THE USE OF AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM IN IDENTIFYING FRAUDULENT VOTERS' REGISTRATION IN LESOTHO

by

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DECLARATION OF OWN WORK

I, Lesole Johannes Chigando, with student number 46267050, declare that
"The use of automated fingerprint identification system in identifying fraudulent voter's registration in Lesotho" is my own original work and that all the sources that I consulted or used have been indicated and acknowledged by means of complete references.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

15 November 2017

SIGNATURE   DATE

(L.J. Chigando)

ABSTRACT

The research was prompted by constant criticism of the Independent Electoral Commission (IEC) because of its poor voter registration and voters' roll. Free and fair elections are the strong arm of democracy. The identified research problem was investigated by means of qualitative research. A thorough literature study from various sources of information, a case file analysis and structured interviews were used to gather the required data. The interviews were conducted with fingerprint experts, a data processor and constituency electoral assistants from the Lesotho Mounted Police Service, the National Identity and Civil Registry at the Ministry of Home Affairs and the IEC respectively.

It was found that using fingerprints and the Automated Fingerprint Identification System (AFIS) can assist in investigations and in combating voter's fraud, as fingerprints are unique. AFIS can be utilised for various purposes by institutions in the private and public sectors. Like any apparatus, AFIS has its own strengths and weaknesses.

KEY TERMS

Automated Fingerprint Identification System; fingerprint; identification; investigation

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CERTIFICATE BY EDITOR

I, Susan van Tonder, MA Linguistics, ID 6009160072083, hereby declare that I have conducted an English proofreading and grammar edit on the draft dissertation entitled "The Use of the Automated Fingerprint Identification System in Identifying Fraudulent Voters' Registration in Lesotho" by Lesole John Chigando. Mr Chigando is responsible for the quality and accuracy of the final submission.

Susan van Tonder

7 December 2017

DEDICATION

THABO BERNARD CHIGANDO (09 December 1947-1988)
MAPALESA AUGUSTINA CHIGANDO (10 October 1948-2014)

I dedicate this research to my late parents. My father was a law enforcement agent. Through his influence and exemplary leadership, I followed in his footsteps and developed a passion for solving complicated and high-profile cases. My widowed mother, who raised me as a teenager with limited financial support to further my studies, unfortunately passed on during this research on 14 February 2014. May their souls rest in peace.

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LIST OF ABBREVIATIONS AND ACRONYMS

ABC	-	All Basotho Convention
AC Power	-	Alternating Current Power
AFIS	-	Automate Fingerprint Identification System
BNP	-	Basotho National Party
CEA	-	Constituency Electoral Assistant
CRB	-	Criminal Record Bureau
DC	-	Democratic Congress
DNA	-	Deoxyribonucleic Acid
EISA	-	Electoral Institute of Sustainable Democracy in Africa
FBI	-	Federal Bureau of Investigation
IAFIS	-	Integrated Automated Fingerprint Identification System
ICT	-	Information Communication Technology
ID	-	Identity Document
IEC	-	Independent Electoral Commission
LCD	-	Lesotho Congress for Democracy
LAN	-	Local Area Network
LMPS	-	Lesotho Mounted Police Service
MRS		Mobile Registration Station
MRU	-	Mobile Registration Unit
NICR	-	National Identity and Civil Registry
PC		Personal Computer
RSA	-	Republic of South Africa
SAPS		South African Police Service
UNISA	-	University of South Africa
USA	-	United States of America
VPN	-	Virtual Private Network
WAN	-	Wide Area Network

CHAPTER ONE: GENERAL ORIENTATION

1.1   INTRODUCTION

The 1998 general elections in Lesotho were tainted by allegations of election fraud and dissatisfaction by the opposition parties that led to the burning of towns, consequently crippling the economy of the country. The concern is what is the so-called election fraud caused by a poor voter registration process. According to the *Lesotho Times* (2012:2), Lesotho can only go forward in consolidating its democracy if the country is able to conduct free and fair elections whose outcomes are not in dispute. The opposition parties are yet to recover from a defeat suffered in the 03 June 2017, snap election and planning to lodge an appeal in the High Court of Lesotho to verify the votes despite discouraged by the Southern African Development Community (SADC) over contentious issue (Public Eye, 2017:1). Furthermore, the Lesotho Congress for Democracy (LCD) has filed a petition in High Court of Lesotho to cancel the election results of four constituencies that was won by the All Basotho Convention (ABC) as they were rigged (Lesotho Times, 2017:4). The basis for conducting such clean elections is a clean voter register. The researcher believes that this can be achieved by the implementation of an effective Automated Fingerprint Identification System (AFIS) system that interface with other role-players nationally, regionally and internationally to prevent, detect, investigate and prosecute cases of fraudulent registration committed against the Independent Electoral Commission (IEC).

The former Prime Minister of Lesotho, Dr Pakalitha Bethuel Mosisili, who at the time of the 2012 elections was the leader of main opposition party in Lesotho, the Democratic Congress (DC), expressed this belief. On his return from Ghana after heading a Commonwealth Observer Mission for Ghana's Presidential and Parliamentary Elections, he stated that:

> in an attempt to achieve clean voter register, Ghana has started
> registration of voters from the scratch, this was to avoid persistent belief
> in the existence of ghost voters and to bar voters from registering and

voting more than once and introduced a new biometric voter registration system, when one register under this new system, all fingerprints and images are captured. Thereafter an Identity Document is produced with all that information (Sunday Express, 2012:2).

1.2   PROBLEM STATEMENT

A senior Independent Electoral Commission (IEC) official was suspended for allegedly tampering with the voter register as the transgression has caused fears of huge vote – rigging in the May 26 polls (Lesotho Times, 2012:1). Lesotho Times (2012:1-2) further states that, elections monitoring committee has alleged that in Mahobong one political party has set up committees in villages to assist voters to acquire passports to vote and that, people were transferred in thousands from constituencies as a plan to commit elections fraud.

The 2012 elections brought further discontent to stakeholders and political parties regarding the voter registration process. The crux of the matter was the delay in completion of the voter's roll, which was purported to have the registration details of a large number of deceased voters. There was also an allegation that the registration process had been rigged. For example, the Basotho National Party (BNP) alleged that a large number of eligible voters had been transferred in the constituencies Hlotse, Mahobong and Mohale's Hoek in an effort to ensure that the DC got greater support (Electoral Institute of Sustainable Democracy in Africa, 2012).

During preparations for the Lesotho's 26 May 2012 general elections, many Basotho's registered twice or more at different constituency's registration centres or stations with the intention of voting more than once for their respective parties to win. Most of them seemed not to be conversant with the AFIS system and thus unaware that they would be detected, as many Basotho lack exposure to technology. As a result, the IEC reported plus or minus 2 000 cases of duplication, with some people claiming that they registered more than once because voter education was not effective enough, while others were

clearly trying to cheat by voting more than once for their parties to garner more votes (Lesotho Times, 2012:2).

In the run up to the 28 February 2015 general elections, the Electoral Institute of Sustainable Democracy in Africa (EISA) mission noted that voter registration in Lesotho sustainably uses biometric methodology. The law provides for eligible voters to register and verify their details before the election date. Voters who wish to transfer are not afforded enough time to re-register and that has dissatisfied some stakeholders. For the 2015 elections, the IEC maintained that it prepared a data cleansing on the voter's roll. The EISA mission noted a discrepancy in the total number of registered voters and the voting age as per the year "2015-population census". This may justify the calls for further review of the voters' roll (Electoral Institute of Sustainable Democracy in Africa, 2012). The Public Eye (2017:10), reiterates that, reluctance to cast vote in recent polls can be attributed to a defective voter's roll and in last decade voter turnout has declined and experts say this was due to IEC poor data, there have been concerns raised concerning the reliability of the voter's roll.

1.3   AIM OF THE RESEARCH

The aim of any research should demonstrate what the researcher desires to achieve through the research (Mouton, 1996:50). Aims are comprehensive statements of anticipated results, or the overall purposes of the study (University of Southampton, s.a.). The aim of this research is to determine the strengths and weaknesses of the four-point AFIS system and, secondly to explore the strengths and weaknesses of the ten-point AFIS system for identifying fraudulent voter registration in Lesotho.

1.4   RESEARCH DEMARCATION

The statement of the research problem explains exactly what the researcher expects to cover in the study. However, it is also important to appreciate what the researcher is not anticipating the research to focus on. What the researcher is not going to address needs to be demarcated. The limits of the study need to

be cautiously restricted so that the researcher can identify every valuable to be studied (Leedy & Ormrod, 2014:43).

The researcher encountered a number of challenges in delimiting the study. The first challenge was that the South African Police Service (SAPS) and the South African Department of Home Affairs did not grant the researcher permission to interview their experts as envisaged. The second challenge was that the National Identity and Civil Registry (NICR) at the Department of Home Affairs in Lesotho use the ten-point AFIS system, but the data processors are not experts in system and fingerprint science. They are only tasked with capturing fingerprints so that is what the researcher interviewed them on. This research is, therefore, limited to the experience of AFIS in Lesotho.

1.5   PURPOSE OF THE RESEARCH

According to Terre Blanche and Durrheim (2002:39), the purpose of a research project reflects the types of conclusion that the researcher aims to draw or the goals of the research – what the researcher wishes to attain through their study. The main driving force behind a piece of research is sometimes the desire to solve a practical problem or to improve procedures (Denscombe, 2002:27). Guided by Denscombe (2002:26-28), the researcher established the following purposes for the study:

- The paramount purpose of this study was to learn new information on the four- and ten-point AFIS systems to recommend the best for use by the Lesotho Election Authorities.
- The researcher aimed to weigh the strengths and weaknesses of the four-point and ten-point AFIS systems and how they can assist the IEC to detect double or multiple registrations.
- The driving force behind this research was the desire to solve the practical problem experienced during elections with fraudulent voters. The research aimed at improving the current procedure used during the election process to identify fraudulent registration. The purpose was to

arrive at recommendations that would address the problem of fraudulent voter registration.

- The researcher aimed to empower and provide information to fellow law enforcement agents about AFIS as a technique that can assist in fighting corruption and in conducting further research for the IEC with the aim of helping the IEC officials who participated in the research.

1.6   RESEARCH QUESTIONS

The research questions stipulate precisely the objective of research, and are not comprehensive. Moreover, they are not related to the aims of research, as described by Denscombe (2002:31).

The following research questions were investigated:
- What are the objectives of investigation?
- What are the strengths and weaknesses of the four-point AFIS system?
- What are the strengths and weaknesses of the ten-point AFIS system for identifying fraudulent voter registration?

1.7   KEY THEORETICAL CONCEPTS

According to De Vos, Strydom, Fouché and Delport (2007:32), definitions are used to facilitate communication and argument, as they make it possible for the researcher to express a concept more easily and clearly, than they would otherwise be able to do. The key concepts of this study are defined below.

1.7.1 Automated Fingerprint Identification System
AFIS is software used to encrypt fingerprints when these are scanned into it. The assigned features of a scanned-in fingerprint are positioned on the x-y axis of a graph, which creates a map that contains both the location and direction of all the features of the fingerprint (Mokwele, 2016:5).

1.7.2 Fingerprint

Fingerprints consist of replicas of friction skin ridges that originate on the palm side of fingers and thumbs. The same friction skin is also found on the surface of the palm and soles of the feet. Seemingly, the skin surface is naturally ridged to provide the human body with a firmer grip and a resistance to slippage. On closer look, friction skin shows a series of lines that resemble hills and valleys. What one sees as the black lines of an inked fingerprint impression are the shape and form of skin ridges (Saferstein, 2011:539).

1.7.3 Identification

Identification consists of information that identifies a person positively, that is obtained lawfully, and that relates to and originates with that particular person (Gilbert, 2007:442).

1.7.4 Investigation

Van Rooyen (2008:13) describes investigation of crime as a systematic, organised search for the truth. It entails observation and inquiry for gathering objective and subjective evidence about an alleged crime or incident.

1.8 RESEARCH DESIGN AND APPROACH

The bridge between the research questions and the execution or implementation of research is derived from the strategic framework of a research design (Terre Blanche & Durrheim, 2002:29). The researcher followed an exploratory research design as AFIS advantages and disadvantages are unknown in Lesotho. According to Maykut and Morehouse (1994:44), in exploratory research, profound knowledge and the viewpoint of participants are of vital importance for broad interpretation of results in a study conducted for an undefined problem to find vague areas of research. It looks for insights into phenomena by employing an open, simple and inductive method. (Terre Blanche & Durrheim, 2002:39). Since exploratory studies usually lead to insight and comprehension, this type of study frequently involves the use of structured interviews.

The current study used a qualitative approach. According to Jackson (2008:88), qualitative research focuses on phenomena that occur in natural settings, and the data are analysed without the use of statistics. Interviews, case file analysis and secondary source information obtained from a literature study were the sources of information for this research. The researcher went out into the field and learned from the experience and knowledge of the participants as suggested by Mouton (2001:149). The researcher interviewed the AFIS technicians (Constituency Electoral Assistants or CEAs) who worked for the IEC and were tasked with the registration of voters and the Lesotho Mounted Police Service (LMPS) fingerprint experts and Data Processor at National Identity and Civil Registry (NICR) at the Department of Home Affairs.

1.9   TARGET POPULATION AND SAMPLING METHOD

De Vos et al. (2007:193) define population as a set of entities in which all the measurements of interest to the researcher are represented. A sample, according to De Vos et al. (2007:194), comprises elements of the population that are considered for actual inclusion in the study. The population consisted of four-point AFIS technicians (CEAs) from the IEC and fingerprint experts from the LMPS – Criminal Record Bureau (CRB).

The probability and non-probability sampling process was combined in this research in the form of systematic random and purposive sampling methods. Probability sampling suggests that each member of the population stands the same chance of being selected (De Vos et al., 2007:198). In non-probability sampling the odds of selecting a particular individual are not known because the researcher does not know the population size or the members of the population (De Vos, et al., 2007:201).

A target population is the population to which the researcher would like to generate his or her results (Welman & Kruger, 1999:122). McMillan and Schumacher (2006:119) state that a population is a group of elements or cases, whether they are individuals, objects or events, that conform to specific criteria and to which the researcher intends to generalise the results of research. The

target population for this study is the Lesotho AFIS technicians (CEAs) of the IEC, who are tasked with capturing fingerprint data into the four-point AFIS, the LMPS fingerprint experts and data processors at the NICR.

1.9.1 Simple random sampling

Lesotho is known as the Mountain Kingdom, which reflects the fact that many villages are not accessible by vehicle but on horseback only because they are situated either high up in the mountains or in deep valleys, and take days to reach. Unfortunately, the voting population is spread all over the country and the constituencies are situated in areas that take days to reach and return. The only fast option for reaching them is to use a helicopter, which is too expensive.

In light of the above, the researcher decided to concentrate on urban and peri-urban areas and left out the population of remote areas because of distance and difficult terrain. There are 80 AFIS technicians attached to the IEC who are responsible for the registration process, with the total number of technicians in the urban and peri-urban areas amounting to 60. The researcher narrowed down the sample of 60 by identifying the AFIS technicians from the IEC with more than five years' experience and got 40 technicians. Technicians with five years' experience were selected because they were expected to make a better contribution than technicians with one year of experience, which would result in research that is more valid. From this number, a sample of 19 AFIS technicians was selected by using the simple random sampling technique. These technicians formed Sample "A". The simple random sampling method as described by Leedy and Ormrod (2005:201) was applied in order to ensure that each technician had an equal chance of being selected as simple random sampling is useful for giving every member of the population an equal chance for selection (Leedy & Ormond, 2005:201-202).

