implemented in preventing fraud through IT auditing in Kenyan commercial banks.
4. Determine the relationship between IT auditing and fraud prevention in Kenyan commercial banks.

1.4 Value of the Study

Although IT auditing is a relatively new concept in Kenya, its implementation rate is high in Kenyan commercial banks due to different factors, as mentioned under Section 1.2. In researching on the concept, literature on IT audit effectiveness and the detection and prevention of fraud was reviewed in order to answer the four research questions.

The researcher's objective was to establish whether there is a relationship between IT audit and detection and prevention of fraud. The study adopted the technology-oriented model of carrying out audits that is dependent on the fraud risk assessments results. Both qualitative and quantitative data collection and analysis methods were used to establish the relationship.

The outcome of the study is expected to provide comprehensive findings for IT audit professionals that shall further their tactical knowledge, as they carry out their duties. It shall also be useful to users, such as the government, CBK, ICPAK and ISACA, who develop control frameworks, as well as Kenyan commercial banks, who are complying with the CBK Risk Management Guidelines. The study shall also add to the body of knowledge for scholars.

CHAPTER TWO

LITERATURE REVIEW

2.1 The Extent of IT Related Fraud

The banking industry is heavily dependent on technology to carry out its operations, and as such, banking business and technology cannot be discussed in isolation (RBI, 2011). Diverse delivery channels have immensely increased the options offered to customers to carry out their transactions with ease, speed and convenience. These developments have led to various challenges such as dependence on vendors due to outsourced IT services, multiplicity and complexity of systems, insider security threats, as well as more exposure to fraud risks (RBI, 2011).

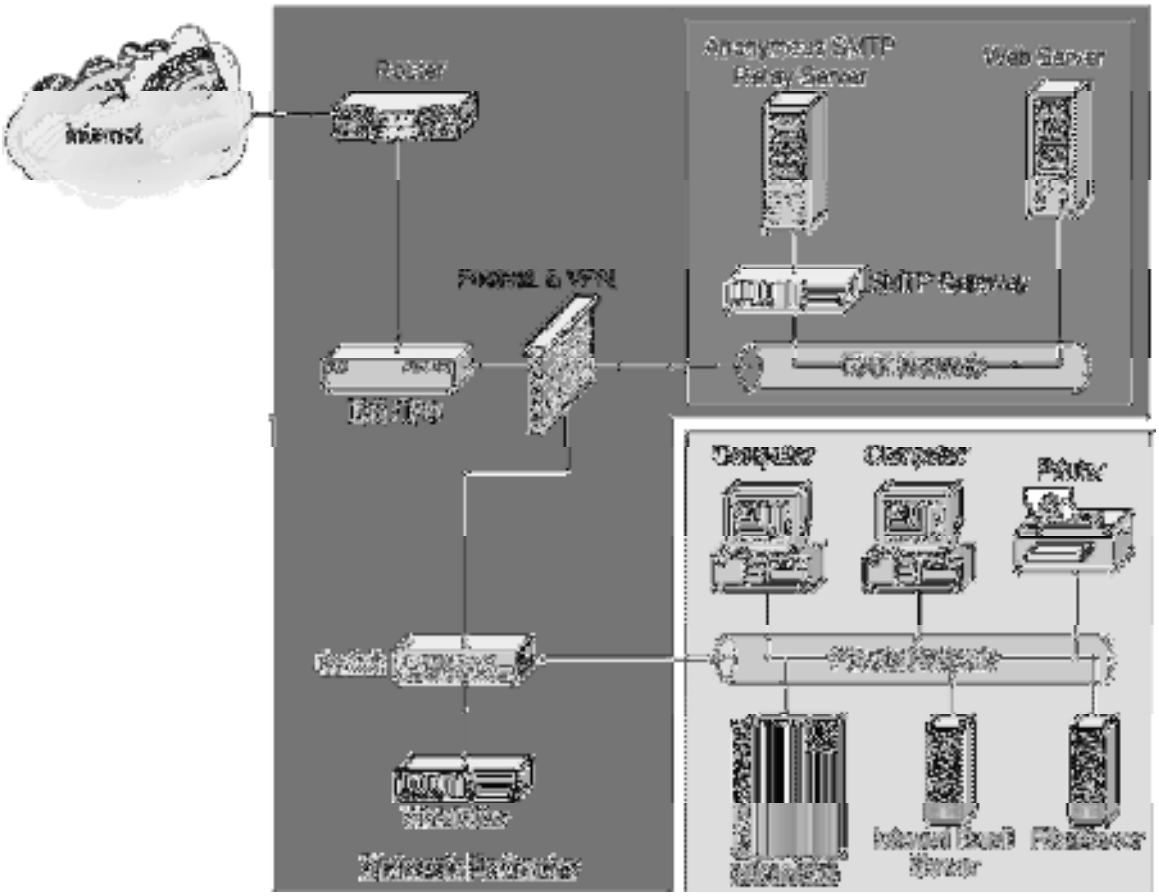
With these IT growth and development, fraud techniques have also evolved over time, and fraudsters are now targeting computer networks to perpetrate fraud. In a bank, frauds can either be perpetrated by an insider, an external party or both parties can collude to defraud the bank. Baker et al. (2008), as quoted by Mulwa (2012) indicates that insider threats are a big threat since they have access to information and assets and can easily pounce on vulnerabilities. Schultz (2002), as cited by Mulwa (2012), further asserts that external threats receive a lot of attention due to their frequency, magnitude or complexity and they include physical security breaches, hacking attempts, system sabotage amongst others. Richards (2008), as mentioned by Launius (2009), notes that unauthorized access to the network can be through war-driving, where criminals drive around with laptops looking for vulnerable wireless access points. War-dialing is also another threat, where hackers get unauthorized access into private networks through a modem, asserts Gunn (2006), as cited by Launius (2009).

Other ways to commit fraud include sniffing, which allows the criminal to see plain text login credentials and confidential information transferred over networks; malware program which hackers can use to obtain credentials that can facilitate access to confidential information. Wilson (2005), as quoted by Launius (2009) annotates that

phishing attacks lure victims to a website masquerading as the legitimate web page. This form of attack affects the internet-banking channel of service delivery. A malware programme known as root kit is usually accompanied by keyloggers to capture sensitive information such as log-in credentials.

Typically, the ICT system configuration in a bank comprises of internal and external networks, hardware, software, applications, system interfaces, operations and human elements, RMG (2013). The internal network infrastructure components include, firewalls, routers, switches, phone systems, servers, remote access connections, computers and printers (Launius, 2009), refer to Figure 2.1. RBI (2009) points out that the security of the network depends on having a secure configuration being defined for applications, servers and platforms.

Figure 2.1: A Bank's Network Infrastructure



Source: Launius (2009)

Aeran (2006) has further reviewed the different types of security threats that an organization may have to face, and this includes; theft of intellectual property and an organization's confidential information, for instance extracting a list of high networth customers and selling them to competitors for commercial gain; password cracking and getting users passwords through illegal installations like keyloggers in order to carry out transactions through identity theft. RBI 2011, points out that criminals commit frauds such as phishing, database and server hacking, network attacks, cross site scripting, card cloning, obtaining confidential information through social engineering and insider threats, that may result in financial and reputational loss.

To show the extent of fraud in the Kenyan market, Pricewaterhouse Coopers conducted a global economic survey in November 2011. The report indicated that 34% of the respondents had experienced a computer network related fraud in 2011, a 13% increase since the last survey conducted in 2009 (GECS, 2011). The analysis of the survey indicated that, in Kenya, there was a 9% increase in levels of computer related fraud in 2011 as compared to 2009.

From another survey conducted by a consulting firm, Deloitte, in May 2011, the report indicated that banking fraud had tripled in 2010 to a massive Kes 3 Billion when compared to 2009. BFIU report for the 2nd quarter of 2013, have also shown that electronics crimes continue to be rampant compared to other frauds, with numerous cases on forgery of application from for RTGS, internet banking and easy 24/7, being reported.

To curb the different types of IT-related fraud, the Banking Act (Cap.488), through CBK, has mandated Kenyan commercial banks to ensure that customers' information is kept confidential from intruders. The CBK Risk Management Guideline No. 7 requires commercial banks to ensure that they protect their ICT system configuration from attacks by identifying possible breaches to the network infrastructure through IT risks analysis. The guideline further denotes that security threats such as malware infestation and internal sabotage could cause severe disruptions to banking operations with huge losses

being incurred and therefore vigilant monitoring of security risks is crucial in containing IT related risks through IT auditing.

2.2 Information Technology Auditing

The IT Governance Institute (ITGI) defines IT governance as "the leadership and organizational structures and processes that ensure that the organization's information technology sustains and extends the organization's strategies and objectives". IT audit is a subset of the IT governance framework that involves collecting and evaluating audit evidence and it helps determine whether a computer system is designed to preserve data integrity and safeguard the assets of the organization by allowing effective achievement of organizational goals and the efficient use of the organization's resources (INTOSAI, 2008). The IT audit process requires the IS auditor to work together with management in identifying controls weaknesses and risks that arise due to the use of technology in running business operations.

Across the globe, the adoption of IT auditing by organizations has been accelerated by regulations and compliance requirements such as Basel II and Sarbanes-Oxley Act (Nicho, 2008). These frameworks were developed to act as points of reference to organizations in managing risks after the financial scandals that led to the collapse of high profile corporations such as Enron and Worldcom (Coram et al., 2006). In Kenya, commercial banks are required to carry out an effective audit of IT risks, by the CBK Risk Management Guidelines of January 2013. This has been necessitated by factors such as the automation of most of the banking processes (KBA, 2013) and the need to thwart electronic frauds that are on the increase (BFIU, 2013).

There are different types of IT audits that can be performed depending on the audit criteria (ISACA, 2013). These includes audits of systems and applications, information processing facilities, system development, management of IT and enterprise architecture, and client/server, telecommunications, intranets, and extranets. A systems and applications audit seeks to establish whether systems and applications are efficient and

that they are adequately controlled to ensure the output from the system is reliable and timely. An information processing facilities audit, verifies the processing facility to ensure that there is efficient processing of inputs that shall generate accurate and reliable output. A systems development audit ensures that the developed system is in accordance with requirements in order to meet organization's goals. Management of IT and enterprise architecture audit involves checking whether the IT management has developed an organizational structure and procedures to ensure a controlled and efficient environment for information processing. A client/server, telecommunications, intranets, and extranets audit seeks to verify that there are adequate controls on the IT network infrastructure (ISACA, 2013).

In order to perform this audits, the IS auditor is required to adopt a systematic process of planning, studying and understanding controls, testing and evaluating controls, reporting and follow up (ISO 19011:2011). This process assists the auditor in improving and implementing quality systems, in the face of different types of IT audits, by applying a risk-based audit approach, use of computer-aided audit tools and techniques, and application of standards like ISO 90003 and ISO 17799 in order to draw valid conclusions (Gallegos et al, 1998).

2.3 Challenges Faced and Measures Implemented in Fraud Prevention

In 2008, ITGI carried out a global survey to determine the challenges faced by those charged with IT governance. The key findings of the survey indicated that communication flow between IT staff and users is still slow, but improving; the alignment between IT governance and business strategy needed to be improved; IT-related problems still persisted in organizations and while IT security was an issue, people were the most critical problem; and IT expertise appreciation and delivery capability was average (ISC Journal, 2008).

Chakrabarty (2013), points out that audit of systems has not been effective in early the detection of fraud due to various factors. These include, inadequate time allocated for an audit, poor sampling methods used in checking of transactions, and lack of trained personnel with the required skill and aptitude to perform IT audit work, poor planning of audit work, not understanding the business processes and systems properly. The June 2008 CPA Journal cited that some of the reasons why auditors fail to identify red flags during an audit were lack of experience; lack of awareness or recognition of an observable condition indicating fraud; failure to brainstorm potential fraud schemes and scenarios; overreliance on client representations and lack of effort to detect fraud (www.nysscpa.org).

To counter these challenges, RBI (2011) pointed out that fraud detection and prevention is a specialized function and as such, IT auditors must undergo continuous training to enhance their skills and competencies. The auditors should also properly plan the audit, and the audit plan should be reviewed in the course of the audit to check if it is still addressing the intended audit objective. Further, the IS auditor must possess essential skills, which include an understanding of general computer controls, data analytics, knowledge of the system infrastructure and an excellent risk acumen (www.theiia.org). General computer controls involve understanding the internal controls around IT systems and applications and the review of controls that mitigate the risk of threats to the systems. Data analytics skill requires the IS auditor to inspect, clean, transform and model data and highlight useful information and suggest recommendations. The knowledge about networks, hardware, operating systems, databases and applications is essential for the IS auditor, so that she can be able to assess the risks and ensure that they addressed appropriately.

Detective measures can be reactive or proactive. Albrecht and Albrecht (2002) denote that “most of the traditional fraud detection methods are reactive since they are initiated by tips or complaints, control overrides or other indicators that someone observes or hears”. Instead of using reactive measures such as relying on whistleblowers and anonymous calls, the IS auditor should be more proactive by taking on a hands-on

approach to fraud detection (Coderre, 2009). The proactive approach requires the IS auditor to aggressively target specific types of frauds and look for indicators, symptoms or red flags (Albrecht and Albrecht, 2002).

In his research, Launius (2009) reiterates that, "understanding the threats present to a private network is important to properly design the perimeter protection for banks". ISO 27001 and ISO 27002:2005 explicitly require risk assessments to be carried out by examining the security policy, organization of information security, physical and environmental security, access controls amongst others.

The IS auditor, can use various statistical methods and tools in detecting fraud which includes Deloitte's Statistical Techniques for Analytical Review (STAR) tool, which helps in the identification of abnormal patterns such as significant fluctuations on data (Deloitte's, 2013); ACL for data analysis used for testing relevant transactions across all applicable business systems and applications (Coderre, 2009). From an assessment carried out in 2011, RBI recommended that the IS auditor should consider fraud vulnerability assessments while identifying fraud risk factors as part of IT risk assessment and audit process. Further, CBK RMG (2013) recommends the use of vulnerability scanners, penetration testing tools and operational and management controls when testing and evaluating the effectiveness of IT controls. Banks are therefore expected to implement tools and techniques that shall help support the procedure that the IS auditors will be performing to increase efficiency and effectiveness of the IT audit.

The RBI report further pointed out that IS auditors must enhance the use of Computer Aided Audit Techniques (CAATs), which may be used effectively in areas such as detection of revenue leakage, the assessment of control weakness and the monitoring of customer transactions for any abnormal patterns RBI (2011). Practices that need to be followed to enable early detection and prevention of fraud include review of new products and processes; creation of fraud awareness amongst staff and customers; enforcing know your employee/vendor procedures; ensuring there is adequate physical security on IT assets; ensuring that there are strict password account management

practices; and ensuring there is proper segregation of duties and dual control is implemented. Other mechanisms that the IS auditor can implement to detect fraud include establishing a confidential way of reporting suspected fraud such as having a dedicated email id and phone number for whistleblowing; mystery shopping and reviews; monitoring of transactions for any irregular patterns; implement a software that shall generate alerts where fraud is suspected (RBI, 2011).

To find vulnerabilities in a network, the IS auditor can use tools such Nmap, a free tool used for network surveying and scanning by probing an IP address or a range of IP addresses and gathering useful information such as the operating system used, the type of devise or the service being provided (Launius, 2009). Network reconnaissance and port scanning reveals the potential holes in the network infrastructure, such as ports that are accessible, that can be used by criminals to launch an attack. Launius, (2009) has listed other security tools that can be used by the IS auditor which include: Kismet, another free wireless scanning tool, which can detect any wireless network, whether the network broadcast is hidden or not; Aircrack-ng, which can break certain encryption algorithms that are meant to protect data travelling on a wireless network. Wireshark and Tcpdump are free tools that are used for sniffing any plain text information transferred over networks from programs like FTP. Nessus is used for vulnerability scanning that identifies security problems in remote computers. Lemos (2009) notes that "a tool named Warvox can be used to speed up war-dialing by using VoIP Lines."

The IS auditor needs to also regularly review the IT strategy, policies and procedures covering areas such as the network architecture, procurement of hardware and software, processes of out-sourcing, in-sourcing and in-house development of solutions (RBI, 2011). Two models have been discussed below to supplement literature reviews on measures the IS auditor needs embrace in order to be effective in early fraud detection and prevention.

2.3.1 Strategic Fraud Detection Model

To guide the IS auditor to early detection of fraud, Albrecht and Albrecht (2002) came up with the Strategic Fraud Detection Model, which is an 8-step process that an IS auditor should follow. The model combines both deductive reasoning and technology to provide a more effective way to detecting fraud.

The first step denotes that each business environment is different and there is no generic fraud detection procedure that can apply to all businesses. The IS auditor is therefore required to gain an understanding of the business by familiarizing herself with the policies and procedures, interviewing key personnel and performing data analysis. The second step requires the IS auditor to identify possible frauds that could exist in that business environment. This is achieved through risk assessment through data analysis, interviews with personnel and brainstorming sessions with other auditors.

The IS auditor is expected to carry out careful analysis in the third step, by considering if there are symptoms in the identified fraud cases. Once the symptoms are defined, supporting data is extracted in the fourth step. Queries run on data should be on the whole population and not on a sampling basis. The fifth step calls for analysis and refining the results. Once anomalies are highlighted and identified as fraud indicators the IS auditor can then investigate them further. The seventh step requires the auditor to follow up on all the identified symptoms and improve or implement new controls to increase efficiency and effectiveness of processes. The last step requires the IS auditor to automate the detection procedures. Once refined, these can be integrated to the business processes in order to prevent anomalies before they occur.

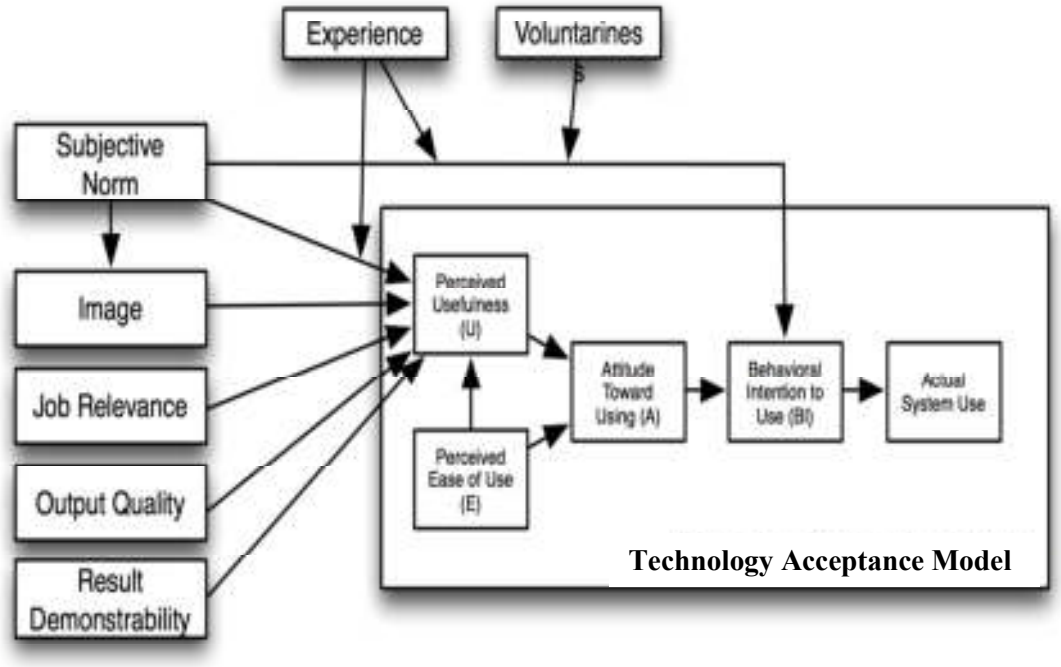
2.3.2 Technology Acceptance Model (TAM) 2

Although the concept of IT auditing is new in the Kenyan market, the implementation rate has been high due to various factors such as the automation of business processes and the increase in electronic crimes (KBA, 2013). These factors, amongst others, have compelled the auditor to use technological tools and techniques in the review of security risks. Some of the challenges that IS auditors face in the detection and prevention on fraud as mentioned in Section 2.3 include lack of trained personnel with the required skill and aptitude to perform IT audit work and lack of effort to detect fraud (Chakrabarty, 2013).

TAM 2, developed by Venkatesh and Davis in 2000, is a good theoretical tool that seeks to establish the effectiveness of IT auditing through application of technology tools and techniques. This model, as depicted in Figure 2.2, has two processes, the social influence process, which includes subjective norm, voluntariness and image; and the cognitive instrumental processes, which includes job relevance, output quality, result demonstrability and perceived usefulness (upload.wikipedia.org).

This study focused on the cognitive instrumental process. Huang et al. (2011) elaborates the factors under cognitive instrumental process as follows: job relevance has been defined as “an individual’s perception regarding the degree to which the target system is applicable to her job”, that assisted in establishing the effect of IT auditing on the IS auditor; output quality has been defined as “the degree to which an individual judges the effect of a new system”; result demonstrability has been defined as “tangibility of the results of using the innovation”; and perceived usefulness implies that users will have a good perception of the system which shall lead to more effectiveness.

Figure 2.2: Technology Acceptance Model 2



Source: upload.wikipedia.org

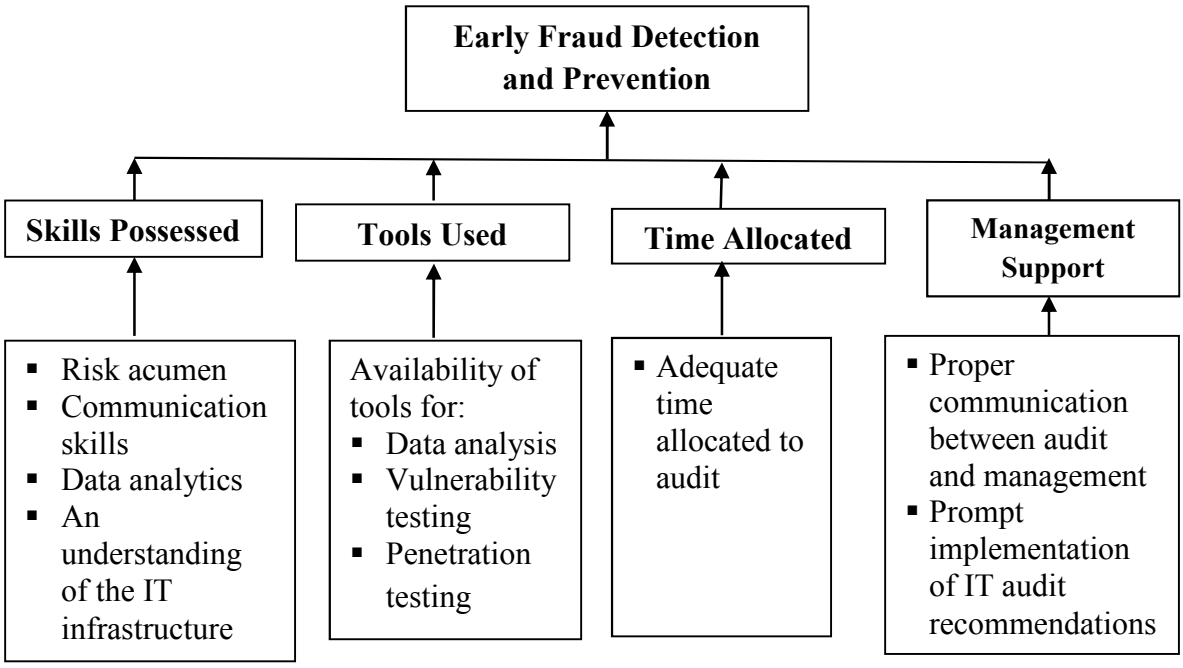
2.4 Relationship between IT Auditing and Fraud Prevention

Welch et al (1986), as cited by Muslimat and Hamid (2012), noted that there is a significant relationship between auditing and fraud detection and prevention. The study indicated that organizations that had an internal audit function presence were more effective in detecting fraud when compared with those without the audit function. It was also revealed that, the procedures and tools used must be effective and efficient for the auditor to detect fraud.

From a study on the importance of the internal audit in fraud detection, Coram et al. (2006) concluded that there is "a significant positive relation between an organization having an internal audit function and the number and value of self-reported frauds." Luehlfing et al. (2003), Marden and Edwards (2005) and Belloli (2006), as quoted by Coram et al. (2006), agree that, "internal audit is a vital tool in fraud detection when assets are misappropriated by employees or outsiders" and the ability to detect fraud is therefore more augmented for organizations that have an internal audit department than those without.

Using the proposed conceptual model in Figure 2.3, the study sought to confirm whether there is a direct relationship between IT auditing and detection and prevention of fraud, and whether the use of technological tools and techniques in performing tests from a fraud risk perspective, is an effective way that leads to early detection of fraud.

Figure 2.3: Proposed Conceptual Model



Source: Researcher (2013)

From the proposed conceptual model, the independent variables are skills that the IS auditor must possess, the tools used in data analysis and vulnerability testing, time allocated for IT audit assignments and management support in the implementation of IT audit recommendations. The dependent variable is early fraud detection and prevention.

The IS auditor must possess skills that enable her to adequately review the IT network infrastructure, properly gain an understanding of the business processes, which eventually assist in determining the fraud risks present. She should then prepare a log of the identified fraud risks, categorized the risks after taking into consideration the Bank's risk appetite and come up with a risk matrix. During the risk analysis exercise, the IS auditor must brainstorm with the team members as well as work closely with the management in order to ensure that all fraud risks are identified and addressed. The auditor should then choose an appropriate tool to use, for instance, she can use ACL for data analysis or Nmap for network vulnerability testing.

As mentioned earlier, the IS auditor faces various challenges in her work such as inadequate time being allocated for an audit, poor sampling methods being used, overreliance on client representations amongst others (CPA Journal, 2008). It is therefore imperative, for the auditor to ensure all these challenges are addressed in a timely fashion to facilitate an effective audit. Once completed, a report on findings must be prepared with the necessary recommendation. Where control gaps are identified, the IS auditor must implement countermeasures to seal the loopholes which ultimately lead to the early detection and prevention of fraud.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter sets out various stages and phases that were followed in the collection, measurement and analysis of data. The following subsections are included; research design, population of the study, data collection and data analysis.

3.2 Research Design

This study made use of a descriptive survey design. This design was used since it is more flexible and it enabled the researcher to collect both qualitative and quantitative data.

3.3 Population of the Study

The study was conducted on all the 43 commercial banks in Kenya and the questionnaires were distributed to selected representatives. A census approach was used and all the representatives of the entire population (the respondents) were targeted. Refer to Appendix I.

3.4 Data Collection

The data was collected with structured questionnaires. IS auditors were requested to fill in the questionnaires which contained both closed and open-ended questions to extract accurate information from the respondents.

The questionnaire had five sections, Section A which covered the respondent's background, Section B which covered the types of computer-related frauds, Section C

which covered the challenges the IS auditor faced in managing fraud, Section D which covered the detection and prevention strategies employed by the IS auditor in commercial banks in Kenya and Section E which covered the relationships of auditing and detection and prevention of fraud.

A "drop-and-pick latter" approach was employed to collect data from IS auditors in various banks. This enabled the researcher in assisting the respondents in case of any issues in filling the questionnaires and ensuring maximum or high response rates.

The questionnaires underwent a test run to ensure effective data capture and reliability before the official roll out.

3.5 Data Analysis

On receiving the questionnaires from the respondents, the data was checked to ensure completeness and consistency. The data was then coded and tabulated to facilitate data analysis and subjected to various analyses.

Descriptive statistic such as mean scores, standard deviation and percentages were used to analyze the data collected for Section A, B, C and D. Factor analysis was further done to rank the various factors for each research objective in order of suitability. Regression analysis was used on the data collected in Section E, to establish if there was a relationship between IT audit and prevention and detection of fraud.

CHAPTER FOUR

DATA ANALYSIS, FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter discusses the analysis of data and the findings thereof. Apoyo (2011) defines data analysis as the process of reducing large amount of collected data, to data that addresses the initial proposition of the study. The research findings relate to the research objectives that guided the study. The data from the completed questionnaires was analyzed and a summary of the key findings presented. Statistical methods which included mean, standard deviation and factor analysis were used.