In order to select the sample using the simple random sampling process, the researcher defined the sample population as the 40 AFIS technicians from urban and peri-urban areas with over five years of experience and wrote the 40 names each on a separate piece of paper. He put the names in a box and then drew 20 names from the box to form the sample. The researcher ended up

using only 19 participants as one AFIS technician was on leave at the time of the interviewing process.

There are only two fingerprint experts in Lesotho who are still serving in the LMPS – CRB both were taken and called Sample "B", because there are limited numbers of individuals with expertise in fingerprints, the researcher decided to interview the two serving fingerprint experts.

1.9.2 Purposive sampling

In purposive sampling, the choice of units is made on purpose; for example, people with different characteristics or groups with various viewpoints that may be suitable for investigating a research problem. This rationale should always be applied when selecting participants. (Leedy & Ormrod, 2005:206). The data processor from the NICR was considered well suited to be selected through purposive or judgemental sampling as Sample "C". The reason for selecting this participant was that he had over five years' experience in using the ten-point AFIS system in Lesotho for the issuing of national identity cards for Basotho citizens and non-citizens and had been using the ten-point AFIS system daily since its inception on 7 July 2012. The researcher was of the opinion that his experience would fill the gap left by Sample "A" and he was requested to describe the ten-point AFIS system, to name the advantages of the system and demonstrate or explain thoroughly how it works in Lesotho.

In total, the study sample consisted of 19 AFIS technicians from the IEC with more than five years' experience as Sample "A" and experts from the LMPS as Sample "B", the data processor from the NICR, as Sample "C".

1.10 DATA COLLECTION

Guest, Namey and Mitchell (2013:3) consider text, images and sounds to be the three main forms of qualitative data. Additionally, they divide text into the categories of object of analysis and proxy for experience. There are different techniques for collecting data and Badenhorst (2007:20) states that in academic context evidence from research comes from two sources: (i) primary

data, such as interviews, observations and experiments, and (ii) secondary published data.

The researcher used primary and secondary data and is of the view that interviews as primary data are first-hand evidence from participants. Interviews are beneficial but may be time consuming in some instances. Literature sources as secondary data are accurate data that can be validated as the sources will be quoted and make research more reliable but likewise they may be time consuming. According to Blaxter, Hughes and Tight (2006:153), all research involves the collection and analysis of data, whether through reading, observation, management and asking questions or a combination of these or other strategies. The researcher consulted literature sources, analysed the cases reported to the LMPS and interviewed IEC technicians.

The researcher used triangulation to obtain data. According to Neuman (2011:149), triangulation involves the use of more than one source on the same topic. Denscombe (2002:104) explains that triangulation provides the social researcher with the means for assessing the quality of data by coming at the same thing from a different angle.

1.10.1 Literature

The researcher visited libraries for information on the topic under investigation guided by the aims and questions of the research. The researcher also collected information on investigation, AFIS and fingerprints, identification, and the strengths and weaknesses of the AFIS system to gain insight into and obtain information about the topic. He consulted international and local books, journals, newspapers and the internet sites of companies that deal with the biometrics and Information Communication Technology. The Information Technology Department of the IEC was also visited to obtain general information about the four-point AFIS system. The information was extracted from the relevant data sources, then analysed to establish whether the authors' opinions and findings coincided or varied. The Unisa Institutional Repository (UnisaIR) was visited and researcher found some material and research on investigation, fingerprints, technology and identification, and obtained

information concerning those concepts but did not find any dissertation with a similar topic.

The researcher used questions in the interview schedules as a standard when gathering literature and those questions were derived from the questions and aims of the research. The first step in tracing relevant literature on a particular topic is to list the headings or keywords under which it may be classified in the catalogue of a library or in a computer retrieval system (Huysamen, 1994:190). Leedy and Ormrod (2005:65) state that a good way to start is to identify one or more keywords or short phrases summarising the research topic that can point the researcher toward potentially useful resources.

1.10.2 Case file analysis

The case study is a qualitative method that can be used for gathering in-depth data about an individual, a programme or for learning more about an unknown or poorly understood situation (Leedy & Ormrod, 2005:108). The researcher was granted permission to conduct research at and visited the LMPS, where he perused 17 reported cases of contravening the National Assembly Electoral Act, of 2011, in terms of which people registered more than once during the 26 May 2012 general elections. The duplication was detected by the Information Technology Department of the IEC when data from the constituencies was fed into the system after registration as a method of housekeeping to check duplication (data cleansing). The researcher took all 17 cases as a sample.

During the case file analysis, the researcher searched for answers to the following questions:

- Which AFIS system was used?
- Did a fingerprint expert identify the matching fingerprint-points needed during the comparison process?
- Which fingers did the suspects commonly use?
- Was the motive or modus operandi behind the fraudulent registration similar?
- Was somebody charged?

- Was there a conviction?
- If there was an acquittal, what was the reason for this?

1.10.3 Interviews

To collect data and to learn about the ideas, beliefs, views, opinions and behaviours of participants, one can use an interview as a two-way conversation (Maree, 2007:87). The researcher conducted individual face-to-face interviews, in accordance with the guidance given by Leedy and Ormrod (2010:188). Face-to-face interviews have the benefit of assisting the researcher to create relationships with potential participants and in this way to get their cooperation. Interviews were conducted in the form of structured individual interviews.

It is advantageous to use structured interviews as they help overcome misunderstandings and misrepresentations, and ensure that participants do not omit difficult questions. The scheduled interview is the most structured way of getting information from participants (Bless & Smith, 2000:105).

The researcher used two interview schedules, which are attached as: Attachment "A" to interview AFIS technicians at Lesotho's IEC as Sample "A", the LMPS fingerprint experts as Sample "B" and Attachment "B" for interviewing the ten-point AFIS data processor at the NICR as Sample "C". Unfortunately, he was refused permission to conduct interviews with AFIS experts from the Department of Home Affairs in the Republic of South Africa. The questions on the schedules were guided by the research aims, research questions and the topic of the research. The questions took the format of a combination of open-ended and closed questions.

The researcher conducted interviews within the stipulated guidelines for productive interviews as outlined in Leedy and Ormrod (2010:149-152) as follows:
- Identify questions in advance: The researcher compiled interview schedules from the research questions to allow the participants to express themselves freely and asked a mixture of open-ended and

closed questions. The researcher used the research questions, aims and purpose to identify the questions for the interview schedules.

- Find a suitable location: The researcher conducted the interviews at participants' workplace: venues were free from disturbances and conducive for interviews, and privacy and anonymity of the identity of participants were observed.

- Get written permission: The researcher obtained written permission to conduct the research from the LMPS (see Annexure A), IEC (Lesotho) (see Annexure B) and Department of Home Affairs – NICR (see Annexure C). The Department of Home Affairs in the Republic of South Africa sent a letter declining the researcher's request to conduct research (see Annexure D). Once interviews were arranged, and prior to conducting the individual interview, each of the participants was asked if they had any objections to the interview being recorded and they all agreed to be recorded and interviewed, and individually gave consent to the researcher to proceed (see Annexure E).

- Establish and maintain rapport: The researcher showed courtesy and respect at all times, and showed interest in all interviews. The questions were based on the participants' experience with the AFIS system.

- Focus on the actual rather than the abstract or hypothetical: The researcher mainly focused on the four-point and ten-point AFIS systems, the fraudulent transactions that had occurred at the IEC and how the police had investigated the cases.

- Do not put words in a participant's mouth: The researcher used a mixture of open-ended and closed questions to give the participants space to respond conclusively.

- Record responses verbatim: The researcher recorded everything that was said by the participants with the aid of a digital tape recorder.

- Keep reactions to yourself: The researcher showed interest in and composure to the responses from the participants.

- Remember that you are not necessarily getting the facts: The participants' responses were treated as perceptions rather than as facts.

1.10.3.1 Piloting of interview schedule

It is beneficial to test different questions on interview schedules for clarity purposes by piloting them. People close to the realities of the actual study are relevant to pilot observations and interviews, and participants should be drawn from the target population (Glesne, 1999:38).

After he had compiled the interview schedule for the CEAs, the researcher tested the interview schedule by physically going out to interview five CEAs from the IEC who were not part of the sample selected for study. He managed to complete three interviews, as one officer was attending a funeral, and another could not be reached. The three interviews were considered sufficient for determining whether the questions were clear and understandable. Where the interviewees encountered problems with the questions, the questions were adjusted and clarified. All these people were selected by their accessibility, availability and their willingness to participate. The interview schedule for the data processor at the NICR was sent to the researcher's co-supervisor for reading and was also adjusted and clarified accordingly.

1.11   DATA ANALYSIS

The analysis of data involves categorising, ordering, manipulating and summarising the data to obtain answers to the research questions. Data analysis is meant to reduce data to a logical and clear form to study, test and draw conclusions from regarding the research problems (De Vos et al., 2007:218). There is no single "right" way to analyse the data in a qualitative study (Leedy & Ormrod, 2005:150).

The researcher used the data analysis spiral approach as detailed by Leedy and Ormrod (2005:150-151), taking the following steps:

- The researcher organised the data from the different data-collection techniques (literature, interviews and case file analysis) using a Microsoft-Spreadsheet

- The researcher perused the entire data body several times to get a sense of what it contained.
- General categories or themes were identified, along with subcategories or subthemes, and each piece of data was classified to extract its meaning.
- The data was integrated and summarised for the research report. This included offering propositions or hypotheses that described the relationship among the categories. The data was also presented in an organisational scheme, such as a tables, diagrams and hierarchies.

1.11.1 Summary of background information

The information was gathered from the AFIS technicians at the IEC – Sample "A" – as follows:

- All the AFIS technicians from the IEC were involved in the registration of 26 May 2012 general elections using the system to capture eligible voters on a daily basis from the opening of registration process by the IEC.
- Most of them had more than ten years' experience.
- They all used the AFIS system.
- They could register more than one hundred eligible voters per day during the registration period.
- The technicians had also received a basic training on AFIS operations, which covered: capturing of photographs, fingerprints and the particulars of applicants, and, thereafter, the printing of the voter's card.

The background of the LMPS fingerprint experts – Sample "B" – was as follows:

- The fingerprint experts from the LMPS had more than ten years' experience.
- None of them made use of the AFIS system.
- They dealt with a number of fingerprint identification cases.
- None of them had received training on the AFIS system.

The background of the data processor – Sample "C" – was as follows:

- The processor had used the ten-point AFIS system since its inception on 7 July 2013 and used the AFIS system on a daily basis when capturing national identity card applications.
- The data processor had received training on how to use the ten-point AFIS system.
- The data processor registered more than one hundred identity document applicants per day.
- He had more than five years of experience.

1.12 METHODS USED TO ENSURE VALIDITY

The validity of a study concerns the accuracy of the questions asked, the data collected, and the explanation offered. Validity also relates to the data and analysis used in the study (Denscombe, 2002:100). According to De Vos et al. (2007:160), an empirical measure that accurately reflects the concept it is intended to measure is called valid. The relevant information was obtained openly and anonymously from the targeted population by means of face-to-face interviewing and open-ended and closed questions.

According to Creswell (2014:201), one of the strengths of qualitative research is its validity, which is centred on determining whether the findings are accurate from the understanding of the researcher, the participants and the readers of the study report. The researcher applied some of eight primary strategies for ensuring validity as described by Creswell (2014:201-203):

- Triangulation: The researcher used different sources and methods to research a specific point to get a real understanding of the point. The researcher utilised multiple data-collection strategies to verify results and different data sources of information to build a coherent justification for the themes identified.
- Use member checking: Accuracy was determined by conducting follow-up interviews with the participants and providing them with an opportunity to comment on the findings.

- Use a rich, thick description to convey the findings: The researcher provided detailed descriptions of the setting and offered many perspectives about the themes identified.
- Clarify any bias the researcher might bring to the study: The researcher undertook self-reflection and put aside his experience in fingerprint science and his qualification in policing to focus on the real issues on the ground.
- Present negative or discrepant information that runs counter to the themes: During the discussions, the researcher brought information contrary to the topics under discussion to build evidence on each topic.

1.13 REPRESENTATIVENESS

Leedy and Ormrod (2014:105) state that whenever researchers need to study a large group of subjects, they often study a sample from that group and then draw inferences about the group as a whole. That sample is termed a "representative sample". Using a sample allows the researcher to obtain information from the smaller sample and generalise it back to the entire population (Ruane, 2005:105). According to Gravetter and Forzano (2009:131), the representativeness of a sample relates to when a small quantity of a population precisely reflects the larger population and that translates as a representative sample with equivalent features of the entire population.

According to Leedy and Ormrod (2014:294), it is ideal for researchers to want participants in a research study to be a representative sample of the population about which they wish to draw. For the purposes of this study, the researcher intentionally selected the CRB fingerprint experts as sample because of their expertise and as there were only two of these officials in the service of the LMPS. The CEAs from the IEC were selected, based on the notion that they had more than five years' experience in the field as technicians. One data processor with five years' experience from the Ministry of Home Affairs was selected to fill in the gaps left by Samples "A" and "B" in relation to the ten-point AFIS system.

1.14 METHOD USED TO ENSURE RELIABILITY

Blaxter et al. (2006:221) state that reliability has to do with how well the researcher has carried out a research project. An instrument is considered reliable if the same instrument is used to measure and reliably gives similar results under comparable circumstances; the focus is not on what is measured, but how reliably that instrument measures (De Vos et al., 2007:163). Reliability therefore means dependability or consistency (Neuman, 2011:196).

For Creswell (2014:203), qualitative researchers should record the processes of their case studies and all the stages they go through. He recommends the formation of a thorough case study procedure and database, in order to allow others to follow procedures, and rectifying errors during recording and ascertaining that participants attend all interviews.

The researcher used the following reliability procedures for qualitative research as described by Creswell (2013:251-253):

- Rectifying errors: The researcher checked the interview transcripts to make sure that they did not contain obvious mistakes made during transcription, and proofread all material and edited it where necessary.

- Attendance of meetings: The scheduled interviews were attended, well documented and the analysis shared. The researcher approached the district managers to make sure that they arranged meetings with the participants as scheduled.

- Credibility: To ensure credibility the researcher solicited participants' views during the interviews to gain clarity on their answers and what might be missing from them.

- Transferability: For transferability, rich, thick descriptions of the systems under investigation were attained through demonstrations by each participant at constituency. Demonstration means that the participants came with all their equipment to the interviews to demonstrate how things are done and what they are you refereeing to

- Dependability: This was achieved by ensuring stability and consistency that all the interviews are logical, recorded and participants' responses captured on the interview schedules.

- Confirmability: On the issue of confirmability, the researcher avoided bias and did not ask the participants leading questions.

- Trustworthiness: The researcher assured the participants that their responses to questions asked would stay anonymous to avoid any form of victimisation.

1.15   ETHICAL CONSIDERATIONS

In research, the researcher should be aware of the general agreement about what is appropriate and inappropriate in scientific research (De Vos et al., 2007:56). The researcher considered ethical conduct when undertaking the research; he consulted and applied the Ethicality Policy of the University of South Africa (Unisa, 2013) and referred to Leedy and Ormrod (2005:101-103), Babbie (1998:444-445) and Friedman (1998:87). From these sources the researcher established that it is imperative to adhere to the following ethical principles during research:

- Avoid harm: The researcher was sensitive and did not expose participants to any form of unethical behaviour, and considered every question posed to participants and their responses confidential. Participants were all assured that their names would not be used in the research, and each one was given a number: from one to forty, for the AFIS technicians, and one and two in respect of fingerprint experts. Participants were referred to by their number in the research report

- Obtain informed consent: The participants consented to take part and signed the prescribed "Informed Consent Form" under the terms and conditions set by the researcher. They were asked to make objections if they had any and all agreed to be on record in the form of a camcorder to ensure transparency during the interviews

- Do not violate privacy: The researcher did not violate any rights or privacy as individuals might have risked losing their jobs. The assurance

was made to the participants on their informed consent form that everything they said would be kept confidential. If anything needed to be disclosed it would be done with their approval

- Be honest with professional colleagues: Under no circumstances did the researcher fabricate data to support a particular conclusion, no matter how seemingly "noble" that conclusion might have seemed to be. A digital tape recorder was used to record the interviews in order to refer back to when the need arose, and the participants' ideas and views were acknowledged

- Acknowledge sources consulted: The literature sources consulted were acknowledged, as well as any person's ideas or words used in the study, and included in the list of references

1.16 RESEARCH STRUCTURE

This dissertation has the following structure:

Chapter 2:   The objectives of investigations

In this chapter, the focus is on the concepts of the fingerprint and fingerprint identification, and the investigation of crime as well as identification and individualisation techniques.

Chapter 3:   The AFIS systems

This chapter focuses on AFIS systems and the disadvantages and advantages of the four- and ten-point AFIS systems. The chapter also deals with fraudulent voter registration.

Chapter 4:   Findings and recommendations

This final chapter summarises the findings of Chapters 2 and 3. Recommendations are then made based on these findings.

CHAPTER TWO: THE OBJECTIVES OF INVESTIGATIONS

2.1 INTRODUCTION

Determining what happened and who is responsible is the process of any investigation in which one establishes, gathers, prepares, detects and presents evidence (Bennett & Hess, 2001:3). Then, the objectives of investigations will be discussed and clarified, and the investigators will adhere to and adopt certain standard operating procedures of every investigation for legally obtaining evidence and sending cases to court. Investigators are also required to be conversant with investigative aids and relevant clues, such as the fingerprints that may assist to solve or prove cases beyond reasonable grounds in court and it is important for all law enforcement agents to have a basic understanding of fingerprint patterns and the technique for recording them (Gilbert, 2007:442).

The Oxford Dictionary of Current English (2004:985) defines being "objective" as not being influenced by personal feelings or opinions in considering and representing facts. Therefore, in this chapter, the researcher will focus on the concept 'criminal investigation', the objectives of investigation, forensic investigation and the difference between criminal and forensic investigation. The researcher will discuss identification and individualisation, and difference between the two concepts. The researcher will unpack the study of fingerprints, focusing on latent fingerprints, fingerprint identification and the purpose of using fingerprint identification in investigations in the public and private sectors. Lastly, the researcher will discuss the categories of identification. A basic understanding of the words and terminology frequently used in the investigation field is essential in familiarising oneself with the total criminal justice system, and a basic knowledge of the crime elements is essential for investigators.

Identifying the crime or incident will dictate what evidence needs to be collected irrespective of modus operandi or type of crime committed. The investigator must present evidence that will be sufficient in court to prove all elements of crime. Without an understanding of this, there is no hope that the investigator

will see a conviction in a court of law (Van Rooyen, 2008:27). This chapter will focus on the first research question; what are the objectives of investigation.

2.2   INVESTIGATION

Myren and Garcia (1989:19), states that the word research means to search again, replication of the process in order to confirm or expand the initial result. The correct meaning stresses that research is cautiously planned, thorough, and comprehensive process of searching for information. This means that the research and investigation are, if not same, at least closely related concepts. One of the definitions of the transitive verb "to investigate" is "to follow the trace of" or "to track," meaning that derived from the Latin word *"vestigium"* meaning "footprint," "trace," or 'sign." As a noun, investigation means the act of investigating or of inquiring into some matter.

Dempsey (2003:29) concurs and defines the word "investigate" as "to search and find into something chronologically and thoroughly". The word "investigate" comes from the Latin word *investigare*, meaning to "search into". *Investigare* is derived from another Latin word, *vestigare*, which means "to track or trace". According to Myren and Garcia (1989:19), in the past investigation main use was for reconstruction of the incidents to take action, like the investigative reporting or police work.

Palmiotto (1988:1), further states that an investigation is an important part of most academic disciplines and professions, including the medical profession, astronomy, chemistry and psychology. Even managers who are concerned with productivity, morale, or disciplinary problems must at times function as investigators. In the criminal justice system field, there exists a wide spectrum of jobs and positions that require knowledge of the investigative process. Youth counsellors, probation officers, parole officers, and law enforcement personnel are only a few of the criminal justice positions that require skills in investigative techniques.

Buckwalter (1984:10) classifies investigations as four general types: civil, criminal, personal and industrial. Investigations may be concerned with civil

litigations, criminal prosecutions and defence, or with personal or business matters that do not involve the courts, such as business background and credit investigations and the search for missing persons. Berg and Horgan (1998:6) and Sennewald and Tsukayama (2001:3) concur that an investigation is the searching for and examination, study, tracking and gathering of factual information that answers questions or solves problems. It is more an art than a science. Although the person engaged in investigation is a gatherer of facts, he or she must develop hypotheses and draw conclusions based on available information. The investigative process is a comprehensive activity that involves information collection, the application of logic and the exercise of sound reasoning.

For Goddard (1977:1), investigation will normally result in two directions: the first one gathering of information from victims, witnesses and suspects and the second one searching for valuable clues that will corroborate a statement or crime committed. Thus, investigation is explained as a systematic, organised search for the truth. This involves searching for direct and indirect evidence in relation to the crime or incident (Van Rooyen, 2008:13).

An investigation is considered successful when evidence is collected in chronological order, obtained legally, there is continuity of possession, suspects and witnesses are interviewed, and leads are collected and well documented with a clear and concise report (Hess & Wrobleski, 2006:318). Once the investigation has reached its concluding phase, the investigation docket is sent to the prosecutor to institute prosecution if there is enough evidence that a crime has been committed. If the prosecution decides to prosecute, the charge sheet will be drafted and a date of trial and the court of trial set. The investigating officer is responsible for securing the attendance of the accused and witnesses by serving subpoenas stipulating the court date and place of trial. Then the docket can be handed over to court prior to the date of hearing to enable the prosecutor to prepare for trial (Joubert, 2005:211).

The Sample "A" and Sample "B" was asked this question: Based on your knowledge, what is your understanding of the concept investigation?

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said investigation is to gather evidence and give direction to the investigator pertaining to a certain case in order to take the actual perpetrator to the courts of law.
- Expert number two said investigation is to investigate the case, arrest the suspect and bring them before the courts for prosecution.

The response to the question indicated that the two experts had some idea of what is meant by "investigation". Sample "A" members did not have any investigation experience. This may be because the AFIS technicians are civilians who do not know about investigation. Therefore, "an investigation is nothing more or less than a search for the truth" (Buckwalter, 1984:3).

2.3   CRIMINAL INVESTIGATION

According to Gilbert (2004:29-30), criminal investigation in the United States of America is meticulously administered by the application of law. All investigators must be familiar with the prescribed lawful procedures applicable to every phase of the detection process. The early changes of criminal law into its present state were neither fast nor without considerable resistance. Criminal law, and the procedures for dealing with criminal evidence, is the results of centuries of questioning and defining the necessity of applying criminal justice. An investigation, therefore, is the systematic and thorough examination of and inquiry into something or someone and the writing of a report to that effect, and that investigation of crime is a vigorous process (Dempsey, 2003:29).

Joubert (2005:209) maintains that the purpose of the criminal justice process is to ensure that the people responsible for the commission of offences are held accountable. It is the responsibility of the main role players in this system, namely the police service, Department of Justice and the Department of Correctional Services, to ensure that criminals are identified, brought to court, given a fair trial and, if convicted, serves their sentences. In this process, the law enforcement agents apply different forensic methods and techniques to

gather evidence and assist to identify suspects, the information collection to secure a conviction (Swanson, Chamelin & Territo, 2003:1).

The ultimate goal behind the pre-trial process is to assess if there is enough evidence against the suspect to secure a conviction. Then, a docket form of a case with statements, documentation and relevant information is opened. The police need to have enough legal powers to make an arrest, conduct a search and seizure and fingerprint suspects. This implies that police should have skills and knowledge of the law to understand their mandate. It is also important that investigating officers bear in mind the rules and the law of evidence during their investigation because not all information and exhibits are admissible as evidence in court. Each step in the investigation process is recorded in the investigation diary in the docket (Joubert, 2005:210-211).

According to Geldenhuys (1997:350), the police by means of overt methods of investigation investigate the majority of criminal offences. These include sealing off the crime scene of the crime; observing the scene to find clues that may give an indication as to who may have committed the offence. Lifting fingerprints from the objects at the scene of crime; questioning people who may have information relating to the commission of the offence; questioning suspects; conducting forensic tests; and compiling identikits of suspects.

Stelfox (2009:6-7) is of the view that the problem with criminal investigation is the need to prove crime beyond reasonable doubt, even when the crime is committed in unpredictable, complex ways. In order to achieve this effectively investigators should:

- Know relevant laws, offender profiles, human conduct, and investigative methods and techniques;
- Be equipped with interviewing and search and seizure skills in the criminal investigation field;
- Have an appreciation for problem solving skills and know how and when to apply them in every situation; and

- Have an understanding of the social context of the environment in which the investigation is undertaken and the impact of the crime on victims, witnesses and the community at large.

Bennett and Hess (2001:3) furthermore state that an observant police officer can initiate an important criminal investigation, sometimes without realising it at first. Criminal investigation combines art and science and requires extraordinary preparation and training (Bennett & Hess, 2001:3). Weston and Wells (1990:1) are of the opinion that criminal investigation is a lawful search for people and things useful in reconstructing the circumstances of an illegal act or omission and the mental state accompanying it. It is a probing from the known to the unknown, backward in time, and its goal is to determine truth as far as it can be discovered in any post-factum inquiry.

Gilbert (2007:56-62), divides the criminal investigation process into three general phases; that is:
- The preliminary investigation: This serves as the foundation for the case; therefore, it must be a proper foundation, or the investigation may be put at risk. It includes identifying which crime has been committed, arresting a suspect if possible, reporting the crime scene, identifying victims and witnesses, obtaining relevant statements, and processing the crime scene Gilbert (2007:56).
- The in-depth investigation: This is the follow-up of initial leads stemming from the preliminary investigation. At this stage, preliminary data is re-examined and the crime scene is revisited and processed further. The documents are also processed, relevant facts and evidence gathered, and relevant forensic methods and techniques applied Gilbert (2007:60-61).
- The concluding investigation: This grows directly from the previous two stages. If preliminary and in-depth investigations have been unsuccessful in identifying, locating and arresting a suspect, an administration decision about whether to continue the case must be

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made. Either the case is suspended, or it is successfully concluded and prepared for prosecution Gilbert (2007:62).

According to Gilbert (2007:33), criminal investigation is a rational, impartial and legal inquiry into a suspected commission of crime. Successful investigations can answer the following questions:

1. Does the law prohibit that criminal act?
2. What is the date and time of the offence?
3. Who are the actual perpetrators, aiders, abettors and accessory after the fact?
4. Is there a competent and compellable witness to that crime?
5. Is there relevant and admissible evidence of the offence?
6. What was the modus operandi?
7. Is there a lack of evidence or is the evidence enough to solve the crime?

Lyman (2013:10) is of the view that criminal investigations are conducted in three different ways:

1. The investigation addresses crimes that have already been committed. In this way, the investigators respond to crime, gather evidence, identify and interview witnesses, and identify and apprehend the suspected offender.
2. Investigations can also work as a crime-prevention initiative to predict criminal activity, like other illegal and organised crime investigations, and differs from the other two investigation initiatives in that:
   - The investigation is made before the commission of a crime.
   - The suspect is identified before the commission of a crime.
3. Investigations are sometimes used as a preventative tool, and as crime deterrence reached by apprehension of the suspected criminal and successful prosecution.

The participants from Samples "A" and "B" were asked to define the concept "criminal investigation":

All participants from Sample "A", the CEAs at the IEC, did not know the concept "criminal investigation" as Sample "A" members did not have any investigation experience.

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said criminal investigation is used to assist investigators to take the right direction and eliminate suspects, and/or identify actual perpetrators.

- Expert number two said criminal investigation is to investigate an offence.

The responses to the question indicated that the participants from the IEC did not understand the meaning of criminal investigations. The apparent reason for this is that the AFIS technicians are civilians who did not know about the criminal investigation, but simply understood that criminal investigation is about gathering information, knowing what crime has been committed, detecting the crime and then taking the suspects to court for prosecution.

Joubert (2005:33) states that police officials are responsible for upholding and enforcing the law, in practice they primarily deal with incidents that concern criminal liability. Since members of the public often report every grievance to the police, even if it involves civil matters, it is important for police officials to distinguish between incidents that give rise to criminal prosecution and those that lead to civil liability. A police official should advise a complainant, where the matter does not involve criminal liability, to contact either a lawyer or the relevant regulatory body for assistance.

2.4   OBJECTIVES OF INVESTIGATION

According to Weston and Wells (1990:3), the objectives of an investigation are to collect information and leads that can assist to identify a suspect for arrest and prosecution. The solving of cases with enough evidence, then prosecuting with enough evidence, serves as justice to the victims of crime. The continuity

of possession or chain of custody should be maintained, and evidence gathered in a lawful manner that can prove that the accused is guilty beyond reasonable doubt (Adams, Caddell & Krutsinger, 2004:2).

Buckwalter (1984:25-26) and Dempsey (2003:29-30) concur with this view and include in the objectives of investigation the following:

- Deciding whether there is enough evidence to prove all the elements of the suspected crime.
- Gathering enough relevant evidence to prove or disprove the case in issue.
- Tracing additional evidence.
- Identifying the person or property involved.
- Discovering any evidence that will support the witness.

Du Preez (1996:4-7), Khan (2007:17) and Lyman (2013:7), mention additional objectives of investigation as follows:

- Identification of crime: deciding which crime has been committed and, if any, what information or valuable clues can be collected.
- Gathering evidence: all the evidence compiled in a case docket in chronological order in the form of written and oral statements from witnesses as well as exhibits that are attached.
- Individualisation of crime: emphasis here is the participation of the suspect in the alleged unlawful act committed and the possibility that the offender, based on the information and evidence gathered during the investigation, has committed a crime.
- Arresting the criminal: after gathering all relevant information, collecting facts and identifying the suspect, the next step is to apprehend the suspect to secure his or her attendance in court on the trial date.
- Recovering of stolen property: to restrict the victims loses to a minimum and to present the recovered property as evidential material at the trial.
- Involvement in the prosecution process: to assist the prosecutor in the prosecution process, by making sure that everyone and everything is present in the court on the trial date.

Khan (2007:17-18), further states that a successful investigation has the following features:

- It follows a chronological chain of events.
- Evidence is constitutionally gathered.
- There is a thorough interview of witnesses.
- Suspects are interrogated within the law.
- All relevant clues are established.
- A conclusive and concise report is compiled.

Sample "A" and "B" were asked: What according to your understanding are the objectives of investigation?

Sample "A", the CEAs at the IEC, responded as follows:

- Eight participants could not answer the question.
- Seven participants said the objective is to get thorough knowledge.
- Two participants said it is to search for the truth.
- Two participants said it is to confirm whether an alleged crime has been committed.

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said the objective of investigation is to eliminate suspects in order to arrest and take the case to court.
- Expert number two said the objective of investigation is to collect the exhibit, obtain statement or evidence, arrest the suspect and take the case to court.