The chapter is divided into five sections: Section One highlights the demographic information of the population, Section Two reports on the various types of IT related frauds facing commercial banks in Kenya, Section Three covers the challenges faced in IT auditing, Section Four which highlights the detection and prevention measures in IT auditing against fraud and Section Five covers the IT auditing and fraud prevention relationship.

4.1.1 Response Rate

From the study, 36 out of 43 sample respondents filled in and returned the questionnaires making a response rate 83.72%. This reasonable response rate was made a reality after the researcher made personal calls and visits to remind the respondents to fill in and return the questionnaires. According to Mugenda and Mugenda (1999) a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent; therefore, this response rate was excellent for analysis and reporting.

4.2 Demographic Information

An analysis of demographic data was done and from the questionnaires respondents gave their personal details like Gender, Age, position and duration of their services. Data which related to the organization such as number of branches, ownership structure, period of operation and size of the organization. These demographic information was essential in providing a background of both the respondents and the banks under study.

4.2.1 Gender of the Respondents

Data on gender was collected from 36 respondents, the data was analyzed and the outcome was as presented on Table 4.1.

Table 4.1: Gender

Gender	Frequency	Percent
Male	35	97.2
Female	1	2.8
Total	**36**	**100.0**

Source: Researcher (2013)

According to the findings, 97.2% of the respondents were male while 2.8% of the respondents were female. Generally, this information may be useful in drawing conclusions about the gender distribution in the IT auditing field.

4.2.2 Age Bracket

Data related to the age of the respondents was collected and tabulated as presented on Table 4.2.

Table 4.2: Age Bracket

Age Bracket	Frequency	Percent
Between 25 and 30	2	5.6
Between 31 and 35	8	22.2
Between 36 and 40	16	44.4
Between 41 and 45	8	22.2
46 and above	2	5.6
Total	**36**	**100.0**

Source: Researcher (2013)

The findings indicate that most of the IT auditing professionals were aged between 36 and 40 years, having had a representation of 44.4%. 22.2% of the respondents were aged between 31 and 35 years and between 41 and 45 years, respectively, while 5.6% of the respondents were aged between 25 and 30 years and 46 and above years, respectively.

4.2.3 Position/Designation in the Bank

Data on respondent's designation was collected and analyzed as presented in Table 4.3.

Table 4.3: Position/Designation in the Bank

Position/ Designation	Frequency	Percent
IS Audit Manager	25	69.4
IS Audit Officer	1	2.8
IT Manager	8	22.2
IT Project Manager	2	5.6
Total	**36**	**100.0**

Source: Researcher (2013)

From the findings, 69.4% of the respondents were IS audit managers whose main responsibility is ensuring that IT-related risks are addressed in a timely manner in order to avert IT fraud. 22.2% of the respondents were IT managers, 5.6% of the respondents were IT project managers while 2.8% of the respondents were IS audit officers. There were respondents who did not have audit-related designation, that is, their designations were IT managers and IT Project Managers. These respondents as depicted in Table 4.5 had however completed certification courses in security and auditing, to enable them perform the IT-auditing role.

4.2.4 Academic Qualification

Data on respondent's academic qualification was collected and analyzed as presented in Table 4.4.

Table 4.4: Academic Qualification

Academic Qualification	Frequency	Percent
Master Degree	4	11.1
Undergraduate Degree	32	88.9
Total	**36**	**100.0**

Source: Researcher (2013)

According to the findings, 88.9% of the respondents had an undergraduate degree while 11.1% of the respondents had a master degree.

4.2.5 Professional Qualification

Data on respondent's professional qualification was collected and analyzed as presented in Table 4.5.

Table 4.5: Professional Qualification

Professional Qualification	Frequency	Percent
Certified Information Systems Audit	18	50.0
Certified Fraud Examiner	2	5.6
Certified Public Accountant	9	25.0
Certified Information Security Manager	4	11.1
Microsoft Certified Systems Engineer	1	2.8
Cisco Certified Network Administrator	2	5.6
Total	**36**	**100.0**

Source: Researcher (2013)

The findings established that 50% of the professionals had a qualification in Certified Information Systems Audit, 25% of the respondents had a Certified Public Accountant qualification, 11.1% of the respondents had a Certified Information Security Manager

qualification, 5.6% of the respondents had a Certified Fraud Examiner and Cisco Certified Network Administrator qualification respectively, while 2.8% of the respondents had a Microsoft Certified Systems Engineer qualification. Certification in information security, auditing and accounting is key in ensuring that the IS auditor possesses the necessary skills in order to perform the IT audit role effectively.

4.2.6 Period of Working in the Bank

Table 4.6: Period of Working in the Bank

Period worked	Frequency	Percent
Below 5 years	22	61.1
Between 5 and 10 years	4	11.1
Between 10 and 15 years	2	5.6
Between 16 and 20 years	6	16.7
Over 20 years	2	5.6
Total	**36**	**100.0**

Source: Researcher (2013)

Table 4.6 shows that majority of the respondents (61.1%) had worked in the bank below 5 years. This is an indicator that in the last five years most banks have embraced the IT audit profession. 16.7% of the respondents indicated that they had worked in the bank for between 16 and 20 years, 11.1% of the respondents indicated that they had worked in the bank for between 5 and 10 years while 5.6% of the respondents indicated that they had worked in the bank for between 10 and 15 years and over 20 years, respectively.

4.2.7 Period the Bank has Been in Operation

Data relating to the period of operation was collected and the analysis presented in Table 4.7.

Table 4.7: Period the Bank has Been in Operation

Bank's period in operation	Frequency	Percent
10 years and below	4	11.1
Between 21 and 30 years	15	41.7
Between 31 and 40 years	1	2.8
Over 40 years	16	44.4
Total	**36**	**100.0**

Source: Researcher (2013)

The analyzed data show that 44.4% of the respondents indicated that the bank had been in operation for over 40 years, 41.7% of the respondents indicated that the bank had been in operation for between 21 and 30 years, 11.1% of the respondents indicated that the bank had been in operation for 10 years and below while 2.8% of the respondents indicated that the bank had been in operation for between 31 and 40 years.

4.2.8 Current Shareholding Structure of the Bank

Data on bank's ownership was collected and presented in Table 4.8.

Table 4.8: Current Shareholding Structure of the Bank

Shareholding Structure	Frequency	Percent
Locally owned institution	7	19.4
Government controlled majority shares institution	2	5.6
Foreign owned but locally incorporated	8	22.2
Foreign owned NOT locally incorporated	1	2.8
Owned by both local and foreigners	18	50.0
Total	**36**	**100.0**

Source: Researcher (2013)

According to the findings, 50% of the respondents indicated that the bank was owned by both local and foreigners, 22.2% of the respondents indicated that the bank was foreign but locally incorporated, 19.4% of the respondents indicated that the bank was a local owned institution, 5.6% of the respondents indicated that the Government controlled majority shares institution while 2.8% of the respondents indicated that the bank was foreign owned but not locally incorporated.

4.2.9 Size of the Bank in Terms of Total Assets Value in Kenya Shillings

Respondents gave response on the size of their bank as analyzed and presented on Table 4.9.

Table 4.9: Size of the Bank in Terms of Total Assets Value in Kenya Shillings

Total Assets Value (Kes)	Frequency	Percent
10 billion and below	3	8.3
Between 11 and 20 billion	3	8.3
Between 21 and 30 billion	11	30.6
Between 31 and 40 billion	2	5.6
Above 50 billion	17	47.2
Total	**36**	**100.0**

Source: Researcher (2013)

From the findings, 47.2% of the respondents indicated that the total asset value was above 50 billion, 30.6% of the respondents indicated that the total asset value was between 21 and 30 billion, 8.3% of the respondents indicated that the total asset value was between 11 and 20 billion and 10 billion and below, respectively while 5.6% of the respondents indicated that the total asset value was between 31 and 40 billion. This is an indication that banks are compliant with the regulations on capital requirements and that the shareholders have invested and expect high returns.

4.2.10 Number of Branches Owned by the Bank in Kenya

Data on the number of branches owned by the Bank was analyzed and presented on Table 4.10.

Table 4.10: Number of Branches Owned by the Bank in Kenya

Branches Owned	Frequency	Percent
20 and below	19	52.8
Between 21 and 40	5	13.9
Between 41 and 60	7	19.4
Between 61 and 80	2	5.6
Above 80	3	8.3
Total	**36**	**100.0**

Source: Researcher (2013)

From the findings, 52.8% of the respondents indicated that the bank owned 20 and below branches, 19.4% of the respondents indicated that the bank owned between 41 and 60 branches, 13.9% of the respondents indicated that the bank owned between 21 and 40 branches, 8.3% of the respondents indicated that the bank owned above 80 branches while 5.6% of the respondents indicated that the bank owned between 61 and 80 branches.

4.2.11 Reporting by the IS Audit Team

From the findings on Table 4.11, 80.6% of the respondents indicated that IS audit team reported to the Board Audit Committee while 19.4% of the respondents indicated that IS audit team reported to the Head of Internal Audit.

Table 4.11: Reporting by the IS Audit Team

Reporting by the IS Audit Team	Frequency	Percent
Board Audit Committee	29	80.6
Head of Internal Audit	7	19.4
Total	**36**	**100.0**

Source: Researcher (2013)

4.3 Extent of IT-Related Frauds

4.3.1 Introduction

The first objective of the study sought to find out the extent to which banks had encountered the following IT-related fraud. The data collected was analyzed and presented on Table 4.12. Responses were measured using a five point Likert scale as follows; 1 represented no extent at all, 2 represented little extent, 3 represented moderate extent, 4 represented great extent and 5 represented very great extent. To consolidate and give presentation of the data, the study used the statistical functions of mean and standard deviation. The mean represents the average rating of all the respondents to the IT-related fraud while the corresponding standard deviation shows the range within which the individual ratings are from the mean.

Table 4.12: Extent of IT-Related Frauds

No.	IT-Related Frauds	Mean Score	Standard Deviation
1	Unauthorized network access	2.75	0.77
2	Hacking (accessing a computer network by circumventing its security system)	1.92	1.27
3	Malware programs	2.30	1.19
4	Sniffing (being able to seeing plain text login credentials and confidential information)	1.67	0.86
5	Cross site scripting (bypassing access controls by use of scripts)	2.17	0.65
6	Hardware-based key loggers (they capture keystrokes)	1.53	0.69
7	Destruction of critical data	1.83	0.73
8	Password cracking	1.47	0.77
9	Tampering with data (unauthorized changes of data or records)	2.86	0.96
10	Theft (stealing information)	3.33	0.76
11	Installation of unauthorized software	2.75	1.34
12	Sabotage	2.31	1.60
13	Intellectual property theft	2.97	1.06
14	Software-based key loggers (they capture keystrokes)	2.19	1.17
15	Password cracking	2.11	1.17
16	Identity theft	3.00	1.33
17	Data interception and manipulation	3.33	1.29
18	Phone call/ Short Messaging System (SMS) interception	2.78	1.33
19	Data interception during file uploads	3.58	1.34
20	Spoofing (pretending to be something or someone that one is not)	3.97	1.08
21	Phishing (acquiring information and/or money from people without their knowledge)	4.06	1.04
22	Insider threats (e.g. selling employer's confidential information to the competitors)	3.75	1.03

Source: Researcher (2013)

Analysis of the research data collected indicates that commercial banks in Kenya have encountered various IT related frauds. As seen in Table 4.12, acquiring information and/or money from people without their knowledge through phishing was the biggest IT-related fraud with a mean score 4.06. Other IT-related frauds encountered to a great extent were spoofing (mean score 3.97), insider threats (mean score 3.75), data interception during file uploads (mean score 3.58), theft of information (mean score 3.33), data interception and manipulation (mean score 3.33) and identity theft (mean score 3.00).

4.3.2 Factor Analysis (Communalities)

4.3.2.1 Introduction

Responses collected were further subjected to factor analysis. Factor analysis reduces data into key information by seeking unobservable (latent) variables that are reflected in the observed variables (manifest variables). Communality is the proportion of variance that each item has in common with other items. The proportion of variance that is unique to each item is then the respective item's total variance minus the communality. The extraction method was the principle component analysis. Communalities are shown in the Table 4.13.

Table 4.13: Factor Analysis (Communalities)

	Communalities		
	Types of IT-Related Frauds		
Factor		Initial	Extraction
F1	Unauthorized network access	1.000	.872
F2	Hacking (accessing a computer network by circumventing its security system)	1.000	.914
F3	Malware programs	1.000	.937
F4	Sniffing (being able to seeing plain text login credentials and confidential information)	1.000	.939

F5	Cross site scripting (bypassing access controls by use of scripts)	1.000	.790
F6	Hardware-based key loggers (they capture keystrokes)	1.000	.829
F7	Destruction of critical data	1.000	.974
F8	Password cracking	1.000	.903
F9	Tampering with data (unauthorized changes of data or records)	1.000	.854
F10	Theft (stealing information)	1.000	.878
F11	Installation of unauthorized software	1.000	.927
F12	Sabotage	1.000	.975
F13	Intellectual property theft	1.000	.765
F14	Software-based key loggers (they capture keystrokes)	1.000	.745
F15	Password cracking	1.000	.835
F16	Identity theft	1.000	.889
F17	Data interception and manipulation	1.000	.808
F18	Phone call/ Short Messaging System (SMS) interception	1.000	.838
F19	Data interception during file uploads	1.000	.846
F20	Spoofing (pretending to be something or someone that one is not)	1.000	.913
F21	Phishing (acquiring information and/or money from people without their knowledge)	1.000	.884
F22	Insider threats (e.g. selling employer's confidential information to the competitors)	1.000	.781

Source: Researcher (2013)

4.3.2.2 Factor Extraction (Total Variance)

In the case of the Types of IT-Related Frauds, principle analysis component was used to extract 22 factors. Eigen values indicate the relative importance of each factor accounting for a particular set and hence those with small Eigen values were omitted. As depicted on Table 4.14, only 4 factors were significant for the analysis.