The responses to the question indicated that Sample "A", the participants from IEC, did not fully understand all the objectives of investigations, but did understand that it is about gaining thorough knowledge about what transpired, searching for the truth and confirming whether an alleged crime has been committed. Sample "B" understands the objectives of investigation that is to gather relevant evidence, arrest and prosecute the offenders.

Based on the literature reviewed and the responses of the participants, the researcher concluded that the primary objective of investigation whether criminal or civil is to determine, to the extent possible, the truth about how a crime occurred. Despite the numerous safeguards built into the criminal justice system, it is possible that an innocent person could be convicted and punished for a crime he or she did not commit. It is imperative to avoid this by fulfilling the objectives of investigation.

It is the investigator's obligation to ensure that injustice does not occur. Bias in identifying witnesses, and lack of physical evidence, will prevent the investigator from reconstructing the incident. Poor management of cases will also result in the accused being found not guilty (Brown, 2001:3).

2.5   FORENSIC INVESTIGATION

There are two different explanations of the word "forensic". The first one relates to "courts of law, juristic or court directed" and to the "use of scientific method" to decide which crime has been committed. The second one relates to the function of "examination or analysing" (Van Rooyen, 2008:14). Bradley (2004:25-26) and Van Rooyen (2008:14) concur that "forensic" simply means related to law and "science" generally refers to a professional field that has accepted standards, on which practitioners have to be trained over an extended period. Stelfox (2009:130-131) agrees that the term 'forensic' means relating to courts or to the law and suggests that in relation to criminal investigation, the term was originally applied to the techniques of biological or physical science that were used during a criminal investigation or in the interpretation of evidence. These techniques became collectively known as "forensic science".

Forensic investigation is mostly connected with the investigation of cybercrime, which includes corruption, fraud, misappropriation and/or other white-collar crimes (Van Rooyen, 2008:14). McCartney (2006: ix), Du Preez (1996:08), Bradley (2004:25-26) and Van Rooyen (2008:87) share the view that forensic investigations are often complex. They involve many disciplines; for example, legal information, technology, auditing and undercover operations and an

assortment of uncommon skills. The forensic investigator must often have a comprehensive understanding of criminal, civil, and labour law. Forensic investigations are also time consuming and require money and patience. Then, finally, the investigator needs to ensure that the process is highly structured and meticulously executed.

According to Nickell and Fischer (1999:2-3) the forensic investigation's real aim is to establish the individuality, or to approach it as closely as possible. However, the researcher's view is that the fraudulent voter registration in Lesotho can be an exception. In this case, the application of forensic investigation capabilities may assist in the prevention, detection, investigation and prosecution of fraudulent registration at Lesotho's IEC. Du Preez (1996:8) maintains that criminalistics is primarily concerned with the implementation of the methods, techniques and instruments of the natural sciences in the investigation of crime.

Van Rooyen (2008:87-102) has identified 10 critical steps of forensic investigations as follows: reporting of allegation, agreement for the investigation plan, planning and preparation of investigation process and case management, gathering information, analysis and verification, recording evidence, instituting legal proceedings, sending the case to court or holding a disciplinary hearing and implementing preventative measures. Once these steps are followed, they can be used to investigate sophisticated crimes. The primary objective of the forensic investigator is to appreciate that crime is detectable.

The participants were asked: "According to you, what is forensic investigation?"

Sample "A", the CEAs at the IEC, responded as follows:
- Thirteen participants did not know what forensic investigation is.
- Three participants said it is an investigation of offence by application of fingerprints.
- One participant said it is an investigation based on fingerprints and technology.

- Two participants said it is an investigation through application of technology, equipment or some expertise.

Sample "B", the fingerprint experts at the LMPS, responded as follows:
- Expert number one said it is the combination of scientific methods of investigations.
- Expert number two did not answer the question.

The responses to the question indicated that Sample "A", the participants from the IEC, and Sample "B" from the LMPS did not understand the meaning of forensic investigations, although a few participants were aware that somehow technology might be applied when conducting forensic investigations. The reason for their lack of knowledge about forensic investigation is that the AFIS technicians are not law enforcement agents and are unfamiliar with crime. They all work for the electoral commission, whose functions are not associated with criminal investigations. That the police experts in Lesotho are not conversant with forensic investigation is probably due to the fact that it is not a common practice for law enforcement agents and it is slightly practiced by one parastatal (the Lesotho Revenue Authority) and foreign financial institutions such as the foreign banks.

2.6 DIFFERENCE BETWEEN CRIMINAL AND FORENSIC INVESTIGATION

Investigation is essentially a search for the truth (Buckwalter, 1984:3). According to McDevitt (2012:13), criminal investigation means two different things and encompasses those police activities that include:
- Arresting of criminals by gathering relevant evidence
- Gathering and presentation of evidence that leads to conviction

Dempsey (2003:32-33) further categorises investigations as criminal or non-criminal, reactive or proactive, and overt or covert. For example, a criminal

investigation may be reactive as well as overt, whereas another criminal investigation may be proactive and covert.

According to Jacobs (2011:3), forensic investigation plays a significant role in the 21st century in the application of forensic science:

- Forensic: evidence should be gathered and properly examined in forensic laboratories chronologically to convince the presiding officers in criminal cases.
- Investigative: the evidence should be cautiously scrutinised; for example, currently people are defensively claiming insanity or memory loss. The perpetrator's state of mind during the commission of crime needs careful consideration.
- Scientist: the necessary qualification, skills, relevant training and good communication throughout investigative disciplines are required for arresting the suspect and for proving cases beyond reasonable doubt utilising modern technology, such as neuroscans and brain fingerprinting.

As mentioned in Section 2.5, "forensic" means what is suitable for a court of law (See also: Jacobs, 2011:3; Nickell & Fischer, 1999:1). This makes it a comprehensive term that encompasses all of the scientific disciplines that are used to investigate with the objective of prosecuting. Jackson and Jackson (2004:1) and Brown and Davenport (2012:4) concur that forensic science is any scientific tool that is utilised to administer justice and that includes civil and criminal cases. The purpose of forensic investigations is the recognition, identification, individualisation and evaluation of physical evidence by means of the natural sciences (Du Preez, 1996:8-9).

Using information obtained from the reviewed studies, the researcher concluded that there is no difference between the concepts "criminal investigation" and "forensic investigation". The concept "criminal investigation", however, only covers criminal matters, while forensic investigations include both criminal and civil (Benson, Jones & Horne, 2016:19).

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The participants were asked: According to your understanding, what is the difference between criminal and forensic investigation?

Sample "A", the CEAs at the IEC, responded as follows:

- Twelve participants could not answer the question.
- Five participants said that criminal investigation may rely on oral evidence, while forensic investigation may rely on fingerprint technology.
- Two participants said that criminal investigation may rely on oral evidence and/or the process of establishing criminal offence while forensic investigation may rely on the application of technology, equipment and other expertise.

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said in forensic investigation the investigators are applying scientific methods of investigations, while in criminal investigations they apply general skills to investigate and information gathering.
- Expert number two said forensic and criminal investigations are similar.

The researcher is of the opinion, based on the literature, the participants' views and his experience as a forensic investigator that in forensic investigation and criminal investigation the goal is to bring the suspected perpetrator to any court of law on either a criminal or civil matter, in any form of law enforcement, whether public or civil. The researcher concludes that forensic science is the application of the natural and physical sciences, such as biology, chemistry, physics and geology, to the law and, more specifically, the application of science to the criminal and civil laws that are enforced by law enforcement agencies in the criminal justice system (Birzer & Roberson, 2012:99).

Table 2.1: Differences between criminal investigation and forensic investigation

Criminal Investigation	Forensic Investigation
• Criminal investigation is the process of bringing a criminal offender to justice by collecting relevant information, identifying valuable clues and maintaining a chain of custody (Dowling, 1979:1). • Criminal investigation is the application of an impartial, rational and lawful process to an alleged offence (Gilbert, 2007:33). • Criminal investigation can be defined as a systematic, organised, thinking, reasoning, examination and analysis process designed to search for the truth, during which an inquiry and thorough analysis are conducted of all types of crimes or unlawful acts (Benson et al., 2016:19).	• Forensic investigation is an objective investigation with the aim of instituting a court case on crime or a delict (Knoesen, 2012:6). • Forensic investigation consists of an in-depth, careful investigation, searching for the truth using expertise and the application of scientific investigation methods and techniques, in order to lawfully discover, collect, prepare, identify and present evidence that can be presented to a court of law, disciplinary council, instructing client or company (Benson et al., 2016:19).

(Sources; Dowling (1979:1), Benson et al. (2016:19) and Knoesen (2012:6)

2.7 IDENTIFICATION

The fundamental question in every investigation is to identify who is liable for the commission of a crime. It should be noted that many questions may be asked in any investigation regarding the identification of a crime (Sennewald & Tsukayama, 2001:227). Van Graan and Budhram (2016:45) state that the purpose of identification in forensic investigation is to identify physical evidence, which can then be analysed to help the investigator pursue a productive path based on the clues provided by the specific characteristics of the physical evidence. Identification rests on the theory that everything in the universe is unique in that it has certain distinctive, individual and class characteristics. The views concerning the concept of identification differ across the sciences, but, generally, it is applied by these sciences to place objects into specified groups; that is, to pinpoint an object as belonging to a specific category of objects (Van Rooyen, 2008:20).

Physical evidence begins when relevant evidence is gathered with careful scrutiny of information that relates to the case under investigation. Before searching for evidence, investigators must be conversant with what they are looking for. Once the investigators have gained an understanding of the available facts of the case and the events that occurred during the commission of a crime, the next step in the process is to apply Locard's theory of exchange (Birzer & Roberson, 2012:90).

Birzer and Roberson (2012:90) agree with the view expressed by Khan (2007:199) and Van Rooyen (2008:20) that establishment of the identity of the suspect or victim in any criminal activity is of paramount importance. To assist investigators in conducting successful investigations, the use of sciences is equally important for analysing the evidentiary items, which would in turn support the suspect's conviction in a court of law. According to the Locard principle, when two objects come into contact, each leaves a trace on the other. For example, when a person touches an object he or she leaves traces such as fingerprints. At the scene of a crime, those traces are usually transferred to the suspect's hand and can connect them with the crime scene (Van Rooyen, 2008:20).

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According to Gilbert (2007:442), the basic types of suspect identification are called positive and tracing. Information that identifies and individualises beyond question, that is legally acceptable and that relates to and originates with a specific individual is called positive identification. Information that relates to personal identity is referred to as "tracing" of an individual. Buckwalter (1984:54-55) states that investigators are often required to establish the identity of people, documents or material objects of evidence. People and things are identified by accurate descriptions. Thus, identification can be seen as a classification scheme in which objects with similar characteristics are placed in one category and such a category has identity and identification. The term "identity" refers to uniqueness and stresses the fact that every object or person can only be identical with itself or himself.

The question "Based on your experience and knowledge, what is the meaning of identification?" was asked to the participants.
Sample "A", the CEAs at the IEC, responded as follows:
- Two participants could not answer the question.
- Two participants said it is the way people are known and distinguished.
- Five participants said it is to differentiate.
- Ten participants said it is the identity of the individual.

Sample "B", the fingerprint experts at the LMPS, responded as follows:
- Expert number one said that identification is to make an individual particular with independent features, patterns and characteristics.
- Expert number two said that identification means to select among others to eliminate.

The response to the question indicated that Sample "A", the participants from the IEC, did not fully understand the meaning of identification, but understood that it is to distinguish, differentiate and identity individuals. The researcher is of the opinion that most of the physical evidence found at scenes of crime can be identified and that identification means that the objects share a common

source. The objects can be categorised or placed into groups with all other items having the same properties (Fisher, 2004:5).

2.8   IDENTIFICATION CATEGORIES

Du Preez (1996:6-7) states that it is important that individualisation is preceded by identification and writes that they supplement each other. The following categories of identification are applied in forensic and criminal investigation:

- Situation identification: relates to crime and point to unlawful nature of situation.
- Witness identification: points to actual perpetrator through facts and witness statements.
- Victim identification: identification of deceased Imprint identification: comparing unknown print with imprint found on an object.
- Origin identification: examining organic and inorganic solids and fluids to analyse common origin.
- Action identification: identification of human acts that connects with crime and completes essential elements of crime.
- Culprit identification: positive identification of suspect not his unlawful act.
- Cumulative identification: compilation of inputs within the framework of whole crime situation.

2.9   INDIVIDUALISATION

The overall aim of individualisation is to individualise the incident as the act of a particular person or persons (Van Graan & Budhram, 2016:64). According to Van Graan & Budhram (2016:64), "individualisation can be described as a process that starts with identification, progresses to classification and leads, if possible, to assigning a unique source to a given piece of physical evidence". According to Fisher (2004:5), some types of physical evidence may come from only one source and most physical evidence may only be associated with a class or group. Only a few kinds of physical evidence can be individualised.

Thus, individualisation means that an item of evidence comes from a unique source. It can be shown to be directly associated with an individual source.

A process of individualisation takes place to determine individuality. It normally consists of a series of identifications and comparisons, which have a twofold aim (Du Preez, 1996:6):

- To individualise positively any objects in dispute
- To conclusively determine the criminal involvement of the object or people that provide the standard of comparison

Evidence can uniquely match the area from where it was gathered. For example, fingerprints can be identified and matched, ballistics marks and food marks can be matched, and handwriting can be compared by an expert. Pieces of broken objects can be mended like a jigsaw puzzle or patterns across a plastic bag that were formed chronologically can be identified (Saferstein, 2013:105-106).

The question "Based on your experience and knowledge what is the meaning of individualisation?" was asked of the participants.
Sample "A", the CEAs at the IEC, responded as follows:

- Nine participants could not answer the question.
- Seven participants said it is to differentiate individuals.
- One participant said it is an outstanding feature.
- Two participants said it is to select from another.

Sample "B", the fingerprint experts at the LMPS, did not answer the question.

The responses to the question indicated that the participants were not fully conversant with the meaning of individualisation, although some were aware that it means to select and differentiate with an outstanding feature.

2.10 DIFFERENCES BETWEEN IDENTIFICATION AND INDIVIDUALISATION

In the field of forensic investigation, such as in ballistics examination and fingerprint identification, investigators rarely confuse the terms "identity" and "individualise". Even though their Latin roots are alike ("*idem*" means "the same" and "*individus,*" means "not visible"), the terms are quite different as they are applied in the forensic investigation discipline. Investigators use the terms "identification" and "identity" continuously (Nickell & Fischer, 1999:2).

In forensic science, individualisation has two meanings (Birzer & Roberson, 2012:104):

1. By examining the various characteristics of something, it can be recognised as unique among the members of its class.
2. When a questioned or unknown object or item is compared with a known or exemplar item, they are found to have a common origin.

According to Nickell and Fischer (1999:3), individualisation involves demonstrating the uniqueness of some item of evidence. This is possible because no two things in nature are the same. The principle that all objects are unique may be expressed as follows:

- No two things that happen by chance ever happen in exactly the same way.
- No two things are ever constructed or manufactured in exactly the same way.
- No two things ever wear in exactly the same way.
- No two things ever break in exactly the same way.

In investigation, "identification" and "individualization" are two indisputable concepts. They complement each other and come after another. Identification without eventual individualisation has no value as evidence but can only lead the investigation in a certain direction (Van Rooyen, 2008:21). The difference between identification and individualisation is of great value to criminal

investigations. Identification is merely concerned with identifying something or somebody belonging to a specific class. That means no comparison is drawn. Individualisation involves comparison of a disputed unknown object found at a scene of crime, for instance, with the suspect. An example is the fingerprint found on a crime scene and compared with the fingerprint of known criminal (Du Preez, 1996:6).