Table 4.14: Factor Extraction (Total Variance)

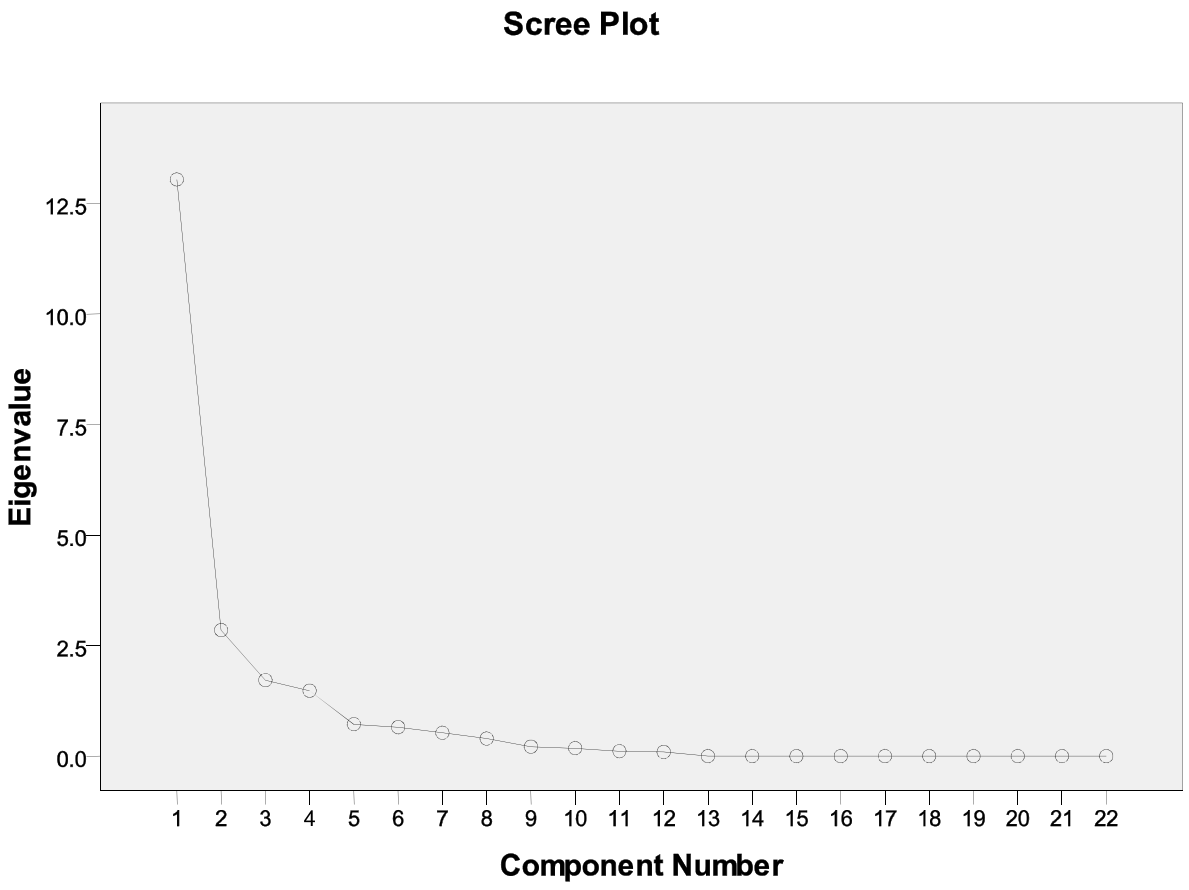
Total Variance Explained									
Types of IT-Related Frauds									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.046	59.299	59.299	13.046	59.299	59.299	6.301	28.640	28.640
2	2.852	12.962	72.261	2.852	12.962	72.261	6.108	27.765	56.405
3	1.719	7.815	80.076	1.719	7.815	80.076	4.359	19.813	76.218
4	1.480	6.729	86.804	1.480	6.729	86.804	2.329	10.586	86.804
5	.722	3.284	90.088						
6	.655	2.979	93.067						
7	.528	2.400	95.467						
8	.398	1.809	97.276						
9	.213	.969	98.245						
10	.180	.818	99.063						
11	.111	.504	99.567						
12	.095	.433	100.000						
13	8.436E-16	3.835E-15	100.000						
14	7.447E-16	3.385E-15	100.000						
15	3.020E-16	1.373E-15	100.000						
16	1.683E-16	7.648E-16	100.000						
17	6.857E-17	3.117E-16	100.000						
18	6.406E-18	2.912E-17	100.000						
19	-1.621E-16	-7.367E-16	100.000						
20	-2.520E-16	-1.145E-15	100.000						
21	-6.210E-16	-2.823E-15	100.000						
22	-8.166E-16	-3.712E-15	100.000						

Source: Researcher (2013)

4.3.2.3 Scree Plot

The scree plot is a plot of the factor Eigen value against the component numbers. According to the scree plot on Figure 4.1, we only considered 4 factors because the curves tend to flatten from the fourth component onwards, due to relatively low Eigen values.

Figure 4.1: Scree plot on Types of IT-Related Frauds



Source: Researcher (2013)

4.3.2.4 Component Matrix

Component matrix contains the relative Eigen values in respect of each factor. Each factor belongs to one of the set of factors extracted and is determined by the Eigen values of the factors relative to each set. Table 4.15 shows which set each factor falls into.

Table 4.15: Component Matrix

Types of IT-Related Frauds	Component				
	1	2	3	4	5
Unauthorized network access	.803	-.098	.213	-.414	
Hacking (accessing a computer network by circumventing its security system)	.789	-.513	.034	.168	
Malware programs	.723	-.186	-.340	-.514	
Sniffing (being able to seeing plain text login credentials and confidential information)	.913	-.251	-.207	.017	
Cross site scripting (bypassing access controls by use of scripts)	.748	.222	.159	-.395	
Hardware-based key loggers (they capture keystrokes)	.669	-.503	.240	.265	
Destruction of critical data	.364	-.177	.899	.037	
Password cracking	.677	-.256	-.304	.535	
Tampering with data (unauthorized changes of data or records)	.766	.450	-.248	-.060	
Theft (stealing information)	.829	-.077	.380	.202	
Installation of unauthorized software	.819	-.337	-.371	-.070	
Sabotage	.903	-.309	-.249	-.050	
Intellectual property theft	.770	.324	.256	-.040	
Software-based key loggers (they capture keystrokes)	.727	-.287	.132	-.343	
Password cracking	.789	-.397	-.014	.234	
Identity theft	.917	.161	.074	-.127	
Data interception and manipulation	.842	.302	.033	-.079	
Phone call/ Short Messaging System (SMS) interception	.899	-.105	-.118	.075	
Data interception during file uploads	.668	.623	-.086	-.070	
Spoofing (pretending to be something or someone that one is not)	.791	.491	.089	.195	
Phishing (acquiring information and/or money from people without their knowledge)	.769	.498	.001	.212	
Insider threats (e.g. selling employer's confidential information to the competitors)	.547	.560	-.084	.401	

Source: Researcher (2013)

Table 4.15 presents the factor analysis on the first objective of determining the extent of IT related fraud in Kenyan commercial banks using the extraction method: principal component analysis with 4 components extracted. Each component represents the correlation between item and the unrotated factor (e.g. in the case of types of IT- related Frauds, the correlation between Malware programs and factor 1 is 0.723). These correlations help formulate an interpretation of the factors of components. This is done by looking for a common thread among the variables that have large loadings for a particular factor or components. The table shows that majority of the factors had high loadings.

From the results in Table 4.16, the variables that measured IT audit and fraud prevention in commercial banks in Kenya in one way or the other are highly correlated with this factor.

Table 4.16: Rotated Component Matrix

Types of IT-Related Frauds	Component			
	1	2	3	4
Unauthorized network access			.744	
Hacking (accessing a computer network by circumventing its security system)		.846		
Malware programs			.855	
Sniffing (being able to seeing plain text login credentials and confidential information)		.756		
Cross site scripting (bypassing access controls by use of scripts)			.660	
Hardware-based key loggers (they capture keystrokes)		.762		
Destruction of critical data				.975
Password cracking		.889		
Tampering with data (unauthorized changes of data or records)	.794			
Theft (stealing information)				.575
Installation of unauthorized software		.752		
Sabotage		.763		
Intellectual property theft	.689			
Software-based key loggers (they capture keystrokes)			.680	
Password cracking		.821	.250	.237
Identity theft	.635			
Data interception and manipulation	.712			
Phone call/ Short Messaging System (SMS) interception		.665		
Data interception during file uploads	.864			
Spoofing (pretending to be something or someone that one is not)	.888			
Phishing (acquiring information and/or money from people without their knowledge)	.886			
Insider threats (e.g. selling employer's confidential information to the competitors)	.847			

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Source: Researcher (2013)

4.3.2.5 Factor Isolation

Factor analysis involves isolating each of the variable factors and grouping them by the four extracted factors based on their factor loading on each set. Table 4.17 shows the summary of the factor isolation.

Table 4.17: Factor Isolation

Factor Group	Types of IT-Related Frauds
Factor 1	**Data Theft and Manipulation** ▪ Tampering with data (unauthorized changes of data or records) ▪ Intellectual property theft ▪ Identity theft ▪ Data interception and manipulation ▪ Data interception during file uploads ▪ Spoofing (pretending to be something or someone that one is not) ▪ Phishing (acquiring information and/or money from people without their knowledge) ▪ Insider threats (e.g. selling employer's confidential information to the competitors)
Factor 2	**IT Systems Insecurity** ▪ Hacking (accessing a computer network by circumventing its security system) ▪ Sniffing (being able to seeing plain text login credentials and confidential information) ▪ Hardware-based key loggers (they capture keystrokes) ▪ Password cracking ▪ Installation of unauthorized software ▪ Sabotage ▪ Password cracking ▪ Phone call/ Short Messaging System (SMS) interception
Factor 3	**Unauthorized Access** ▪ Unauthorized network access ▪ Malware programs ▪ Cross site scripting (bypassing access controls by use of scripts) ▪ Software-based key loggers (they capture keystrokes) ▪ Password cracking

Factor 4	**Data Loss** ▪ Destruction of critical data ▪ Theft (stealing information) ▪ Password cracking

Source: Researcher (2013)

Table 4.17 shows that there are 4 extracted groups on the extent of IT-related frauds. Data theft and manipulation, IT systems security and unauthorized access are the extracted group factors 1, 2 and 3 which contain the most number of variable components. Factor 1 isolates data theft and manipulation as listed in Table 4.17 and includes (i) Tampering with data (ii) Intellectual property theft (iii) Identity theft (iv) Data interception and manipulation (v) Data interception during file uploads (vi) Spoofing (vii) Phishing; and (viii) Insider threats.

Factor 2 elements comprises IT systems insecurity and it includes (i) hacking (ii) sniffing (iii) hardware-based key loggers (iv) password cracking (v) installation of unauthorized software (vi) Sabotage (vii) Password cracking; and (viii) Phone call/ Short Messaging System interception. Factor 3 elements comprises unauthorized access and includes (i) unauthorized network access (ii) malware programs (iii) cross site scripting (iv) software-based key loggers; and (v) password cracking. Factor 4 elements comprises of the following IT-related frauds (i) destruction of critical data (ii) theft (stealing information) (iii) password cracking.

It is clear that most of the 22 factors listed in the questionnaire were grouped together by their correlation with each other and brought down to four main group factors. The most number of factor elements were in groups 1, 2 and 3 while few elements fell in factor group 4.

4.4 Challenges Faced in IT Auditing

The second objective of the study sought to establish the challenges faced during IT auditing by the IS auditor in Kenyan commercial banks. The data collected was analyzed and presented in Table 4.18. Responses were measured using a five point Likert scale as follows; 1 represented no extent at all, 2 represented little extent, 3 represented moderate extent, 4 represented great extent and 5 represented very great extent. To consolidate and give presentation of the data, the study used the statistical functions of mean and standard deviation. The mean represents the average rating of all the respondents to the IT-related fraud while the corresponding standard deviation shows the range within which the individual ratings are from the mean.

Table 4.18: Challenges faced in IT-Auditing

No	Challenges faced in IT-Auditing	Mean Score	Standard Deviation
1	Lack of audit tools to use during an IT audit	3.03	0.77
2	Insufficient time being allocated per IT audit assignment	2.31	0.75
3	Lack of technical expertise in using vulnerability tools	2.83	0.74
4	Lack of adequate knowledge on the banks IT policies and procedures	1.25	0.44
5	Failure of management in implementing and carrying out staff training on fraud	1.94	0.53
6	Failure by management in implementing IT audit recommendations	1.75	0.77
7	The absence of a formal fraud policy in place	1.00	0.00
8	Fraud policy not regularly being referred to in employee communications	1.39	0.69

Source: Researcher (2013)

According to the findings, the respondents indicated that they faced lack of audit tools to use during an IT audit (mean score 3.03) and lack of technical expertise in using vulnerability tools (mean score 2.83) to a great extent. The respondents indicated that

they faced insufficient time being allocated per IT audit assignment, failure of management in implementing and carrying out staff training on fraud and failure by management in implementing IT audit recommendations to a little extent as shown by mean scores of 2.31, 1.94 and 1.75 respectively. The respondents indicated that they faced fraud policy not regularly being referred to in employee communications, lack of adequate knowledge on the banks IT policies and procedures and the absence of a formal fraud policy in place to a very little extent as shown by mean scores of 1.39, 1.25 and 1.00 respectively.

4.5 Countermeasures Implemented in Preventing Fraud through IT Auditing

The third objective sought to establish the countermeasures implemented in preventing fraud through IT auditing in Kenyan commercial banks. Data was collected on IT audit detection and prevention approaches against fraud and on IT audit strategies implemented to curb fraud.

4.5.1 IT Audit Detection and Prevention Approaches

4.5.1.1 Introduction

Responses were measured using a five point Likert scale as follows; 1 represented no extent at all, 2 represented little extent, 3 represented moderate extent, 4 represented great extent and 5 represented very great extent. To consolidate and give presentation of the data, the study used the statistical functions of mean and standard deviation. The mean represents the average rating of all the respondents to the IT-related fraud while the corresponding standard deviation shows the range within which the individual ratings are from the mean. Data collected was analyzed and presented in Table 4.19.