Fisher (2004:5-6) concurs with the ideas expressed by Du Preez (1996:6) and Nickell and Fischer (1999:3) that there is a slight difference between individualisation and identification in terms of fingerprints, and demonstrates that the fingerprint may identified. Features of the fingerprint are classified into groups; for instance, a whorl or loop. In addition, fingerprint evidence can be useful beyond identification as fingerprints are unique in nature. During its processing, a latent fingerprint can point to one person, which means that the print can be matched or individualised.

Table 2.2: Differences between identification and individualization

Identification	Individualisation
Identification of something or somebody belonging to a specific category (Du Preez,1996:6)	Involves comparison, usually of the disputed object found at the scene of the crime with one of known origin obtained, for example, from suspect (Du Preez,1996:6)
Identification means that the items share common source (Fisher, 2004:5)	Individualisation means that an item of evidence comes from a unique source (Fisher, 2004:5)
Identification is the examination of the chemical and physical properties of an object and using them to categorize the object as a member of a group (Houck, 2007:38)	Individualisation occurs when at least one unique characteristic is found to exist in both the known and the questioned samples (Houck, 2007:40)

Identification based on the theory that everything in the world is unique as it has certain distinctive, individual and class characteristics (Van Rooyen, 2007:20)	Individualisation can be the recognition of an object as unique among a certain class, or an unknown item can be identified as having common origin with a known object (Sapse & Kobilinsky, 2012:2)

(Du Preez (1996:6); Fisher (2004:5); Mouck (2007:38); Van Rooyen (2007:20); Sapse and Kobilinsky (2012:2))

2.11   UNDERSTANDING THE CONCEPT OF FINGERPRINTS

The hand of a human being, including fingers, palms and foot soles, has multifarious patterns of hills and valleys designed for handling an object. There are different ridge characteristics within a fingerprint pattern that serve as a means of personal identification in terms of fingerprint classifications (Birzer & Roberson, 2012:88).

Tistarelli, Li and Chellappa (2009:83) state that, historically, fingerprints were taken by applying ink on a finger and rolling it against paper. This is called the "ink-on-paper" capture method. Nowadays, live-scan digital images by directly sensing the finger surface with an electronic fingerprint scanner are widely accepted as civilian and criminal fingerprint systems. According to Gilbert (2007:442), the study of fingerprints for identification purposes, called dactyloscopy, is based upon distinctive ridge outlines that appear on the bulbs on the inside of the end joints of the fingers and thumbs.

Horgan (1979:123-126), Jackson and Jackson (2004:86-87) and Fish, Miller, Braswell and Wallace (2014:89) identify four types of fingerprints:

- Latent fingerprints: These are the prints that cannot be seen with the naked eye.
- Visible fingerprints: These are formed when the appropriate substance is transferred by the fingertips onto a suitable surface.

- Plastic fingerprints: These are found on plastic-type surfaces such as soap, butter, wax, soft putty, tar, grease, or other materials that form a mould of the fingerprint when touched.
- Wet fingerprints: These prints are made in liquids, such as blood.

Jackson and Jackson (2004:80), Adams et al. (2004:157) and Fish et al. (2014:86) emphasize that fingerprints are an infallible means of establishing identity and can be used as a means of personal identification, based on the following premises:

- The fingerprints of an individual stay unchanged throughout life. The friction ridge pattern of an individual is formed in the foetus, at about 28 weeks after conception. This pattern lasts throughout life, although it may be damaged; for example, by deep scarring. It also lasts for some time after death and can be useful in post-mortem identification (Jackson & Jackson, 2004:80).
- No two fingerprints are identical. In the 1890s, Sir Francis Galton calculated that there may be more than 64 billion different fingerprints. Despite this, after millions of individuals have been fingerprinted, no two identical fingerprints have been found (Fish et al., 2014:86).

The question "According to your understanding, what is a fingerprint?" was asked to Samples "A" and "B".

Sample "A", the CEAs at the IEC, responded as follows:

- Three participants did not know what a fingerprint is.
- Three participants said it is the identity of a person.
- Thirteen participants said it is the prints on the fingers.

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said a fingerprint is the impression made by a finger at any surface.
- Expert number two said a fingerprint is the print made by or left after touching a surface or an object.

Although Sample "B" could not academically explain what a fingerprint is, it is apparent that they understood the meaning of "fingerprint". Their responses support the definitions given by Gilbert (2007:442) and Birzer and Roberson (2012:88). The researcher is of the opinion that some of the definitions given by Samples "A" and "B" agree with those found in the literature. Jackson and Jackson (2004:80), Adams et al. (2004:157) and Fish et al. (2014:86) concur that fingerprints are an infallible means of establishing identity, and are the formal method of identifying perpetrators of crime. Today, it is a powerful means of identifying, particular human beings, as there are no two people with same fingerprint, even identical twins (Fish et al. 2014:86).

2.11.1 Latent fingerprint

Jackson and Jackson (2004:87) define latent fingerprints as fingerprints that are not seen with the naked eye. These fingerprints need to be developed in order to make them visible as opposed to visible prints and plastic imprints. Horgan (1979:125) states that latent fingerprints are not readily visible; they are hidden or concealed. Latent prints are the type of print commonly encountered by investigators. These prints are created by the deposit of bodily secretions, including water, oils, salts and amino acids. To make them visible to the eye they require some form of development (Birzer & Roberson, 2012:93). Fingerprint powders and chemical sprays or solutions are also needed to develop latent prints so that they may be preserved and used for identification purposes and in court trials.

Fish et al. (2014:95) write that latent prints are made by fluids and/ or moisture on a surface, which result in visible impressions on the object. Mozayani and Noziglia (2011:170) state that the friction ridges on fingers, palms and the soles of the feet have pores, or openings, which show moisture. When a person touches an object, they usually leave an impression of those ridges. This imprint is normally not detectable and needs to be developed in order to be visible, and this is what is called a latent print.

According to Fisher, Tilstone and Woytowicz (2009:63) after completing the search for visible prints, the examiner will look for latent prints, or those that are

not readily visible, there are many procedures available for the development of latent prints, and the choice depends on several factors that is, whether it is rough or smooth surface. To find a latent print, the examiner will select an appropriate method based on properties of the surface being examined, such as whether it is hard or soft, porous or nonporous, absorbent or nonabsorbent (Fisher, Tilstone & Woytowicz, 2009:63).

Jackson and Jackson (2004:87-94), Gilbert (2007:446-448), Fisher et al. (2009:64-70), and Fish et al. (2014:100-103) identify different methods and techniques of developing latent fingerprints on any surface at the crime scene:

- Gentian Violet: This is a purple dye that stains the fatty components of sweat; it is useful for developing latent fingerprints present on the adhering surface of good quality sticky tape, although it does not work well on conventional sellotape.

- Iodine Fuming: This is one of the oldest techniques used to develop latent fingerprints; it can be applied to practically any surface, both porous and nonporous.

- Ninhydrin: This is an extensively used reagent for developing latent prints on porous surfaces, such as paper, cardboard, plasterboard or plaster such as Artex.

- Physical Developer: For this technique, a sequence of aqueous solutions is used to visualise latent prints on porous surfaces (especially paper) that have been wet.

- Powders: Powders are the basis of a common visualisation technique, suitable for hard, relatively smooth, nonporous surfaces, such as tiles and mirror glass.

- Radioactive Sulphur Dioxide: This technique is used on surfaces, such as clean, fine fabric, adhesive tape and paper.

- Small Particle Reagent: This is composed of molybdenum disulphide (MoS2) particles suspended in a solution of detergent.

- Sudan Black: This may be used to develop latent fingerprints on nonporous substances, such as metals and plastics, and is effective when these surfaces are covered with a film of grease or oil.

- Super Fuming: It is suitable for use on a variety of nonporous surfaces, such as rubber, metals and electrical tape.
- Vacuum Metal Deposition: This involves the evaporation of a metal, usually zinc or gold, and its deposition, under vacuum, as thin film on the latent print.

The question "According to you, what is a latent fingerprint?" was asked of Samples "A" and "B".

The participants of Sample "A", the CEAs at the IEC, did not know what a latent fingerprint is.

Sample "B", the fingerprint experts at the LMPS, responded as follows:
- Expert number one said a latent fingerprint is an invisible fingerprint and palm impressions left on or at any surface.
- Expert number two said "latent fingerprint" refers to the invisible print left at the surface but may be made visible using fingerprint powders and reagents.

From the responses from Sample "A", it is apparent that the fingerprint technicians at the IEC did not know what a latent fingerprint is, while both the fingerprint experts from Sample "B" knew what a latent fingerprint is. Their responses are in agreement with the descriptions given by Jackson and Jackson (2004:87), Birzer and Roberson (2012:93) and Fish et al. (2014:95). The researcher is of the opinion that the definitions given by Sample "B" support those in the literature. From the one-on-one interviews with these participants, it was clear that they had a lot of experience in dealing with latent fingerprints.

2.11.2 Fingerprint as identification technique

Genge (2003:21) states that unlike trace evidence, fingerprint evidence is unique. It cannot be stolen, borrowed or forgotten. If it is found at a crime scene so was the person to whom it belongs. As mentioned above, fingerprint identification is known as dactyloscopy and involves the comparison of impressions made by friction ridges. All fingerprints are divided into three classes of general patterns: loops, whorls and arches (Fish et al., 2014:86).

Genge (2003:40-41) describes five patterns of loops, whorls and arches found in fingerprints:

- Arch: This is a wave across print, which is smooth and round without points.
- Tented arch: This looks like a plain arch; it goes up in the center of the wave and forms separate triangles at its center.
- Ulnar loop: This is like a loop: the ridges flow from one side of the fingerprint, and turn back, leaving on the one that they entered. An ulnar loop runs in the direction of the little finger.
- Radial loop: Radial loops are loops that flow in the direction of the thumbs.
- Whorl: This looks like a whirl in water; the ridges make a circle shape that is oval or spiral.
- Double-loop whorl: This whorl is made when two loops meet each other and spin around in circle and it has two deltas.
- Central-pocket loop whorl: This whorl is a characteristic within a characteristic of the loop at the middle of the whorl, intruding the outer edge of the whorl as a delta.
- Accidental whorl: This is characterised by the whorl parts; they are not inside lines drawn between deltas. They appear as small whorls inside what would then be a tented arch – sort of a "pointy whorl".

Fisher et al. (2009:61) suggest that, despite their patterns, all fingerprint types have many distinguishing characteristics in their ridge details, collectively termed "minutiae". These fine details are the basis for individualisation from a fingerprint lift. Examples of minutiae include ridge endings, bifurcations and islands. Sometimes the island is extremely small and is classed as a dot. The Lesotho Criminal Record Centre of the LMPS is still using the traditional way of storing ten fingerprint and palm print sets that are in (the pigeonholes) those are ancient cabinets used to store ten-fingerprints and palms for search and identification purposes. Recently, fingerprint records have been classified and stored by systems that depend on the three fundamental characteristics

explained. Each of the three pattern types has distinguishing focal points, which are the basis for all ten-finger classification systems (Fisher et al., 2009:58).

According to Jackson and Jackson (2004:84-85), the fingerprint database is the only complete database that allows the identification of individuals. Every person who has been arrested and charged, reported or summoned for a recordable offence has his or her fingerprints taken. If not already on file to confirm the identity of the individual concerned, these fingerprints are added to the national database. Once fingerprints have been recorded, classified, and filed, they can always be compared to others, whether latent prints recovered from a present crime scene or another set of prints taken and classified by a different technician years later (Nickell & Fisher, 1999:124-125).

Jackson and Jackson (2004:84-85) further explain that, in making a comparison between a scene of crime print and one held on file, the fingerprint expert looks at the following features, whenever these are identifiable in the scene print:
- The type of fingerprint pattern;
- The finger type; and
- The ridge characteristics, especially the ridge endings and bifurcations.

If there is enough ridge characteristics in the same positions on both the scene print and that held on file, the fingerprint expert can make identification. Then the AFIS is applied. This allows the fingerprint expert to connect with virtually every other department that connects to the AFIS system. If there is a match, it will take only a few minutes to establish compared with the months or years it would take an expert to search the files (Adams et al., 2004:216).

The question "In your opinion, what is fingerprint identification?" was asked to Samples "A" and "B".
Sample "A", the CEAs at the IEC, responded as follows:
- Seven participants could not answer the question.
- Nine participants said it is to identify a person through fingerprints.
- Three participants said it is the process of differentiating fingerprints.

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said fingerprint identification is the process whereby fingerprints are identified with their patterns and characteristics and then classified.
- Expert number two said fingerprint identification is the comparison of the ridge features of one print with those of another by starting at specific ridge feature.

The responses to the question indicated that the Sample "A" did not understand concept of fingerprint identification while Sample "B" participants did understand the concept of fingerprint identification and that it is the process of identifying a person through their fingerprints. The researcher is of the opinion from the above literature discussions and feedback from the participants that fingerprint identification is currently the most common and almost universal means of personal identification (see also: Scott, 1978:151). Huang, Chang and Chen (2007:463) build on this view by stating that fingerprint identification is becoming increasingly popular for access control, criminal verification, credit card and passport authentication, and digital rights management. Fingerprint recognition systems have become one of the most popular biometric systems used in many applications, including law enforcement, border control, and forensics (Yoon, 2014:1).

2.11.3 Purpose of using fingerprint identification in investigation

Manamela and Mokwena (2016:140-141) state that prints found at the scene of an incident will help the investigator to do the following during the investigation:

- Locate the person who allegedly committed the incident by comparing and identifying the suspect's prints or the scene prints manually or electronically via an AFIS search
- Eliminate the person from the alleged incident by taking prints of victims or complainants and comparing them to prints gathered from the scene of incident

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- Identify human remains, especially when other methods of forensic investigation cannot be used

According to Gilbert (2007:442), it is vital for police to have a basic knowledge of fingerprint patterns and how to record them. This is important when fingerprinting suspects and attending a crime scene, searching for latent fingerprints. This works as positive means of identification in most incidents.

The reliability of fingerprint evidence has been universally accepted for many years (Mozayani & Noziglia, 2011:146). According to McCartney (2006:3-4), fingerprints serve two purposes within the criminal justice system:

1. To identify individuals before the police for the purpose of matching with criminal records
2. To compare with latent prints located at the scene of crime

According to McCartney (2006:5), the admission of fingerprint evidence taken without consent is justified by reasoning that people forfeit the right to personal liberty by committing crime. A suspect's liberty will be unavoidably invaded to the extent necessary for police to establish the identity of the accused and his connection with the crime. If the accused is innocent, no harm is done in fingerprinting. If, on the other hand, he is guilty, the fingerprinting process will make it more likely that his guilt may be established. While the protection of individual liberty is desirable, the taking of fingerprints is considered important.

The researcher is of the opinion that fingerprint identification should be used by law enforcement agencies, in the public and private sector to identify and individualise suspects in the process of forensic and criminal investigations. As fingerprints result in positive identification of human beings and as no two fingerprints alike, fingerprint identification may result in swift investigations and readily available evidence. The Criminal Procedure Act No.9 of 1981allows suspects to be fingerprinted, as postulated by the researcher, and section 288 (1) regulates the obtaining of data through the following fingerprints, photographs or documents certified by the officer at CRB of Lesotho or any other country. Huma 1996 (1) SA 232 (W) (in Bekker, Geldenhuys, Swanepoel,

Joubert, Terblanche and Van der Merwe, 2005:119-120) the court held that the taking of fingerprints does not violate the accused's right to remain silent or his right to have his dignity respected and protected.

The question "In your opinion, what is the purpose of using fingerprints identification in forensic investigation?" was asked of Samples "A" and "B". Sample "A", the CEAs at the IEC, responded as follows:

- Nine participants said the purpose of using fingerprint identification in forensic investigation is to identify an individual.
- Eight participants said the purpose of using fingerprint identification in forensic investigation is because fingerprints are unique.
- Two participants could not answer the question.

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said the purpose of using fingerprint identification in forensic investigation is to identify the actual perpetrator.
- Expert number two said the purpose of using fingerprint identification in forensic investigation is to lead forensic investigation into the right direction.

The response to the question indicated that most of the Sample "A" and Sample "B" participants understands the purpose of using fingerprints in forensic investigation. The researcher is of the opinion that fingerprints may be used for other purposes, such as linking suspects to crime and identifying unknown dead bodies.

2.11.4 Fingerprints as unique identification technique
To sum up what has been discussed above, during the third to fourth month of foetal development fingerprint ridges are formed. They develop on the skin of the thumbs and figures. Their function is to provide the fingers with a firmer grip and to avoid slippage. They allow the fingers to grip and take up items and they form patterns with ridge characteristics. All fingerprints are unique, and patterns differ as do ridge characteristics. Those patterns contain farrows of sweat pores

or oil from glands. Mixed with dirt they produce a fingerprint (Nath, 2010:12). Saferstein (2011:357) states that the acceptance of fingerprint evidence by the court has always been predicated on the assumption that no two individuals have identical fingerprints. Fingerprint pattern formation consists of two components: developmental and genetic. The ridge pattern development depends not only on genetic factors but also on unique physical conditions. The entire development process is so chaotic that, over the entire course of human history, there is virtually no chance that the exact same pattern formed twice. What this means, though, is that fingerprints are different on every finger of a person's hand; they are different on the same fingers of opposite hands; and even the fingerprints of identical twins are different from each other (Science ABC, 2016).

The question "To your knowledge, what makes a fingerprint unique as an identification technique?" was asked of Samples "A" and "B".

Sample "A", the CEAs at the IEC, responded as follows:

- Seventeen participants said fingerprints of people differ.
- One participant said there are no two people with identical fingerprints.
- One participant said it is the result of deoxyribonucleic acid (DNA).

Sample "B", the fingerprint experts at the LMPS, responded as follows:

- Expert number one said the fingerprint patterns, ridge characteristics and ridge counting make fingerprint identification unique.
- Expert number two said fingerprint identification is faster, cheaper and accurate and there are no two persons with identical fingerprints.

The answers provided by the sample clearly show that the Sample "A" and Sample "B" participants knew that fingerprints differ. Moreover, the experts stated that fingerprints are unique through their features, and that fingerprint identification is fast and accurate. This concord with literature consulted such as Saferstein (2011:357).

2.12   SUMMARY

From the discussion in this chapter, it is apparent that the objective of investigations is very clear to the researcher and that investigator needs to adhere to them and adopt them as their standard operating procedure in every investigation. The investigator also needs to be conversant with the investigative aids and the valuable clues that are left and/or found at the crime scene. It is also clear that the fingerprints can assist to solve or prove cases beyond reasonable doubt in courts. Then, it is of vital importance that law enforcement agencies have a basic understanding of fingerprint patterns and the technique for recording them (Gilbert, 2007:442). Moreover, it is the investigator's responsibility to ensure that suspects are taken to court and punished without being biased or having a lack of evidence. Poorly planned and conducted investigations have resulted in acquittals of the guilty and convictions of innocent people (Brown, 2001:3).

CHAPTER THREE: THE AUTOMATED FINGERPRINT IDENTIFICATION SYSTEMS

3.1   INTRODUCTION

The identification of large population groups was introduced in the 1890s through biometric fingerprint identification. Sir Edward Henry used this method to classify friction ridges, their direction and the way they flow, their patterns and other visible characteristics that made it easier for examiners to classify these images as classes that could be understood by other examiners in the field. As the result, the classifications were used for search and comparison. The modern system has made it easy to capture fingerprints and classify images (Komarinski, 2005:5). According to Fisher (2004:106), AFIS symbolises a huge device in the fingerprint identification technology. Before AFIS was developed, it was difficult to compare a latent fingerprint found at a crime scene with those of criminals in the database. It was also time consuming to make a manual search for a latent print against a million inked prints before the introduction of AFIS.

This chapter will focus on the second and third research questions; what are the strengths and weaknesses of the four-point AFIS system; and what are the strengths and weaknesses of the ten-point AFIS system for identifying fraudulent voter registration.

3.2   THE AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM

The international law enforcement agencies in the late 1960s and early 1970s in USA, United Kingdom, France and Japan initiated the projects aimed at developing the AFIS system. The objective of their research was to utilise new gadgets that would assist in replacing manual processes of classifying, searching and matching ten-print cards used for identification (Moses, 2017).

AFIS is an automated system. The Oxford Dictionary of Current English (2004:89) defines the word "Automation" as the use or introduction of automatic

equipment in a manufacturing or other process or facility. According to Petkovich (2011:13), there are issues that must be considered when deciding which portions of the biometric system should be automated, attended or supervised. It is important to determine whether the subjects are cooperative or non-cooperative and whether the system must operate covertly or non-covertly.

The AFIS system is designed to identify fingerprints. As detailed in Chapter 2, a fingerprint is an impression of the pattern of friction ridge skin found on the under surfaces of the terminal joints of the fingers and thumbs. The palms of the hands, the soles of the feet and the under surfaces of the toes also bear similar papillary ridge patterns, which can be used to prove identity (Phillips & Bowen, 1985:57). A fingerprint is the feature pattern of one finger. It is an imprint that is formed by the friction ridges of the skin and thumbs; they have long been used for identification because of their immutability and individuality. "Immutability" refers to the permanent and unchanging character of the pattern on each finger. "Individuality" refers to the uniqueness of ridge details across individuals. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as by features called minutiae, which are some abnormal points on the ridges. However, as shown by intensive research on fingerprint recognition, fingerprints are not distinguished by their ridges, but by the minutiae points (Tukur, 2015:1).

According to Van Heerden (1977:10), identification rests on the theory that everything in the universe is unique in that it has certain distinctive, individual and class properties. Van Graan and Budhram (2016:47) further state that the term "identification" is explained as a classification system when objects with similar characteristics are classified into one category and a name is given to each category. Fingerprint identification involves the comparison of known prints (record prints) with unknown prints found at crime scenes for the express purpose of identification (Gardner, 2012:256).

One can thus conclude that identity means uniqueness. A thing can be identical with itself only, and never with anything else. Regardless of resemblance, it is distinct from and independent of anything else. The Oxford Dictionary of

Current English (2004:1462) defines the word "system" as a complex whole; a set of things working together as a mechanism or interconnecting network. In the 1890s, Sir Edward Henry, by corresponding with Sir Francis Galton (see Section 2.11), came to recognise the limitations associated with fingerprint classification and determine that, in order for fingerprints to be useful as a systematic means of personal identification, a simplified method was required to allow law enforcement to file and retrieve numerous file records easily (Senn & Stimson, 2010:81).

Unfortunately, Henry's finger pattern definitions proved extremely difficult to convert into computer descriptions. The Henry-based AFIS also suffered from the same limitations as the traditional manual matching system in that it required a trained technician and it was not fully automated. In addition, the Henry system worked only if all ten fingerprints were available, which was not often the case in crime scene investigations (Girard, 2011:150).

Komarinski (2005:4) concurs with the view of Petkovich (2011:13) and Gardner (2012:256) and gives a brief explanation of the four components of the name "AFIS" According to Gardner (2012:256) "Automation (A) has replaced searching for fingerprint cards for comparison. Fingerprint (F) involves individual rolled fingerprints cards or a fingerprint scanner. Identification (I) is a process of getting fingerprint images from the database of fingerprints for comparison. The system (S) is the technology used to connect with other software and other identification systems".

Jain and Pankanti (2017) further describe the fingerprint identification system as a computer-aided fingerprint identification with three important phases: (i) data acquisition: sensing of the fingerprint; (ii) feature extraction: extraction of the image from the machine; and (iii) decision-making: identifying, matching and comparing the fingerprint. The AFIS processes the fingerprint identification through computers, usually by digital images that can be searched and coded (Komarinski, 2005:37).

3.2.1 AFIS functions and capabilities

The development of the FINDER (Fingerprint Reader) system has resulted in the widespread adoption of AFIS by most of the states and hundreds of city or country law enforcement agencies in the USA. AFIS computers are faster and more affordable (Gilbert, 2007:450). Moses (2017) states that numerous law enforcement AFIS installations entail the following functions:

- Search of a known set of fingerprints against the database can return with accurate results: search evidence against ten-print AFIS database and latent print from crime scene; search latent from a scene of crime within other latent crime scene files; or search newly taken ten-print within unsolved latent prints file.
- Technology that developed the AFIS concept has also created live-scan fingerprinting. Live scanning allows police to place a suspect's fingers on a glass plate that is then read by a special device to produce a digital image of the prints. The image can then be transmitted over phone lines to a main AFIS computer centre for immediate comparison (Gilbert, 2007:450-451).

Moses (2017) adds that enhancements have been developed to allow other functions that expand AFIS capabilities, including:

- Adding palm-print records to the database to enable search for latent palm-prints from scene of crime.
- Interfacing the AFIS system to other systems for efficiency and backup.
- Linking AFIS digital systems and live-scan fingerprint capture devices.
- Adding hand-held portable devices for identity on the ground, this made by scanning one or more of the subject's fingers, taking out the minutiae and transmitting it to AFIS, which will respond with positive or negative results that may be followed by the thumbnail image of the subject's mug shot.
- Adding multimodal identification systems that encompass fingerprint, palm-print, iris and facial recognition.

Saferstein (2011:544) maintains that the core function of AFIS computerised technology is being able to scan and digitally convert fingerprints into rapid computer processing. AFIS has a scanning capacity that converts fingerprints into digital minutiae, with visible data depicting ridge points of termination and dividing of those ridges into tow ridges. The similar position and location of ridge details are determined, enabling the computer to store the fingerprint digitally in distinctive patterns. Moses (2017) concurs with Gilbert's (2007:450-451) view that the same technology that developed the AFIS concept has also created the live-scan fingerprinting process.

Saferstein (2011:544), Bennett and Hess (2001:112) and Gilbert (2007:450-451) write that AFIS uses computers to review and map fingerprints. The system creates a spatial geometry of the minutiae of a print, which is changed into a binary code for the computer's searching algorithm. The capability of registering thousands of details makes it possible for the computer to complete a search in minutes that would take days manually. The search success rate has been up to 98% in some departments with files of under one million. For latent print examiners, the AFIS system has provided a quantum leap in latent print identification (Komarinski, 2005:82).

The question "According to your knowledge, what is the AFIS system?" was asked of all participants of the identified samples.
Sample "A", the CEAs at the IEC, responded as follows:

- Eighteen participants said AFIS is the system used to register eligible voters by capturing fingerprints, photo and personal information, also the village and constituency.
- Only one participant said AFIS is the modern technology used to register voters in Lesotho.

Sample "B", the fingerprint experts at the LMPS, responded as follows:
- Expert number one said he does not know what the AFIS system is.
- Expert number two said AFIS is the system that is used to store fingerprints and the particulars.

Sample "C", the data processor at the NICR, responded as follows:

- It is a biometric and/or ten-fingerprint system that contains birth certificate, identity document, marriage and death certificates; it is accessed through a username and password with limited scope, which means that one processor cannot perform all the functions.

From the responses from Sample "A", it is clear that most of participants only knew about the AFIS system at their disposal. On the other hand, Sample "B" did not know about the AFIS system – they just know it from a distance. The apparent reason for this is that the LMPS does not use an AFIS system. Sample "C" is conversant with the AFIS system as he knows the features and is able to operate the system.

3.3   THE FOUR-POINT AFIS SYSTEM

Face Technologies (2015) explains that the (four-point AFIS system) Mobile Registration Station or Unit (MRS/U) as it is called in Lesotho by the IEC is used for the capturing or verification of citizens or voters' information for registration purposes. The station is fully mobile and has its own built-in batteries that provide it with power. The MRS/U is able to capture data, such as photograph, fingerprint, signature and text data using customised software. The MRS is provided as part of the various solutions in the "Face Technologies" circle of life concept. This concept involves:

- Advancing service delivery by going out to the public and obtaining their data, not getting the public to come for services and provide data.
- Affording an instant proof of registration.
- Uploading data into the MRU and transferring it at a later stage to a personal computer (PC) or server.
- Customising functions to satisfy different clients.
- Custom designing software to meet different clients' specifications.

Face Technologies (2015) states that the MRS contains the following features:

- All installed in IP 67 complaint lockable, ruggedised water-resistant carry case with a total mass of 16-22 kg (configuration dependent)
- Mini CPU (VIA 1.2 GHz Fanless CPU)
- 120 GB hard drive
- 8" colour screen
- 84 mini keyboards
- 500 DPI fingerprint reader
- 1.2 Mpixel webcam and light source
- A4 colour printer
- USB ports
- Ethernet port 10/100 Mbs
- Win XP operating system
- 220 V/12 V power input built-in batteries for 4, 8 or 12 operational hours (configuration dependent)

Samples "A" and "B" were asked to explain how the four-point AFIS system works.

Sample "A", the CEAs at the IEC, explained as follows:

- Nineteen participants pointed out that when operating the four-point AFIS system, first one needs to enter a username and password. Then key into live registration "mode", select the constituency that one wishes to register and get the registration centre. After that, select the village, then capture the left-hand fingerprints starting with the index finger followed by the thumb and repeat the same process on the right-hand side. The operator should capture the photograph, signature and information details and then produce the IEC voter's card.

Sample "B", the fingerprint experts at the LMPS, could not explain and did not know about the four-point AFIS system. From the above responses, it is clear that most AFIS technicians from the IEC were conversant with how the four-point AFIS system operates. This may be as a result of their experience. In contrast, the fingerprint experts from the LMPS did not know how the four-point

AFIS works because their organisation does not have an AFIS system and they had never used one before.

3.3.1 Understanding the four-point AFIS system

According to Royal Oman Police (2015), the mobile units are issued with a computer laptop with the civil status system and other equipment for the registration and use of data in districts in remote areas, for servicing the residents in those districts. MRUs were developed in 11 April 2009. In application of modern technology, MRUs were used to enhance other networks to provide speedy and efficient service to people living in remote areas. These units are compressed and portable and can be carried anywhere. They are user friendly in harsh weather conditions and difficult terrain. Notably, they are able to perform similar functions equally to those at local registration offices.

Figure 3.1: Photographs of the four-point AFIS apparatus

Source: Royal Oman Police (2015)

3.3.2 Limitations of the four-point AFIS system

The IEC in Lesotho introduced independent MRUs throughout the registration centres in the entire country. Additionally, the registration centres were extended to the neighbouring Republic of South Africa so that Lesotho citizens in that country could access the registration centres. There was no interaction

between MRUs and their respective district servers. This was why, during the registration, the information was temporarily stored in the MRUs. After the completion of the registration, the MRU information was physically loaded into the district servers. The virtual private network (VPN) was used to connect the IEC headquarters with the district server and all data was consolidated. Moreover, the voters' data from the MRUs was migrated into a central location on a monthly basis (Independent Electoral Commission of Lesotho, 2013).

The question "What, according to your knowledge, are the limitations of using the four-point AFIS system?" was asked of Sample "A" and Sample "B". Sample "A", the CEAs at the IEC, explained the limitations as follows:

- Fifteen participants said that the four-point AFIS system cannot detect multiple or double registrations during the registration.
- Two participants said that the four-point AFIS system sometimes malfunctions and it is very slow.
- Two participants could not answer the question.