Table 4.19: IT Audit Detection and Prevention Approaches

No	IT Audit Detection and Prevention Approaches	Mean Score	Standard Deviation
1	**Network surveying** (to obtain information on the network map such as domain names, server names, internet service provider information, IP addresses of hosts)	3.97	0.77
2	**Network reconnaissance** (scanning a network for available information such as ports that are accessible)	3.97	0.77
3	**Port scanning** (to obtain information about closed and open ports that are running on the network)	3.97	0.77
4	**Vulnerability scanning** (by attempting to analyze the weaknesses noted from the scans to launch an attack)	3.97	0.77
5	**Password cracking**	1.78	1.27
6	**Social engineering** (attempting to obtain security information from staff/ customers)	2.81	0.79
7	**Physical security checks on IT assets**	2.97	1.11
8	**Use of data analytics** (to analyze financial data for fraud patterns)	3.17	1.54

Source: Researcher (2013)

According to the findings, the respondents indicated that network surveying; network reconnaissance; port scanning and vulnerability scanning were largely used by banks as shown by a mean score of 3.97 respectively. The respondents indicated that the use of data analytics, physical security checks on IT assets and social engineering were applied to a moderate extent as shown by mean scores of 3.17, 2.97 and 2.81, respectively. The respondents further indicated that password cracking was used to a little extent (mean score of 1.78).

4.5.1.2 Factor Analysis (Communalities)

4.5.1.2.1 Introduction

Responses collected were further subjected to factor analysis. Factor analysis reduces data into key information by seeking unobservable (latent) variables that are reflected in the observed variables (manifest variables). Communality is the proportion of variance that each item has in common with other items. The proportion of variance that is unique to each item is then the respective item's total variance minus the communality. The extraction method was the principle component analysis. Communalities are shown in the Table 4.20.

Table 4.20: Factor Analysis (Communalities)

Communalities			
IT Audit Detection and Prevention Approaches			
F1	Network surveying (to obtain information on the network map such as domain names, server names, internet service provider information, IP addresses of hosts)	1.000	.995
F2	Network reconnaissance (scanning a network for available information such as ports that are accessible)	1.000	.995
F3	Port scanning (to obtain information about closed and open ports that are running on the network)	1.000	.995
F4	Vulnerability scanning (by attempting to analyze the weaknesses noted from the scans to launch an attack)	1.000	.995
F5	Password cracking	1.000	.891
F6	Social engineering (attempting to obtain security information from staff/ customers)	1.000	.728
F7	Physical security checks on IT assets	1.000	.774
F8	Use of data analytics (to analyze financial data for fraud patterns)	1.000	.856

Source: Researcher (2013)

4.5.1.2.2 Factor Extraction (Total Variance)

In the case of the IT Audit Detection and Prevention Approaches, principle analysis component was used to extract 8 factors. Eigen values indicate the relative importance of each factor accounting for a particular set and hence those with small Eigen values were omitted. As depicted on Table 4.21, only 3 factors were significant for the analysis.

Table 4.21: Factor Extraction (Total Variance)

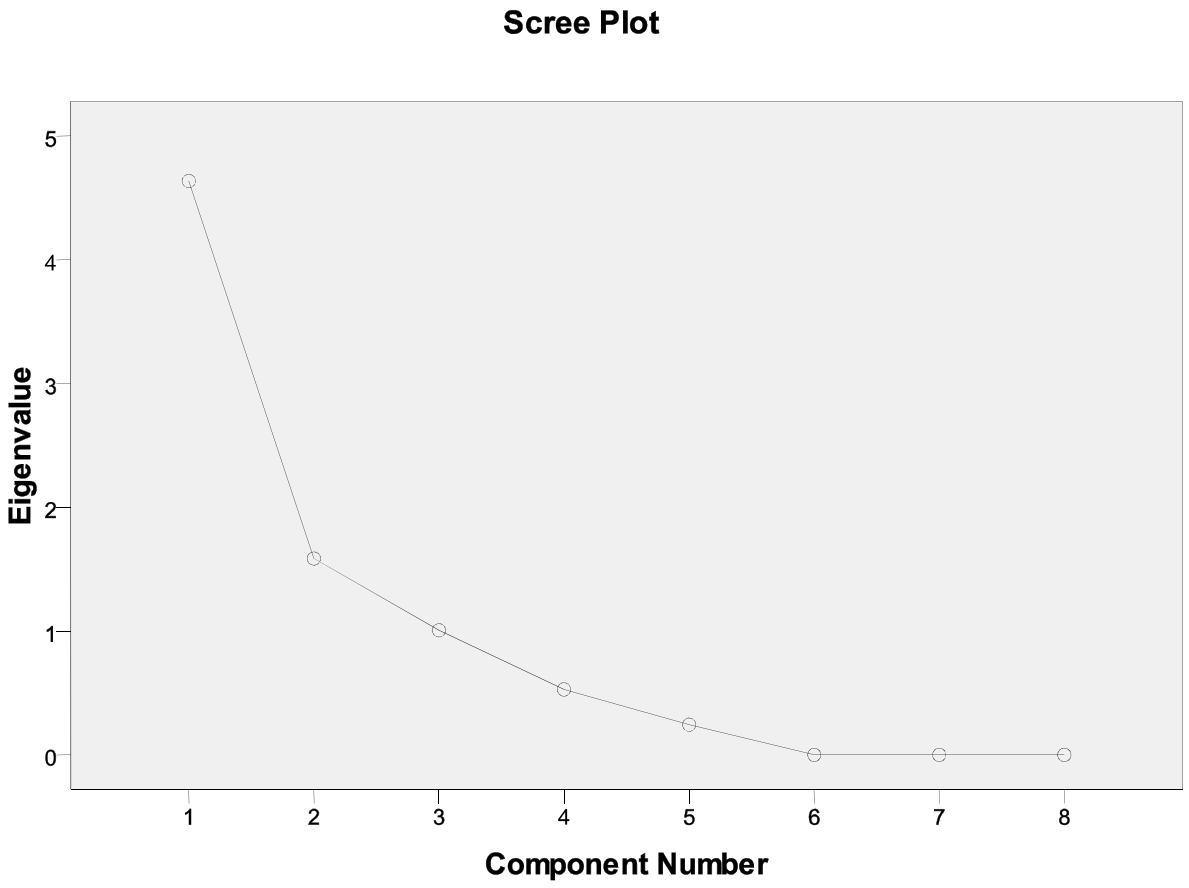
Total Variance Explained									
IT Audit Detection and Prevention Approaches									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.636	57.954	57.954	4.636	57.954	57.954	4.145	51.808	51.808
2	1.586	19.825	77.778	1.586	19.825	77.778	1.674	20.931	72.739
3	1.006	12.578	90.356	1.006	12.578	90.356	1.409	17.617	90.356
4	.528	6.603	96.958						
5	.243	3.042	100.000						
6	.000	.000	100.000						
7	.000	.000	100.000						
8	.000	.000	100.000						

Source: Researcher (2013)

4.5.1.2.3 Scree Plot

The scree plot is a plot of the factor Eigen value against the component numbers. According to the scree plot in Figure 4.2, we only considered 3 factors because the curves tend to flatten from the third component onwards, due to relatively low Eigen values.

Figure 4.2: Scree Plot on IT Audit Detection and Prevention Approaches against Fraud



Source: Researcher (2013)

4.5.1.2.4 Component Matrix

Component matrix contains the relative Eigen values in respect of each factor. Each factor belongs to one of the set of factors extracted and is determined by the Eigen values of the factors relative to each set. Table 4.22 shows which factor each set falls into.

Table 4.22: Component Matrix

IT Audit Detection and Prevention Approaches against Fraud	Component				
	1	2	3	4	5
Network surveying (to obtain information on the network map such as domain names, server names, internet service provider information, IP addresses of hosts)	.980	.071	-.173		
Network reconnaissance (scanning a network for available information such as ports that are accessible)	.980	.071	-.173		
Port scanning (to obtain information about closed and open ports that are running on the network)	.980	.071	-.173		
Vulnerability scanning (by attempting to analyze the weaknesses noted from the scans to launch an attack)	.980	.071	-.173		
Password cracking	.447	.608	.567		
Social engineering (attempting to obtain security information from staff/ customers)	-.360	.756	.166		
Physical security checks on IT assets	-.194	.765	-.389		
Use of data analytics (to analyze financial data for fraud patterns)	.656	-.199	.622		

Source: Researcher (2013)

Table 4.22 presents the factor analysis of the Information Technology Audit and Fraud Prevention in Commercial Banks in Kenya. Each component represents the correlation between item and the unrotated factor (e.g. in the case of IT Audit Detection and Prevention Approaches against Fraud, the correlation between Port scanning and factor 1 is 0.980). These correlations help formulate an interpretation of the factors of components. This is done by looking for a common thread among the variables that have large loadings for a particular factor or components.

From the results in Table 4.23, the variables that measured Information Technology Audit and Fraud Prevention in Commercial Banks in Kenya in one way or the other are highly correlated with this factor.

Table 4.23: Rotated Component Matrix

IT Audit Detection and Prevention Approaches against Fraud	Component		
	1	2	3
Network surveying (to obtain information on the network map such as domain names, server names, internet service provider information, IP addresses of hosts)	.979		
Network reconnaissance (scanning a network for available information such as ports that are accessible)	.979		
Port scanning (to obtain information about closed and open ports that are running on the network)	.979		
Vulnerability scanning (by attempting to analyze the weaknesses noted from the scans to launch an attack)	.979		
Password cracking			.890
Social engineering (attempting to obtain security information from staff/ customers)		.672	
Physical security checks on IT assets	.	.879	
Use of data analytics (to analyze financial data for fraud patterns)			.590

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Source: Researcher (2013)

4.5.1.2.5 Factor Isolation

Factor analysis involves isolating each of the variable factors and grouping them by the eight extracted factors based on their factor loading on each set. Table 4.24 shows the summary of the factor isolation.

Table 4.24: Factor Isolation

Factor Group	Detection and Prevention Measures in IT-Audit against Fraud
Factor 1	**Network scanning** ▪ Network surveying (to obtain information on the network map such as domain names, server names, internet service provider information, IP addresses of hosts) ▪ Network reconnaissance (scanning a network for available information such as ports that are accessible) ▪ Port scanning (to obtain information about closed and open ports that are running on the network) ▪ Vulnerability scanning (by attempting to analyze the weaknesses noted from the scans to launch an attack)
Factor 2	**IT Security Checks** ▪ Social engineering (attempting to obtain security information from staff/ customers) ▪ Physical security checks on IT assets
Factor 3	**Password Cracking and Data Analysis** ▪ Password cracking ▪ Use of data analytics (to analyze financial data for fraud patterns)

Source: Researcher (2013)

Table 4.24 shows that there are 3 extracted groups on Detection and Prevention Measures in IT-audit against Fraud. Factor 1 covering network scanning isolates most of the detection and prevention approaches in IT-Audit against fraud as follows (i) network surveying (ii) network reconnaissance (iii) port scanning (iv) vulnerability scanning**.** Factor 2 elements comprise of the following IT security checks and includes (i) social engineering (ii) physical security checks on IT assets. Factor 3 on system access and data analysis isolated the following elements (i) password cracking (ii) use of data analytics.

Most of the 8 factors listed in the questionnaire were grouped together by their correlation with each other and brought down to 3 main group factors. The most number of factor elements were in group 1 whilst a few elements fell in factor group 2 and 3.

4.5.2 IT Audit Strategies Implemented

4.5.2.1 Introduction

The study sought to find out the IT audit strategies implemented by the bank in preventing IT-related fraud. Table 4.25 presents the findings on the data collected. Responses were measured using a five point Likert scale as follows; 1 represented no extent at all, 2 represented little extent, 3 represented moderate extent, 4 represented great extent and 5 represented very great extent. To consolidate and give presentation of the data, the study used the statistical functions of mean and standard deviation. The mean represents the average rating of all the respondents to the IT-related fraud while the corresponding standard deviation shows the range within which the individual ratings are from the mean.

Table 4.25: IT Audit Strategies Implemented

No	IT Audit Strategies Implemented	Mean Score	Standard Deviation
1	Ensuring a formal fraud policy is in place	4.78	0.42
2	Carrying our regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud	4.58	0.50
3	Application of robust fraud risk assessment, during the planning phase of the IT audit	4.39	0.65
4	Enforcing compliance of the policies and controls	4.67	0.48
5	Ensuring that duly executed Service Level Agreements, with third party service providers, are in place	4.67	0.48
6	Ensuring that the bank has implemented strict password	4.78	0.42

	and account management policies and practices		
7	Ensuring that role based access controls and/or dual access controls are instituted	4.86	0.35
8	Ensuring that there is proper segregation of duties	4.69	0.62
9	Ensuring that data loss prevention suites are used (e.g. restrictions on removal media like flash disks, CDs, etc.)	4.28	0.61
10	Ensuing that the bank has secure backup and recovery processes in place	4.69	0.47
11	Ensuring prompt deactivation of computer access following staff termination	4.61	0.49
12	Recommending built in controls during software development	4.56	0.50
13	Enforcing the use of data encryption	4.44	0.50
14	Ensuring that there is use of structured defense against remote attacks (e.g. installation of firewalls)	4.69	0.47
15	Establishing a confidential mechanism of reporting of suspected fraud cases (e.g. through whistle blowing, anonymous calls)	4.58	0.50
16	Ensuring that system change controls are implemented	4.11	0.32
17	Ensuring that there is tracking and securing of the physical environment (e.g. by use biometric systems)	4.36	0.49
18	Recommending the need of staff fraud awareness training	3.92	0.65

Source: Researcher (2013)

From the findings, the respondents indicated that to a very great extent, banks had implemented IT audit strategies by ensuring that role based access controls and/or dual access controls are instituted (mean score of 4.86), formal fraud policy was is in place (mean score of 4.78) and strict password and account management policies and practices implementation (mean score of 4.78). The respondents further indicated that banks had implemented IT audit strategies by ensuring that there is proper segregation of duties, by ensuring that there are secure backup and recovery processes in place and that there is use

of structured defense against remote attacks (mean score of 4.69) respectively. The respondents also pointed out that banks had implemented IT audit strategies by enforcing compliance of the policies and controls and ensuring that duly executed Service Level Agreements, with third party service providers, are in place to a very great extent (mean score of 4.67).

4.5.2.2 Factor Analysis (Communalities)

4.5.2.2.1 Introduction

Responses collected were further subjected to factor analysis. Factor analysis reduces data into key information by seeking unobservable (latent) variables that are reflected in the observed variables (manifest variables). Communality is the proportion of variance that each item has in common with other items. The proportion of variance that is unique to each item is then the respective item's total variance minus the communality. The extraction method was the principle component analysis. Communalities are shown in the Table 4.26.

Table 4.26: Factor Analysis (Communalities)

Communalities			
	IT Audit Strategies Implemented		
F1	Ensuring a formal fraud policy is in place	1.000	.935
F2	Carrying our regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud	1.000	.851
F3	Application of robust fraud risk assessment, during the planning phase of the IT audit	1.000	.832
F4	Enforcing compliance of the policies and controls	1.000	.965
F5	Ensuring that duly executed Service Level Agreements, with third party service providers, are in place	1.000	.965

F6	Ensuring that the bank has implemented strict password and account management policies and practices	1.000	.935
F7	Ensuring that role based access controls and/or dual access controls are instituted	1.000	.931
F8	Ensuring that there is proper segregation of duties	1.000	.852
F9	Ensuring that data loss prevention suites are used (e.g. restrictions on removal media like flash disks, CDs, etc.)	1.000	.910
F10	Ensuing that the bank has secure backup and recovery processes in place	1.000	.919
F11	Ensuring prompt deactivation of computer access following staff termination	1.000	.900
F12	Recommending built in controls during software development	1.000	.925
F13	Enforcing the use of data encryption	1.000	.864
F14	Ensuring that there is use of structured defense against remote attacks (e.g. installation of firewalls)	1.000	.919
F15	Establishing a confidential mechanism of reporting of suspected fraud cases (e.g. through whistle blowing, anonymous calls)	1.000	.951
F16	Ensuring that system change controls are implemented	1.000	.736
F17	Ensuring that there is tracking and securing of the physical environment (e.g. by use biometric systems)	1.000	.837
F18	Recommending the need of staff fraud awareness training	1.000	.938

4.5.2.2.2 Factor Extraction (Total Variance)

In the case of IT-audit strategies implemented, 18 factors were extracted of which five were significant for the analysis. Eigen values indicate the relative importance of each factor accounting for a particular set and hence those with small Eigen values were omitted. According to Table 4.27, only 5 factors were significant for the analysis.

Table 4.27: Factor Extraction (Total Variance)

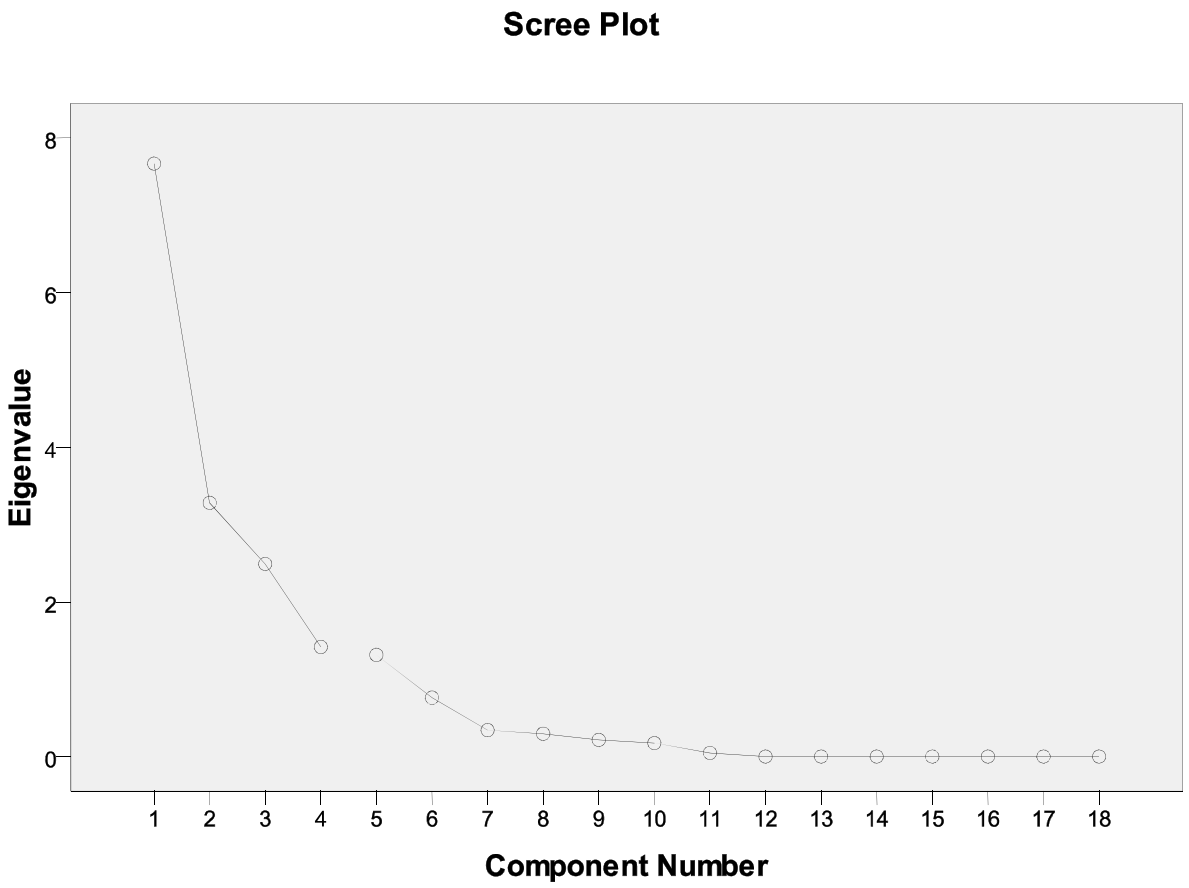
Total Variance Explained									
IT Audit Strategies Implemented									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.665	42.584	42.584	7.665	42.584	42.584	5.873	32.629	32.629
2	3.280	18.224	60.808	3.280	18.224	60.808	3.882	21.568	54.198
3	2.489	13.830	74.638	2.489	13.830	74.638	2.569	14.273	68.471
4	1.417	7.872	82.510	1.417	7.872	82.510	2.488	13.823	82.294
5	1.314	7.300	89.809	1.314	7.300	89.809	1.353	7.515	89.809
6	.761	4.229	94.038						
7	.341	1.896	95.933						
8	.295	1.639	97.572						
9	.215	1.195	98.767						
10	.175	.971	99.738						
11	.047	.262	100.000						
12	8.862E-16	4.923E-15	100.000						
13	1.297E-16	7.207E-16	100.000						
14	6.260E-17	3.478E-16	100.000						
15	2.436E-17	1.353E-16	100.000						
16	-3.250E-34	-1.806E-33	100.000						
17	-2.666E-16	-1.481E-15	100.000						
18	-1.707E-15	-9.482E-15	100.000						

Extraction Method: Principal Component Analysis.
Source: Researcher (2013)

4.5.2.2.3 Scree Plot

This is a plot of the factor Eigen value against the component numbers. According to the scree plot in Figure 4.3, we only considered 5 factors because the curves tend to flatten from the fifth component onwards, due to relatively low Eigen values.

Figure 4.3: Scree Plot on IT Audit Strategies implemented



Source: Researcher (2013)

4.5.2.2.4 Component Matrix

Component matrix contains the relative Eigen values in respect of each factor. Each factor belongs to one of the sets of factors extracted and is determined by the Eigen values of the factors relative to each set. Table 4.28 shows which set each factor falls into.

Table 4.28: Component Matrix

IT Audit Strategies Implemented	Component				
	1	2	3	4	5
Ensuring a formal fraud policy is in place	.883	-.235	.308	.070	-.017
Carrying our regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud	.843	.243	-.194	-.143	.149
Application of robust fraud risk assessment, during the planning phase of the IT audit	.266	.267	.686	-.443	.151
Enforcing compliance of the policies and controls	.882	.134	.098	-.360	-.172
Ensuring that duly executed Service Level Agreements, with third party service providers, are in place	.882	.134	.098	-.360	-.172
Ensuring that the bank has implemented strict password and account management policies and practices	.883	-.235	.308	.070	-.017
Ensuring that role based access controls and/or dual access controls are instituted	.741	.157	.368	.462	-.092
Ensuring that there is proper segregation of duties	.415	.272	-.254	.581	.450
Ensuring that data loss prevention suites are used (e.g. restrictions on removal media like flash disks, CDs, etc.)	.725	-.296	-.480	-.255	.039
Ensuing that the bank has secure backup and recovery processes in place	.771	-.535	.149	.110	.066
Ensuring prompt deactivation of computer access following staff termination	.488	.514	-.139	.097	-.607
Recommending built in controls during software development	-.035	.223	.848	.381	-.103
Enforcing the use of data encryption	.316	.842	-.062	.087	.209
Ensuring that there is use of structured defense against remote attacks (e.g. installation of firewalls)	.771	-.535	.149	.110	.066
Establishing a confidential mechanism of reporting of suspected fraud cases (e.g. through whistle blowing, anonymous calls)	.572	.650	-.420	.156	.025

Ensuring that system change controls are implemented	.310	.193	.092	-.248	.729
Ensuring that there is tracking and securing of the physical environment (e.g. by use biometric systems)	.701	.014	-.559	.077	-.165
Recommending the need of staff fraud awareness training	-.274	.874	.239	-.192	-.069

Extraction Method: Principal Component Analysis.
Source: Researcher (2013)

Table 4.28 presents the factor analysis of the Information Technology Audit and Fraud Prevention in Commercial Banks in Kenya. Each component represents the correlation between item and the unrotated factor (e.g. in the case of IT Audit Strategies Implemented, the correlation between ensuring that role based access controls and/or dual access controls are instituted and factor 1 is 0.741). These correlations help formulate an interpretation of the factors of components. This is done by looking for a common thread among the variables that have large loadings for a particular factor or components.

From the results in Table 4.29, the variables that measured Information Technology Audit and Fraud Prevention in Commercial Banks in Kenya in one way or the other are highly correlated with this factor.

Table 4.29: Rotated Component Matrix

IT Audit Strategies Implemented	Component				
	1	2	3	4	5
Ensuring a formal fraud policy is in place	.909				
Carrying our regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud		.595			
Application of robust fraud risk assessment, during the planning phase of the IT audit				.714	
Enforcing compliance of the policies and controls				.701	
Ensuring that duly executed Service Level Agreements, with third party service providers, are in place				.701	
Ensuring that the bank has implemented strict password and account management policies and practices	.909				

Ensuring that role based access controls and/or dual access controls are instituted	.700				
Ensuring that there is proper segregation of duties		.733			
Ensuring that data loss prevention suites are used (e.g. restrictions on removal media like flash disks, CDs, etc.)			.739		
Ensuing that the bank has secure backup and recovery processes in place	.946				
Ensuring prompt deactivation of computer access following staff termination		.617			
Recommending built in controls during software development	.149				
Enforcing the use of data encryption		.842			
Ensuring that there is use of structured defense against remote attacks (e.g. installation of firewalls)	.946				
Establishing a confidential mechanism of reporting of suspected fraud cases (e.g. through whistle blowing, anonymous calls)		.934			
Ensuring that system change controls are implemented					.786
Ensuring that there is tracking and securing of the physical environment (e.g. by use biometric systems)			.571		
Recommending the need of staff fraud awareness training				.450	

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Source: Researcher (2013)

4.5.2.2.5 Factor Isolation

Factor analysis involves isolating each of the variable factors and grouping them by the eight extracted factors based on their factor loading on each set. Table 4.30 shows the summary of the factor isolation.

Table 4.30: Factor Isolation

IT Audit Strategies Implemented	
Factor 1	**Compliance to Policies and Procedures** ▪ Ensuring a formal fraud policy is in place ▪ Ensuring that the bank has implemented strict password and account management policies and practices ▪ Ensuring that role based access controls and/or dual access controls are instituted ▪ Ensuring that the bank has secure backup and recovery processes in place ▪ Recommending built in controls during software development ▪ Ensuring that there is use of structured defense against remote attacks (e.g. installation of firewalls)
Factor 2	**IT-Audit Checks** ▪ Carrying out regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud ▪ Ensuring that there is proper segregation of duties ▪ Ensuring prompt deactivation of computer access following staff termination ▪ Enforcing the use of data encryption ▪ Establishing a confidential mechanism of reporting of suspected fraud cases (e.g. through whistle blowing, anonymous calls)
Factor 3	**IT Security Checks** ▪ Ensuring that data loss prevention suites are used (e.g. restrictions on removal media like flash disks, CDs, etc.) ▪ Ensuring that there is tracking and securing of the physical environment (e.g. by use biometric systems)

Factor 4	**IT Audit Planning and Audit Recommendations** ▪ Application of robust fraud risk assessment, during the planning phase of the IT audit ▪ Enforcing compliance of the policies and controls ▪ Ensuring that duly executed Service Level Agreements, with third party service providers, are in place ▪ Recommending the need of staff fraud awareness training
Factor 5	**Change Controls Implementation** ▪ Ensuring that system change controls are implemented

Source: Researcher (2013)

Table 4.30 shows there are 5 extracted group factors. Extracted group factors 1 and 2 contain the most number of variable components. Factor 1 on compliance to policies and procedures shows the following isolated IT-audit strategies (i) ensuring a formal fraud policy is in place (ii) ensuring that the bank has implemented strict password and account management policies and practices (iii) ensuring that role based access controls and/or dual access controls are instituted (iv) ensuring that the bank has secure backup and recovery processes in place (v) recommending built in controls during software development; and (vi) ensuring that there is use of structured defense against remote attacks.

IT audit checks make up factor 2 elements which comprises of the following (i) carrying out regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud (ii) ensuring that there is proper segregation of duties (iii) ensuring prompt deactivation of computer access following staff termination (iv) enforcing the use of data encryption; and (v) establishing a confidential mechanism of reporting of suspected fraud cases.

Factor 3 are IT security checks elements and they comprise of the following IT-audit strategies (i) ensuring that data loss prevention suites are used (ii) ensuring that there is tracking and securing of the physical environment. Factor 4 elements, IT audit planning and audit recommendations comprises of the following (i) application of robust fraud risk

assessment, during the planning phase of the IT audit (ii) enforcing compliance of the policies and controls (iii) ensuring that duly executed Service Level Agreements, with third party service providers, are in place (iv) recommending the need of staff fraud awareness training. Factor 5 element comprises of one IT-audit strategies of ensuring that system change controls are implemented.