Sample "B", the fingerprint experts at the LMPS, could not answer the question. The main reason why they could not answer this question is that they never used four-point AFIS and the LMPS does not have the system at their disposal.

3.3.3 Strengths of the four-point AFIS system

According to BioLink (2017), the Mobile Biometric Kit is rugged and user friendly and contains a portable biometric system for enrolling and identifying voters at the polling centres. Compared to other biometric fingerprint technologies, for example, eye identification (IRIS) and voice identification, the Mobile Biometric Kit can reliably identify millions of people. The biometric kit is perfect for use in places where a powered biometric system in an easy-to-carry and easy-to-deploy package is needed.

BioLink (2017) lists some of its benefits as:

- It has a laptop computer.

- It has adequate space to support different configurations, including thermal label and ID printers, fingerprint scanners, a high-resolution web camera, and LAN connection or WIFI connection.
- It can operate for at least ten hours on battery power without the need for electrical power.
- It is contained in a strongly built case that is completely water-resistant, and has an automatic pressure valve that is suitable for a harsh environment.

The question "What, according to your knowledge, are the strengths of four-point AFIS system?" was asked of the participants of Samples "A" and "B". Sample "A" explained as follows:
- Nine participants said that it contains fingerprints, photos and signatures all in one, produces quality pictures and the battery lasts for a long time.
- Seven participants said that it produces a voter's card instantly.
- Three participants could not answer the question.

Sample "B", all the LMPS fingerprint experts, did not know the strengths of the four-point AFIS system because they had never used this system throughout their service. As for Sample "A", most participants were conversant with the literature, which indicated knowledge of the strengths of the four-point AFIS system, BioLink (2017).

3.3.4 Weaknesses of the four-point AFIS system

A disadvantage of AFIS that is not shared by the manual fingerprint identification system is that it operates via a computer program, with data stored on a computer database. Computers are vulnerable to hacker attacks and other security issues surrounding digitally stored data. As computers control much critical infrastructure, technology is a target for potential terrorists (Mokwele, 2016:70). In addition, some agencies in the Kingdom of Lesotho do not have access to AFIS systems and therefore cannot link up with other systems in place (Evaluability Assessment of Mobile Automated Fingerprint Identification System, 2016).

Komarinski (2005:167) argues that the AFIS systems do not directly communicate with each other. Many AFIS systems are different and have independent software. Some AFIS systems in different cities are independent and supported by different service providers. The placing, recruitment levels and hours of operation also differ for the companies that operate AFIS systems. The policies for the access and retention of data might be different, as might be the department responsible for offering such systems.

The question "What, according to your knowledge, are the weaknesses of using four-point AFIS system?" was asked of Samples "A" and "B".

Sample "A", the CEAs at the IEC, answered as follows:
- Fifteen participants said that the four-point AFIS system does not identify or detect multiple registrations and sometimes misinformation occurs when uploading into the system.
- Only two participants said it is too slow.
- Another two could not answer the question.

Sample "B", the fingerprint experts at the LMPS, could not answer the question, as the LMPS experts do not use the four-point AFIS system. From the responses of the CEAs, it is clear that the four-point AFIS is not the perfect system for the IEC as most of the weaknesses were identified by the participants and these can work against the commission in terms of fraudulent voter registration.

3.3.5 The use of the four-point AFIS system to identify fraudulent voter registration in Lesotho

Voter registration in Lesotho is mandatory and a continuous process. For the 2002 elections, the IEC completely discarded the voters' list that had been used in 1998, as many parties had queried its accuracy and validity. The commission also used a new technology of fingerprint and image identification and recording. Recent publications do not mention the use of digital voter

registration kits or computers off line – but this is still the practice in Lesotho (Institute for Democracy and Electoral Assistance, 2014).

Table 3.1: Summary of all 17 reported cases that were analysed by the researcher at the LMPS

Questions Asked	Answers/findings
• Which AFIS system is used?	In all cases, the four-point AFIS system was used by CEAs of the IEC to capture the fingerprints of the suspects or eligible voters.
• Did fingerprint expert identify matching fingerprint points needed during comparison process?	The fingerprint expert was able to match all fingerprint points needed for comparison.
• Which fingers did the suspects commonly use?	The suspects or eligible voters used the index finger and thumb during the registration process.
• Is the motive or modus operandi behind fraudulent registration similar?	The cases were not similar in their modus operandi. There were suspects who claimed that they had registered more than once due to lack of voter education, which meant that they were not aware that what they were doing was actually a crime. However, there were those who knowingly registered twice with the aim of increasing numbers of registered and eligible voters to give their parties an upper hand.

• Was somebody charged?	All of the suspects were charged under the National Assembly Electoral Act of 2011, section 157.
• Was there a conviction?	The IEC has since withdrawn the charges against all suspects.
• If there was an acquittal, what was the reason?	The complainant withdrew the charges.

(Source: Case Analysis: Lesotho Mounted Police Service)

The question "How could the four-point AFIS system be used to identify fraudulent voter registration in Lesotho?" was asked to all the samples.

Sample "A", the CEAs at the IEC, answered as follows:

- Fifteen participants said that the four-point AFIS system should be interfaced at constituency level and be installed with a gadget or software that can detect multiple registrations.
- Four participants could not answer the question.

Sample "B", the fingerprint experts at the LMPS, could not answer the question, the reason being that they were not conversant with the four-point AFIS system and the registration process. In addition, the LMPS does not use the four-point AFIS system.

The Automated Fingerprint Identification System (AFIS) started in the late 1970s because of the explosion in computer technology, and as computer, technology has improved as well as AFIS (Gardner, 2012:257). Houck (2007:74-75), states that, there was an improvement in 1999 when the FBI technologically advanced a new automated fingerprint system known as the Integrated Automated Fingerprint Identification System of IAFIS, mainly it is a ten-print system for searching an individual's fingerprints like a standard AFIS, it can also digitally capture latent and ten-print images. Girard (2008:148-149),

concurs with Houck (2007:74-75) that continuing limitations led the FBI to changing the AFIS in the 1990s. In 1999, the FBI released the new version of this system, the Integrated AFIS.

3.4 THE TEN-POINT AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM

Saferstein (2011:544) concurs with the views of Girard (2011:150-151) and Lyman (2013:62) that the Henry system and its sub-classifications have proven to be a cumbersome system for storing, retrieving and searching for fingerprints, particularly as a fingerprint collection grows in size. Menzel (1999:131-132) states that, in the past, fingerprint evidence was generally useful only when a suspect was present because it was generally simply not feasible to search the very large files of inked-fingerprint-cards. The development of AFIS, which involves extensive computer systems for entering and storing fingerprints, has meant that an unknown print can be entered and searched against the database. This has made cold searching a reality. A developed latent fingerprint can be photographed and placed in the AFIS reader, which is a video camera interfaced to the AFIS computer. The fingerprint image then appears on the computer monitor, minutiae are marked, and ridge tracing may take place, to produce the digitised fingerprint image.

Houck (2007:74-75), furthermore states that IAFIS can also perform the following:
- Enhance an image to improve its quality
- Compare crime scene fingerprints against known ten-print records retrieved from the data base
- Search crime scene fingerprints against known fingerprints when no suspects have been developed; and
- Automatically search the prints of an arrestee against a data base of unsolved cases

The current AFIS systems match fingerprint details. Normally, human and computer investigators focus on points where forensic ridge lines end or where one ridge splits into two (bifurcations). Together, this individual feature sometimes called typical. To determine a match, the scanner system must find adequate number of minutiae points that the two prints share. The exact number of points needed for a positive identification depends on the individual country and an expert fingerprint examiner makes decision on that (Girard, 2008:149).

Samples "A" and "B" had no knowledge of the ten-point AFIS because they did not use it. The decision was made to apply for permission to interview officials of the SAPS and the South African Department of Home Affairs, where the system is used, but this application was not successful. Consequently, an application was made for permission to interview the data processor from the NICR Department at the Department of Home Affairs in Lesotho. This application was approved.

Sample "C", the official at the NICR tasked with the production of identity documents, states that the ten-point AFIS system is a fingerprint identification system that contains the following: birth certificates, identity documents, and marriage and death certificate information. The systems are accessed through the username and password allocated to the data processor, who has limited scope to perform all the functions in the system. The system has the following components or hardware: a camera and a stand, signature pad, MRZ gadget (device) for quality assurance, identity card printer, PC monitor and document scanner.

Figure 3.2 below presents the ten-point AFIS components and configuration: this the process through which either fingerprints are taken using a paper-and-inkpad method or the fingers and palms are rolled on a glass plate located on the live-scan terminal. A scanner below the plate then reads the information from the prints. This information is electronically transmitted to a repository, where a technician transmits the information to AFIS for comparative searching (Smith & Zinn, 2016:421).

Figure 3.2: Ten-point AFIS
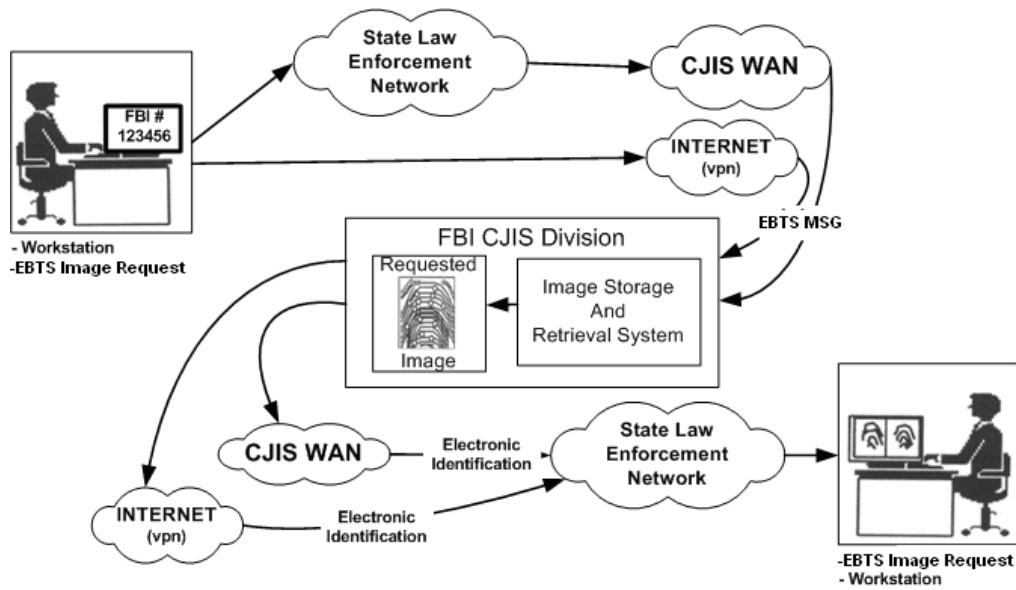
(Source: Federal Bureau of Investigation – Criminal Justice Information Service Division, 2013)

3.4.1 Differences between the four-point and ten-point AFIS systems

Sample "C", the data processor at the NICR, provided the following differences between the four-point and ten-point AFIS systems.

Table 3.2: Differences between the four-point and ten-point AFIS systems

Four-Point AFIS	Ten-Point AFIS
• Can capture four fingerprints.	• Can capture ten fingerprints.
• The process can be completed with only four fingerprints captured.	• The process can be completed with seven fingerprints and in case of fewer approvals is needed from a supervisor.
• It opens the way for fraudulent and/or multiple registrations as it leaves other fingers that might be used.	• It detects multiple registrations as it captures all fingerprints.

(Source: Independent Electoral Commission, 2013 and National Identity and Civil Registry, 2016)

3.4.2 Limitations of using the ten-point AFIS system

Fisher (2004:107) mentions that most AFIS technologies are being utilised at present, but their disadvantage is that they do not interact with each other. The prints stored at one AFIS database cannot be accessed by a foreign system from another service provider. The solution to the problem is to scan the print, or copy it into the other AFIS system so that they can share data. The efficiency of the AFIS system can be made better by bridging the gap with computer software and hardware. Gardner (2012:258) concurs with the view of Fisher (2004:107) that another problem that affects AFIS is that different types of AFIS are very old and subsequently incompatible when searching for or storing data in this system and this inhibits the interfacing of AFIS databases.

According to Komarinski, (2005:168), the system does not yet cooperate or integrate with other systems. There are standards that must be met when collecting and transmitting the ten-print records and images to law enforcement agencies and AFIS service providers use these standards and specifications when manufacturing individual AFIS systems. Nations have not found sufficient political and economic benefits to make available the funds needed for these systems to interact.

Gardner (2012:258) agrees with the view of Komarinski (2005:168) that one issue affecting AFIS is that many different types of AFIS system have been developed over the years, which has resulted in incompatible search and storage systems, and this prevents collaborative exchange of AFIS databases. Only in present decade, through standardisation, Lesotho has smaller AFIS systems that are not interfaced with the larger national system.

The question "According to your experience what are the limitations to the ten-point AFIS system?" was asked of Sample "C". The response was that, "yes", it has limitations as it does not capture palm-prints, and the fingerprints of a prospective applicant that is an amputee can be waived by a supervisor, which makes the system susceptible to fraudulent transactions.

3.4.3 Strengths of the ten-point AFIS system

The ten-point AFIS system does have certain strengths. One major benefit of this technology is the ability to transmit the print image over telephone or cable lines from an AFIS system to a computerised criminal record centre. This feature also allows international sharing of databases to help capture criminals who move from one country to another.

Hawthorne (2009:8-9) reiterates that AFIS can now do in seconds what used to take months under the manual system of filing and searching. Mokwele (2016:70) concurs with Bennett and Hess (2001:111) and Hawthorne (2009:8-9) and adds that a further advantage is that AFIS prints enlarge automatically while, in the manual system, a fingerprint expert has to use a magnifying glass to enlarge both prints. Although the manual system has proven to be a successful in ten-print card files, it provides little assistance in cold searches for a single fingerprint when the name of a suspect has not been generated in a specific case.

Jamieson, Stephens and Kumar (2005:2-3) agree with Bennett and Hess (2001:111) and Hawthorne (2009:99), and illustrate the advantages of the ten-point AFIS as follows:

- Acceptance: most people understand its applicability.
- Accuracy: fingerprint technology is mostly accurate; the chances of accepting a false print are low.
- Ease of use: very little time is required for enrolment with a fingerprint scanning system; one could consider fingerprint scanning relatively not disconcerting.
- Installation: technology has made fingerprint scanners easy to install and inexpensive.
- Training: these devices require no training to use and little training to support.
- Uniqueness: a fingerprint is a unique identifier specific to the individual as there are no two people with identical fingerprints.

- Security: fingerprints cannot be lost or stolen, and are difficult to reproduce.

According to Fisher (2004:107), AFIS has revolutionised the way police departments search latent prints for matches. Traditionally, the police would go to a crime scene to dust for latent prints but with the application of AFIS, scene of crime officers or fingerprint experts are able to collect more quality latent prints at crime scenes and have a greater chance of identifying criminals via the AFIS system. Pepper (2005:90) shares the view that the ten-point AFIS system allows the national verification of ten prints taken, the searching of ten prints (fingerprints found at scene of crime) outstanding scenes of crime marks, and the searching of crime marks against the ten-print database. The search of crime scene marks against the ten-print database initiates a response within 20 minutes of launching the mark on the system, with a list of possible matches being produced. The likelihood of the first name on the list being a successful match ranges between 70% and 90%.