Most of the 18 factors listed in the questionnaire were grouped together by their correlation with each other and brought down to 5 main group factors. The most number of factor elements were in groups 1 and 2 whilst a few elements fell in factor group 3, 4 and 5.

4.6 IT Auditing and Fraud Prevention Relationship

The fourth objective pursued to determine the relationship between IT auditing and fraud prevention in Kenyan commercial banks. The data collected in establishing the relationship between IT auditing and fraud were analyzed and presented in Table 4.31 and Table 4.32.

4.6.1 Extent to which IT-Audit Prevents Fraud in the Bank

With regard to the extent to which IT audit prevented fraud in the bank, Table 4.31 indicates that 61.1% of the respondents concurred that IT audit prevented fraud in the bank to a great extent while 38.9% of the respondents indicated that IT audit prevented fraud in the bank to a very great extent.

Table 4.31: Extent to which IT Audit Prevents Fraud in the Bank

Extent to which IT Audit prevents Fraud in the Bank	Frequency	Percent
Great Extent	22	61.1
Very Great Extent	14	38.9
Total	**36**	**100.0**

Source: Researcher (2013)

4.6.2 Factors affecting the Effectiveness of IT Auditing in Preventing Fraud

The study sought to find out the extent to which factors relating to IT auditing affected fraud prevention in the bank. Data collected was analyzed and presented on Table 4.32. Responses were measured using a five point Likert scale as follows; 1 represented no extent at all, 2 represented little extent, 3 represented moderate extent, 4 represented great extent and 5 represented very great extent. To consolidate and give presentation of the data, the study used the statistical functions of mean and standard deviation. The mean represents the average rating of all the respondents to the IT-related fraud while the corresponding standard deviation shows the range within which the individual ratings are from the mean.

Table 4.32: Factors affecting the Effectiveness IT Auditing in Preventing Fraud

No.	Factors affecting the effectiveness IT Auditing	Mean Score	Standard Deviation
1	Skills possessed by the IS auditor	4.39	0.65
2	Tools used by the IS auditor	4.42	0.65
3	Time allocated for each IT audit assignment	4.42	0.65
4	Management support in implementing IT audit recommendations	4.80	0.40

Source: Researcher (2013)

From the findings, the respondents indicated that management support in implementing IT audit recommendations affected fraud prevention in the bank to a very great extent (mean score 4.80). The respondents indicated that tools used by the IS auditor, time allocated for each IT audit assignment and skills possessed by the IS auditor affected fraud prevention in the bank to a great extent as shown by a mean score of 4.42, 4.42 and 4.39 respectively.

4.6.2.1 Regression Analysis

In this study, a multiple regression analysis was conducted to test the influence among predictor variables. The research used Statistical Package for Social Sciences (SPSS V 17.0) to code, enter and compute the measurements of the multiple regressions.

Table 4.33: Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0.763	0.746	0.578	0.1076
a. Predictors (Constant): Skills, Tools, Time and Management support				

Source: Researcher (2013)

R-Square (coefficient of determination) is a commonly used statistic to evaluate model fit. R-square is 1 minus the ratio of residual variability. The adjusted R^2, also called the coefficient of multiple determinations, is the percent of the variance in the dependent explained uniquely or jointly by the independent variables. Table 4.33 shows that 74.6% of the changes in fraud prevention could be attributed to the combined effect of the predictor variables.

Table 4.34: ANOVA (Analysis of Variance)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	821.593	4	205.398	20.24	.000[a]
Residual	324.723	32	10.15		
Total	1146.316	36			

Source: Researcher (2013)

a. Predictors (Constant): Skills, Tools, Time and Management Support.

b. Dependent Variable: Fraud Prevention.

Table 4.34 shows that the residual sum of squares (the sum of squared deviations from the least squares line) is 324.723, while the total sum of squares (the sum of squared deviations from the mean) is 1146.316. The probability value of 0.001 indicates that the regression relationship was highly significant in predicting how Skills, Tools, Time and Management Support led to fraud prevention. The F critical at 5% level of significance was 3.671 since F calculated is greater than the F critical (value = 20.24), this shows that the overall model was significant.

Table 4.35: Estimated Coefficients

Model	Unstandardized coefficients(B)	p-Value
Const.	18.79	3.25e-09 ***
Skills	0.708	0.0133 ***
Tools	0.642	0.0395 ***
Time	0.706	0.0236 ***
Management support	0.710	0.0154 ***

Source: Researcher (2013)

* Significant at 1%

** Significant at 5%

*** Significant at 10%

The "coefficients" on Table 4.35 provides the regression equations. Under "unstandardized coefficients," the "Constant" (18.79) is the "a" coefficient. The remaining values in this column are the "b" coefficients. Rewriting this in standard algebraic form, the unstandardized regression equation is:

FP= 18.79+ 0.708 S+ 0.642TL+ 0.706TI+0.710MS + e

Where FP is fraud prevention, S is Skills, TL is tools, TI is time and MS is Management support.

A unit change in skills will lead to a 0.708 change in fraud prevention. A unit change in tools will lead to a 0.642 change in fraud prevention. A unit change in time will lead to a 0.706 change in fraud prevention while a unit change in the management support will lead to a 0. 710 change in fraud prevention.

Table 4.35 shows that skills, tools, time and management support at 1%, 5% and 10% level of significance, they are significant in explaining the variations in fraud prevention.

4.7 Discussion of the Findings

From the above data analysis and findings, it is apparent that IT-related fraud is prevalent in Kenyan commercial banks, and most banks have largely encountered phishing, spoofing, insider threats and data interception during file uploads. Due to this increase in electronic frauds (BFIU, 2013), most banks have put in a key measure of implementing IT auditing in order to manage fraud, IT systems failures and disruptions (RMG, 2013).

Thus, to address the likelihood of electronic fraud risk IS auditors in Kenyan commercial banks, largely ensure that role based access controls and/or dual access controls are instituted, formal fraud policy is in place and the banks have implemented strict password and account management policies and practices. The findings showed that the IT audit approaches and mitigation strategies implemented by the IS auditors incline towards early detection and prevention of fraud. However, most IS auditors in Kenyan commercial banks indicated that they have encountered various challenges such as lack of audit tools (mean score 3.03), lack of technical expertise in using vulnerability tools (mean score 2.83) and insufficient time allocation on audit assignments (mean score 2.31) and this largely affected the effectiveness of IT auditing in preventing fraud.

As aforementioned in the statement of the problem, there are varied opinions amongst auditors on the expectation-performance gap (Sherer and Turley, 2007) and the assertion that auditors have responsibility in the prevention and detection of fraud is a controversial topic amongst auditors, regulators and the public. From the findings, 61.1% of the IS auditors concurred that IT audit prevented fraud in the bank to a great extent, while 38.9% assented that IT audit prevented fraud in the bank to a very great extent. It is therefore evident that IS auditors have a significant role in the early detection and prevention of fraud. The regression analysis findings further affirmed that there is a direct relationship between IT auditing and fraud prevention in Kenyan commercial banks. Other researchers, as discussed in the literature review, have concurred that audit is a vital tool in fraud detection and the ability to detect fraud is therefore more augmented for organizations that have an internal auditors than those without (Coram et al., 2006).

The resulting conceptual model as shown in Figure 2.3 has been supported by the findings which show that a unit change in management support, skills, time and tools used, lead to 0.710, 0.708, 0.706 and 0.642 change in fraud prevention, respectively. These findings are also consistent with the strategic fraud detection and TAM 2 models used. These models combine the use of technology based tools and deductive reasoning which were perceived as useful by the IS auditors in effectively detecting and preventing fraud.

While the initial objective of the study was to determine the effectiveness of IT auditing in fraud prevention and detection amongst Kenyan commercial banks, the resultant concept has provided findings on myriad IT audit challenges, IT audit approaches and mitigation strategies that shall enhance the body of knowledge for scholars and give rise to further research in the IT auditing field. It shall also provide a holistic view on IT auditing to banks, government and other regulators such CBK, ICPAK and ISACA in the fight against fraud. Moreover, it shall provide further impetus for banks and other organizations to adopt the resulting conceptual model, which will help increase the productivity, efficiency and effectiveness of IS auditors leading to early detection and prevention of fraud.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The objectives of this study were to determine the extent of IT related fraud in Kenyan commercial banks, establish the challenges faced during IT auditing by the IS auditor, establish the countermeasures implemented in preventing fraud through IT auditing and determine the relationship between IT auditing and fraud prevention. This research study was conducted on IS auditors in Kenyan commercial banks, and the response rate achieved was 83.72%. Although the entire population of 43 banks was targeted, 36 respondents did fill the questionnaire.

5.2 Summary of the Findings

The study found out that most of the respondents had certification in auditing, accounting and information security. It also became apparent that the IT auditing field is largely dominated by male professionals (97.2%). The study also pointed out that banks had encountered phishing, spoofing, insider threats and data interception during file uploads to a great extent. The study established that the common IT audit approaches used include network surveying, network reconnaissance, port scanning and vulnerability scanning. The study also revealed that the banks had implemented IT audit strategies by ensuring that role based access controls and/or dual access controls are instituted, ensuring a formal fraud policy was in place and by ensuring that the bank has implemented strict password and account management policies and practices.

5.3 Conclusions

The study concludes that since the most common IT-related frauds were phishing, spoofing, insider threats and data interception during file uploads, IS auditors should put

more focus while planning for IT-audits on areas that could be affected by these types of frauds. Since all the respondents had encountered an IT-related fraud, it imperative that each bank puts in place mitigation strategies to help reduce fraud risk.

From the research, these mitigation strategies were notably, the carrying out regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud; ensuring that there is proper segregation of duties; ensuring prompt deactivation of computer access following staff termination; enforcing the use of data encryption; establishing a confidential mechanism of reporting of suspected fraud cases; ensuring a formal fraud policy was in place; ensuring that the bank has implemented strict password and account management policies and practices; ensuring that role based access controls and/or dual access controls are instituted; ensuring that the bank has secure backup and recovery processes in place; recommending built in controls during software development and ensuring that there is use of structured defense against remote attacks.

5.4 Limitations of the Study

From the study it was noted that some banks have not recruited IS auditors to perform IT auditing work but instead they use IT managers and IT project managers to perform this role. Such staff may not have the expertise required to perform the IT-audit role effectively and therefore the information provided on the questionnaire may have been limited since it was difficult to get sufficient time to go through the questionnaires with these respondents. Further, some respondents may not have given focused attention while completing the questionnaire due to the qualitative nature of the study.

Another limitation is that some of the banks with majority foreign ownership have their data stored and managed outside the country hence local staff may not have full knowledge of the controls in place. Further, this study is limited to commercial banks in

Kenya and excludes other financial intermediation players such as the forex bureaus, mortgage banks, micro finance institutions and pension funds.

5.5 Recommendation for Further Research

The study recommends that banks should continue to enforce, practice and maintain high ethical standards in performance of the duties as well as ensure that fraud governance is in place. The study therefore recommends that articulating a fraud and corruption control policy is a vital step, but a policy will only be effective if implemented with the support of appropriate procedures and operating guidelines. Further, good communication and extensive consultation with internal and external stakeholders at each stage of the process are very important. The success in fighting frauds as a whole depends on the extent to which everyone contributes to the assessment of risk and embraces the philosophy of actively managing it. Better work could be achieved in future by using information from other industries, such as the forex bureaus, mortgage banks, micro finance institutions and pension funds, in order to generalize on the effectiveness of IT auditing and fraud prevention in the Kenyan context.

REFERENCES

Aeran A. (2006): *Comprehensive overview of Insider Threats and their controls*

Albrecht C.C. and Albrecht W.S. (2002): *Strategic Fraud Detection- A Technology-Based Model.* Rollins Center for eBusiness

Albrecht C.C. and Albrecht W.S. (2001b): *Conducting a Pro-active Fraud Audit: A Case Study*. The Journal of Forensic Accounting I: (January-June) pp 1-12

Alleyne P. and Howard M. (2005): *An Exploratory Study of Auditors' Responsibility for Fraud Detection in Barbados.* Managerial Auditing Journal

Apoyo, H. (2011). *Management of reputation risks among commercial banks in Kenya.* Unpublished MBA Thesis, University of Nairobi.

Association of Certified Fraud Examiners (2010): Global Fraud Study: Report to the Nations on Occupational Fraud and Abuse

Baker, W.H., Hylender, C.D. and Valentine, J.A. (2008). *Data Breach Investigations Report*

Banking Fraud Investigation Unit: *Second Quarter Report on Trend of Fraud Cases Committed in the Banking Industry*- April to June 2013

Bostley R.W.B. and Dover C.B. (1972): *Sheldon's Practice and Law of Banking*, 10th ed, London, Macdonald and Evans

Boynton W., Johnson R. and Kell W. (2005): *Assurance and the integrity of financial reporting*, 8th ed. New York, John Wiley & Sons Inc

Brink V.Z. and Witt H. (1982): *Internal Auditing*. New York, John Wiley & Sons

Central Bank of Kenya (CBK) *Risk Management Guidelines (RMG) No.7 of January 2013*: Information and Communication Technology (ICT) Risk, pp 54-70

Chakrabarty K.C. (2013): *Fraud in the banking sector- causes, concerns and cures*

Coderre D.G. (2009): *Fraud Analysis Techniques using ACL*. John Wiley & Sons

Coram P., Ferguson C. and Moroney R. (2006): *The Importance of Internal Audit in Fraud Detection*. A thesis of The University of Melbourne and Monash University

Delloite, 2011: *A Survey- Kenyan Banks Suffer Brunt of Theft*

Gallegos F., Senft S., Manson D.P. and Gonzales C. (1998): *Information Technology Control and Audit*, 2nd ed., New York: Auerbach Publications, pp.41-43

Gay G., Schelluch P. and Reid I. (1997): *Users Perception of the Auditing Responsibilities for the Prevention, Detection and Reporting of Fraud, other illegal acts and error.* Australian Accouting Review

GECS (Global Economic Crime Survey), November 2011, Price Waterhouse Coopers. www.pwc.com/crimesurvey (Date Accessed: 16 August 2013)

http://www.businessdictionary.com/definition/countermeasures.html (Date Accessed: 14 August 2013)

http://www.centralbank.go.ke/index.php/regulations-and-guidelines (Date Accessed: 19 August 2013)

http://www.centralbank.go.ke/images/docs/Bank%20Supervision%20Reports/Quarterly%20Performance%20Reports/2nd%20quarter%20of%202012%20Banking%20Sector%20Performance%20%20Development%20-Revised.pdf (Date Accessed: 19 August 2013)

http://daf.csulb.edu/offices/univ_svcs/internalauditing/audits.html (Date Accessed: 20 August 2013)

http://www.theiia.org/intAuditor/itaudit/2012-articles/so-you-want-to-be-an-it-auditor/ (Date Accessed: 24 August 2013)

http://www.nysscpa.org/cpajournal/2008/608/essentials/p20.htm (Date Accessed: 21 August 2013)

http://upload.wikipedia.org (Date Accessed: 23 August 2013)

http://www.kba.co.ke/index.php?option=com_contentand view=articleand id=129:working-together-to-make-banking-betterand catid=57:slideshow (Date Accessed: 19 August 2013)

http://www.kba.co.ke/component/content/article/57-slideshow/131-increasing-access-to-credit (Date Accessed: 19 August 2013)

Huang Y., Weng Y.C., Chou H. and Wu M. (20011): *TAM2 based study of website user behavior – Using Web 2.0 Websites as an Example*. Chung-Hua University

Information Systems Control (ISC) Journal (2008): *The Magazine for IT Governance Professionals*. Volume 3 pp.14

Information Standards Guidelines on Auditing No. 9: *Audit Considerations for Irregularities and Illegal Acts*

International Standards on Auditing No.*240: The Auditor's Responsibilities to Consider Fraud in an Audit of Financial Statement* (Revised)

ISACA (2013): http://www.ISACA.org (Date Accessed: 23 August 2013)

ISO 19011:2011 *Guidelines for auditing management systems*

IT Audit Monograph Series # 1 (2008): *Information Technology Audit-General Principles*

http://intosaiitaudit.org/India_GeneralPrinciples.pdf (Date Accessed: 19 August 2013)

Kenneth C. Brancik (2008): Inside Computer Fraud. *An In-depth Framework for Detecting and Defending Against Insider I.T. Attacks*

Kenya Revenue Authority Anti-fraud and Corruption Policy, July 2006

Launius S.M.(2009): *Securing the Network Perimeter of a Community Bank*. SANS Institute

Lee T.H., Ali A.M. and Bien D., (2009): *Towards an Understanding of the Audit Expectation Gap*. A Published Journal of The International Institute for Science, Technology and Education

Mugenda. O. A. and Mugenda A. G. (1999). *Research methods: Quantitative and Qualitative approaches*, Nairobi, Act Press

Mukinda Fred, "Sh 500 Million lost to Kenya Bank Fraud in just a month", January 13, 2011. Daily Nation: http://www.nation.co.ke/News/Sh500m%20lost%20to%20bank%20fraud%20in%20just%20a%20month%20/-/1056/1089298/-/s98rt1/-/index.html (Date Accessed: 23 August 2013)

Mulwa D. (2012): *A Survey of Insider Information Security Threats Management in Commercial Banks in Kenya*. A thesis of University of Nairobi

Muslimat A.S. and Hamid K.T. (2012): *The Role of Internal Audit Unit in Fraud Prevention in Government Owned Hospitals in a Nigerian Setting*

Nicho M. (2008): *Information Technology Audit- Systems Alignment and Effectiveness Measures. A thesis of AUT University*

Nieschwietz R.J., Joseph J. and Schultz J. (2000): *Empirical Research on External Auditor's Detection of Financial Statement Fraud*. Journal of Accounting Literature 19 pp 190-246

Oyinlola A. O. (2010): *The Role of Auditors in Fraud Detection, Prevention and Reporting in Nigeria.* An e-journal of Tai Solarin University

Palmrose Z. (1987): *Litigation and Independent Auditors-The Role of Business Failures and Management Fraud*. Auditing: A Journal of Practice and Theory 6 pp 90-103

Perspective Magazine, 2009: *The Future of Branchless Banking in the United Kingdom*

Reserve Bank of India (2011): *Working Group on Information Security, Electronic Banking, Technology Risk Management and Cyber Frauds*

Schultz, E. E. (2002). *A framework for understanding and predicting insider attacks*. Computers and Security 21 (6), pp 526-531

Sherer M. and Turley S. (2007): *Current Issues in Auditing*, 3rd ed.

Simpson B. (2011): *An Introduction to Computer Auditing*

Welch S.T., Holmes S.A. and Strawser R.H. (1996): *The Inhibiting Effect of Internal Auditors on Fraud*

Wagner H.J. (2001): *Information Systems Auditing and Electronic Commerce*. A thesis of University of Illinois

APPENDIX ONE
Research Questionnaire

I am undertaking a research on Information Technology Audit and Fraud Prevention in Commercial Banks in Kenya as part of my academic qualifying requirement. Your assistance, through completion of this questionnaire will be highly appreciated. Any information provided shall be in confidence. Thank you in advance for taking the time to fill in the questionnaire.

SECTION A: DEMOGRAPHIC INFORMATION

1. Please tick to indicate your Gender.

   Male ……..( )

   Female……( )

2. Please tick the age bracket in years in which your age falls.

   Below 25……( )

   Between 25 and 30…….( )

   Between 31 and 35…….( )

   Between 36 and 40…….( )

   Between 41 and 45…….( )

   46 and above……..( )

3. Please indicate your Position/Designation in the bank.

   IS Audit Manager…….( )

   IS Audit Officer……...( )

   Others [*Specify*] ……

4. Please indicate your academic qualification.

   Master Degree ……( )

   Undergraduate Degree……( )

Others [*Specify*] ……

5. Please indicate your professional qualification.
   Certified Information Systems Audit……( )
   Certified Fraud Examiner……..( )
   Certified Public Accountant ……( )
   Certified Information Security Manager……( )
   Microsoft Certified Systems Auditor…..……( )
   Microsoft Certified Systems Engineer……( )
   Cisco Certified Network Administrator ……( )
   Cisco Certified Network Engineer …… ……( )
   Others [*Specify*] ……

6. For how long have you worked in the bank? ……

7. For how long has your bank been in operation?
   10 years and below..……..( )
   Between 11 and 20 years……( )
   Between 21 and 30 years……( )
   Between 31 and 40 years……( )
   Over 40 years ……..( )

8. What is the current shareholding structure of your bank?
   Locally owned institution……( )
   Government controlled majority shares institution….( )
   Foreign owned but locally incorporated……..( )

Foreign owned NOT locally incorporated……...( )

Owned by both local and foreigners……( )

Other [*Specify*]……

9. What is the size of the bank in terms of total assets value in Kenya Shillings?

   10 billion and below……..( )

   Between 11 and 20 billion……( )

   Between 21 and 30 billion……( )

   Between 31 and 40 billion……( )

   Between 41 and 50 billion……( )

   Above 50 billion……...( )

10. Please tick to indicate the number of branches owned by the bank in Kenya.

    20 and below……( )

    Between 21 and 40……...( )

    Between 41 and 60……( )

    Between 61 and 80……( )

    Above 80……...( )

11. To who does the IS audit team report?

    Board Audit Committee……( )

    Board Information and Technology Committee……( )

    Chief Executive Officer (CEO)…….( )

    Others [*Specify*] ……( )

SECTION B: TYPES OF IT-RELATED FRAUDS

12. Please tick to indicate the extent to which the bank has encountered each of the following IT-related fraud.

IT-Related Fraud	No Extent at All	Little Extent	Moderate Extent	Great Extent	Very Great Extent
	1	2	3	4	5
Network Related Fraud					
Unauthorized network access					
Hacking (accessing a computer network by circumventing its security system)					
Malware programs					
Sniffing (being able to seeing plain text login credentials and confidential information)					
Cross site scripting (bypassing access controls by use of scripts)					
Hardware Related Fraud					
Hardware-based key loggers (they capture keystrokes)					
Destruction of critical data					
Password cracking					
Tampering with data (unauthorized changes of data or records)					
Theft (stealing information)					
Software Related Fraud					
Installation of unauthorized software					
Sabotage					
Intellectual property theft					
Software-based key loggers (they capture keystrokes)					

Applications Related Fraud					
Password cracking					
Identity theft					
Systems Interfaces Related Fraud					
Data interception and manipulation					
Phone call/ Short Messaging System (SMS) interception					
IT Operational Frauds					
Data interception during file uploads					
Spoofing (pretending to be something or someone that one is not)					
Phishing (acquiring information and/or money from people without their knowledge)					
Insider threats (e.g. selling employer's confidential information to the competitors)					
Others *[Specify and Rate accordingly]*					

SECTION C: CHALLENGES FACED IN IT AUDITING

13. Please tick to indicate the extent to which you have experienced each of the following challenges in IT auditing in the bank.

Challenges Faced	No Extent at All	Little Extent	Moderate Extent	Great Extent	Very Great Extent
	1	2	3	4	5
Lack of audit tools to use during an IT audit					
Insufficient time being allocated per IT audit assignment					
Lack of technical expertise in using vulnerability tools					
Lack of adequate knowledge on the banks IT policies and procedures					
Failure of management in implementing and carrying out staff training on fraud					
Failure by management in implementing IT audit recommendations					
The absence of a formal fraud policy in place					
Fraud policy not regularly being referred to in employee communications					
Others *[Specify and Rate accordingly]*					

SECTION D: DETECTION AND PREVENTION APPROACHES IN IT AUDIT AGAINST FRAUD

14. Please tick to indicate the extent to which you use each of the following approaches in detecting and preventing fraud related to computer networks in the bank.

IT Audit Approaches Used	No Extent at All	Little Extent	Moderate Extent	Great Extent	Very Great Extent
	1	2	3	4	5
Network surveying (to obtain information on the network map such as: - domain names - server names - internet service provider information - IP addresses of hosts)					
Network reconnaissance (scanning a network for available information such as ports that are accessible)					
Port scanning (to obtain information about closed and open ports that are running on the network)					
Vulnerability scanning (attempting to analyze the weaknesses noted from the scans to launch an attack)					
Password cracking					
Social engineering (attempting to obtain security information from staff/ customers)					
Physical security checks on IT assets					
Use of data analytics (to analyze financial data for fraud patterns)					
Others *[Specify and Rate accordingly]*					

15. To what extent has each of the following IT audit strategies been implemented by the bank in preventing IT-related fraud?

Mitigation Strategies	No Extent at All	Little Extent	Moderate Extent	Great Extent	Very Great Extent
	1	2	3	4	5
Ensuring a formal fraud policy is in place					
Carrying our regular reviews of information security processes, policies and standards and providing recommendations to seal loopholes that may lead to fraud					
Application of robust fraud risk assessment, during the planning phase of the IT audit					
Enforcing compliance of the policies and controls					
Ensuring that duly executed Service Level Agreements, with third party service providers, are in place					
Ensuring that the bank has implemented strict password and account management policies and practices					
Ensuring that role based access controls and/or dual access controls are instituted					
Ensuring that there is proper segregation of duties					
Ensuring that data loss prevention suites are used (e.g. restrictions on removal media like flash disks, CDs, etc.)					
Ensuing that the bank has secure backup and recovery processes in place					
Ensuring prompt deactivation of computer access following staff termination					
Recommending built in controls during software development					
Enforcing the use of data encryption					
Ensuring that there is use of structured defense against remote attacks (e.g. installation of firewalls)					
Establishing a confidential mechanism of reporting of suspected fraud cases (e.g. through whistle blowing, anonymous calls)					
Ensuring that system change controls are implemented					
Ensuring that there is tracking and securing of the physical environment (e.g. by use biometric systems)					
Recommending the need of staff fraud awareness training					
Others *[Specify and Rate accordingly]*					

SECTION E: IT AUDITING AND FRAUD PREVENTION RELATIONSHIP

16. To what extent is IT audit preventing fraud in the bank?

    Tick to indicate the extent in the boxes given below:

    No extent at all……. ( )

    Little extent…….. ( )

    Moderate extent…… ( )

    Great extent…….. ( )

    Very great extent……...( )

17. Please tick to indicate the extent to which each of the following IT related factors affect fraud prevention in the bank.

Independent Variables	**No Extent at All**	**Little Extent**	**Moderate Extent**	**Great Extent**	**Very Great Extent**
	1	**2**	**3**	**4**	**5**
Skills possessed by the IS auditor					
Tools used by the IS auditor					
Time allocated for IT audit assignments					
Management support in implementing IT audit recommendations					
Others *[Specify and Rate accordingly]*					

APPENDIX TWO
List of Commercial Banks in Kenya

1. African Banking Corporation Ltd
2. Bank of Africa Kenya Ltd.
3. Bank of Baroda (K) Ltd.
4. Bank of India
5. Barclays Bank of Kenya Ltd.
6. CFC Stanbic Bank Ltd.
7. Charterhouse Bank Ltd
8. Chase Bank (K) Ltd.
9. Citibank N.A Kenya
10. Commercial Bank of Africa Ltd.
11. Consolidated Bank of Kenya Ltd.
12. Co-operative Bank of Kenya Ltd.
13. Credit Bank Ltd.
14. Development Bank of Kenya Ltd.
15. Diamond Trust Bank (K) Ltd.
16. Dubai Bank Kenya Ltd.
17. Eco bank Kenya Ltd
18. Equatorial Commercial Bank Ltd
19. Equity Bank Ltd.
20. Family Bank Ltd
21. Fidelity Commercial Bank Ltd
22. Fina Bank Ltd
23. First community Bank Limited
24. Giro Commercial Bank Ltd.
25. Guardian Bank Ltd
26. Gulf African Bank Limited
27. Habib Bank A.G Zurich
28. Habib Bank Ltd.
29. Imperial Bank Ltd
30. I and M Bank Ltd
31. Jamii Bora Bank Ltd.
32. Kenya Commercial Bank Ltd
33. K-Rep Bank Ltd
34. Middle East Bank (K) Ltd
35. National Bank of Kenya Ltd
36. NIC Bank Ltd
37. Oriental Commercial Bank Ltd
38. Paramount Universal Bank Ltd
39. Prime Bank Ltd
40. Standard Chartered Bank (K) Ltd
41. Trans-National Bank Ltd
42. Victoria Commercial Bank Ltd
43. UBA Kenya Bank Ltd