Gilbert (2007:450-451) concurs with the view of Fisher (2004:107) and Pepper (2005:90) that the ten-point AFIS system can compare a latent print with 300,000 file databases in 15 minutes. The system can produce up to 25 prints in its database that have a strong probability of being similar to the compared latent fingerprint. Recent AFIS databases have the extended capacity to hold nearly five million fingerprint samples.

As mentioned above (see Section 3.2.1) the live-scan fingerprinting process is a strength of the AFIS system. It allows police in the field to place a suspect's fingers on a glass plate that is read by a device to produce a digital image of the prints. This image is then transmitted over a phone line to a main AFIS computer centre for immediate comparison for outstanding warrants or arrest history.

A further value of AFIS lies in its filling and retrieval capability. The system can manage and search literally millions of records, something that cannot be achieved manually (Gardner, 2012:257-258). AFIS systems are gaining support

from authorities, since most of the work that was made by clerks, such as, searching, classifying fingerprint cards, storing them in the pigeonholes and searching for misfiling, has been eliminated. The technology has replaced that workforce, and they are being redeployed or retired. According to Komarinski, (2005:84-85) in other countries, such as USA, this improvement has created new opportunities for skilled workers, such as data processors, managers, and program and policy analysts and Lesotho is going through a similar path.

The question "What are the strengths of the ten-point AFIS system to identify fraudulent voter registration?" was asked of Sample "C". The participant said that it is end-user friendly, the system can detect multiple voter registrations, and it is fast as he can register more than two hundred applicants per day without any interruptions. These ideas clearly concur with the points raised by the literature consulted.

3.4.4 Disadvantages of the ten-point AFIS system

The ten-point AFIS system like any other system has its own disadvantages. Jamieson et al. (2005:2-3) mention the following as disadvantages:

- Acceptance: Although this is also an advantage, user acceptance is not guaranteed, as some people view this as an invasion of privacy.
- Injury: An injury to the finger being printed, whether temporary or permanent can interfere with the scanning process.
- Security: The technology that is used to store fingerprints as statistical algorithms may also be able to be used or modified to recreate an accurate depiction of the print itself. This raises serious concerns related to how such data should be stored, manipulated and protected to prevent fraudulent use.

A further problem involves altering fingerprints. The problem of altered fingerprints falls under a broader category of attacks known as biometric obfuscation. Obfuscation can be defined as a purposeful attempt by an individual to mask his identity, so that it cannot be recognised by a biometric system, by altering the biometric trait prior to its being entered into the system

(Yoon, 2014:127). Jain and Pankanti (2017:9) furthermore state that, while significant progress has been made in automatic fingerprint identification, there are still a number of research issues that need to be addressed to improve system accuracy. Most of the shortcomings in the accuracy of AFIS can be attributed to the acquisition process.

Therefore, it is necessary that AFIS should have the capability to determine the identity of individuals with altered fingerprints. To tackle the problem of fingerprint alteration, new algorithms for detecting and matching altered fingerprints are urgently needed (Yoon, 2014:130).

A further problem identified by Hawthorne (2009:99) is that AFIS does not make identifications; it is rather a sophisticated filing and searching system. Identification is the responsibility of the latent print examiner. The latent print examiner enters the applicable information into AFIS then allows the system to search through the database. When the search is complete, AFIS then produces a list of possible matches to compare with. The AFIS technician or examiner might select that list, after which the latent print examiner starts with the first set of fingerprints to make an identification of a possible match. In some cases, there can be no positive identification because that appropriate information has not yet been entered into the AFIS system. Obviously, this can happen, when a person has not been fingerprinted and his or her prints not entered into the AFIS database (Hawthorne, 2009:99).

Mokwele (2016:82-83) stipulates further disadvantages of AFIS as follows:
- Computer crimes involve a skilled computer hacker that might compromise the security of the targeted system.
- Dealing with prints of poor quality makes the system very slow.
- When officers do not retake suspects' prints in time the results of the delay have negative effects on service delivery, the justice system and the private sector.
- AFIS can search for only one scanned fingerprint at a time and the expert can only identify one visibly clear impression.

The question "According to your understanding and experience, what are the disadvantages of the ten-point AFIS system?" was asked of Sample "C". He concurred with some of the literature sources consulted that:

- There is poor hygiene as the machine is not cleaned after every applicant.

- The machine is very slow due to dirt caused by sweat and dirty fingers of applicants and it takes a long time to capture the fingerprints.

- It does not capture the prints of burned fingers and damaged fingers, they are rejected.

- Whenever the system restarts after having shut down, it can reject an applicant or treat it as if it is a duplication.

- In the case of amputated fingers, it can capture fingerprint patterns that fall under the fingertip, which might mislead the investigator during the search as it recognises these patterns as a fingerprint.

3.4.5 The working of the ten-point AFIS system

According to Sample "C", the ten-point AFIS system works in the following manner: the applicant fills in a form, for example for a birth certificate, with the applicant's full particulars through supporting original documents. The applicant's form is registered, and then the data is entered into the system and is verified and corrected. The birth certificate is then printed and a serial number for the certificate issued. This is followed by quality assurance. After this, the applicant can collect the certificate. This process applies to birth, death and marriage certificates. For the production of identity cards, the system automatically allocates the applicant an identity number, and requires a photocopy of the applicant's birth certificate and the filled-in identity card application form.

According to Sample "C", the applicant must be aged 16 or older. The data processor must verify and check the birth records to determine whether the applicant has complied with the requirements of the birth certificate. If not, the application is rejected, and a compliant interview is held with the applicant as

part of due diligence to ensure that the applicant is not using someone else's birth certificate.

The Sample "C" states that, process of capturing fingerprints involves the following steps:

Step 1: Scan the application number.

Step 2: Capture the identity document number.

Step 3: Then the full particulars are populated automatically.

Step 4: Capture the applicant's fingerprints, starting with four right-hand fingers, then four left-hand fingers, followed by the two thumbs.

The application is then saved. Where more than six fingers cannot be captured; for example, if they are deformed, damaged or cannot be fingerprinted, the matter is escalated to the manager. The particulars of the applicant's next of kin are entered, and then the birth certificate and application form are scanned into the system. The documents are double checked and the image (fingerprint image) and signature captured. The identity document and card are printed, and the serial number verified. Quality assurance is carried out by a special machine (gadget) and confirms that the particulars reflected on the identity card correspond with those in the system. After this, the card is issued to the applicant (Sample "C").

Komarinski (2005:73-84) summarised as follows how AFIS works:

- Databases: The system may have databases of more than three records. For example, the ten-print database, which has information on two fingers; the latent cognisant database, which contains information on all ten fingers; and the unsolved latent database, which stores latent images that are not identified on AFIS Komarinski (2005:73).

- Processing: This involves placing fingerprints correctly and checking the fingerprint image quality. The palms are placed on a flat plate to live scan and capture images. Then digital prints are taken with descriptions of scars, marks and tattoos and loaded onto the system. Komarinski (2005:76-77).

- Why AFIS works: The AFIS system works as a result of the interaction of information, identification and subsystems, and of communication linkages. Role-players are agency managers, academics, system analysts and service providers Komarinski (2005:84).

- Why is some identification missed? Missed identifications are usually caused by poor quality of images and minutiae on the local AFIS system. This poor quality is caused by carelessness or by an officer who is not concentrating. It can also be caused by the type of software in different components of the AFIS system Komarinski (2005:86-87).

3.4.6   Improving the voters' roll in Lesotho

"Worldwide, computerised fingerprint search systems have succeeded in turning what seemed like science fiction into practical reality" (Gilbert, 2007:451). The following question was asked to Sample "C" how could ten-point AFIS improve the voters-roll in Lesotho? Sample "C" suggested that it is essential to interface the IEC database with the NICR database. This would allow the NICR to merge registered voters with all citizens and non-citizens issued with Lesotho's identification document. This process would allow the ten-point AFIS to detect deceased voters captured on the four-point AFIS system and enable the Information Technology Department to conduct effective and accurate data cleansing. After data cleansing it would be possible to detect multiple and/or fraudulent voter registrations.

The Sample "C" suggests that systems can be merged for identity purposes and the physical addresses of the eligible voters, thereby assisting the IEC to demarcate constituencies, and identify males and females registered with the IEC in the voters' roll. This can go as far as identifying underage voters and foreigners who are not eligible for voting.

3.4.7   The ten-point AFIS contribution to the investigation of voter's fraud

The following question was asked to Sample "C" how will ten-point AFIS contribute to the investigation of voter's fraud? The Sample "C" suggested that

the ten-point AFIS could contribute to the investigation of voter fraud in the following manner:

- Establish the true identity of the suspect

- Produce a photograph for tracing and arresting the voter if at large or unknown

- Provide the voter's full residential address

- Identify the correct age of the voter under investigation

- Provide the real constituency of the voter

- Establish if he or she is eligible to vote

In the late 19th century, fingerprints began to be used for the purpose of ensuring that a person was who they said they were, and this was established by taking a print of their fingertip and comparing it to one that was already on record (Stelfox, 2009:91-92). According to Gilbert (2007:452), automated fingerprinting systems have proven their value in solving previously unsolvable felony investigations. In this regard, the researcher of the opinion that, from the sources consulted, the ten-point AFIS system can make a positive contribution to IEC in relation to the investigation of voter fraud.

The ten-point AFIS will also contribute to the investigation of voter fraud by locating a person who has allegedly committed an incident by comparing and identifying the suspect's prints manually or electronically via an AFIS search (Manamela & Mokwena, 2016:140). The CP&E Act. No. 9 of 1981 further stipulates that, fingerprint record photograph or document shall only be admissible in evidence if produced to court by a law enforcement officer having custody thereof.

3.5   SUMMARY

This chapter identified that AFIS is a forensic method and technique that can be used by law enforcement agents, and the public or private sectors for storing their fingerprint data and client information. The discussion presented in the chapter indicated that the application of complete AFIS is not well known by the

law enforcement agencies and the four-point AFIS technicians of Lesotho's IEC but it is known by the personnel using the ten-point AFIS at the Department of Home Affairs – NICR.

It would be useful for the law enforcement agencies in Lesotho to find out about the application of AFIS and for the IEC to gain more insight into AFIS technology as it has been shown in this chapter that this would make voter registration more efficient and effective.

CHAPTER FOUR: FINDINGS AND RECOMMENDATIONS

4.1   INTRODUCTION

The researcher decided to conduct research on this topic: "The use of automated fingerprint identification system in identifying fraudulent voter's registration in Lesotho" as a result of the constant election result disputes by parties that have lost elections, which have resulted in political instability. The Lesotho IEC in most instances did what it could to ensure fair elections because there is no system that can assure all political parties that elections are not rigged through manipulation of the voters' roll. This leaves the commission facing accusations of so-called election fraud and issues of credibility even if the elections were free and fair and the outcomes unquestioned.

The aim of this research is, first, to determine the strengths and weaknesses of the four-point AFIS system and, secondly, to explore the strengths and weaknesses of the ten-point AFIS system and its potential for identifying fraudulent voter registration in Lesotho. In order to achieve the aims and address the problem of voter registration using the four-point AFIS system, the researcher formulated three research questions. The research was conducted, and the following research questions were answered:

- What are the objectives of investigation?
- What are the strengths and weaknesses of the four-point AFIS system?
- What are the strengths and weaknesses of the ten-point AFIS system for identifying fraudulent voter registration?

4.2   FINDINGS

The research findings are based on secondary information obtained from national and international literature sources and primary information from the interviews with the AFIS CEAs at Lesotho's IEC, the fingerprint experts at the LMPS and a data processor at the NICR.

4.2.1　Research question 1: What are the objectives of investigation?

The research revealed the following information:

What is investigation?

According to the literature, investigation is an important discipline and profession that is generally conducted by law enforcement agencies where due processes must be followed at every step taken by the investigator when identifying the type of crime alleged to have been committed and when collecting relevant evidence.

What is forensic investigation?

It was found after having consulted relevant sources that forensic investigation is a scientific method of establishing whether a crime has been committed. Forensic investigation can be applied to civil and criminal matters.

What is the difference between criminal and forensic investigation?

The literature indicated that there is a difference between criminal investigation and forensic investigation and that the objectives differ as criminal investigation covers criminal matters and aim is to secure conviction of accused person by proofing case beyond reasonable doubt, while forensic investigation include both criminal and civil matters, such as; disciplinary hearing and delicts.

What are the objectives of investigation?

It was also established from the literature that the objectives of investigations are to identify which crime has been committed, to gather all clues surrounding the case that may afford evidence, to individualise the crime and, thereafter, to arrest all the possible suspects.

What is identification?

The literature sources consulted reveal that identification may not be achieved if the subjects involved are not identified and individualised that translate to positive identification that an item belongs to a specific category.

What is individualisation?

The participants interviewed, literature visited and case files analysed revealed that individualisation demonstrates the uniqueness of an item by comparison.

What is a fingerprint?

The researcher established from participants and literature that, fingerprint is multifarious patterns of hills, and valleys designed for handling an object with different ridge characteristics within a fingerprint pattern. That, serves as personal identification in fingerprint classifications, and is unique as there are no two people with similar fingerprints, even the identical twins.

4.2.2 Research question 2: What are the strengths and weaknesses of the four-point AFIS system?

The research revealed the following information:

What is the AFIS system?

It was found that AFIS is a system with automation and identification capabilities that has replaced manual filing, searching and identification of individual fingerprints.

What is the four-point AFIS system?

It was established that the four-point AFIS is a unique gadget that positively identifies fingerprints. It can be used in the field as it can be contained in a carry-case and operated with portable built-in batteries. The four-point AFIS system can be linked to a laptop or PC and it is fitted with a "WI-FI" facility that allows the system to connect to the network remotely.

What are the limitations of the four-point AFIS system?

It was also established that the four-point AFIS system has weaknesses, such as that when operational it captures four fingers and leaves out the other six fingers, which can result in data duplication. It was established after consultations with participants that the system sometimes becomes very slow during the registration process.

What is the use of the four-point AFIS system for identifying fraudulent voter registration?

The research established that the four-point AFIS system at the IEC could be interfaced with other AFIS systems, such as the ten-point AFIS system at the NICR. The research established that no one can manipulate or alter fingerprints captured into the system.

4.2.3 Research Question 3: What are the strengths and weaknesses of the ten-point AFIS system for identifying fraudulent voter registration in Lesotho?

The research revealed the following information:

What is the ten-point AFIS system?

The interviews from the participant interviewed confirmed that the ten-point is modern system that replaces old AFIS system after having found to have shortfalls of the old system

What is the difference between the four- and ten-point AFIS systems?

It was found during the research that the four-point AFIS only capture four fingerprints and susceptible to duplication and ten-point AFIS capture all fingerprint can detect duplication and ten-point AFIS if fewer fingerprint are captured it needs approval of supervisor whereas four-point AFIS process is completed by any four prints.

What are the imitations of using the ten-point AFIS system?

The sources consulted showed that the new system has problems with interfacing with the old systems.

What are the strengths of the ten-point AFIS system?

It was established that the ten-point AFIS system is able to transmit over telephone or cable lines from one system to another. It was also found that the ten-point AFIS system is fast enough to process over a million fingerprints in seconds. It was established that the ten-point AFIS collects more quality latent

prints at a crime scene and has a greater chance of identifying potential criminals with ease than the manual processing of fingerprints. It was established that the ten-point AFIS system is capable of live-scan. For example, it can identify a possible match in real time or live for users while out in the field or far from the AFIS system.

What are the disadvantages of the ten-point AFIS system?

It was found that while the ten-point AFIS system can identify a possible match, it nonetheless requires the services of a qualified fingerprint expert to make a final positive identification of fingerprints.

How does the ten-point AFIS system work?

After the interview with the data processor and having consulted relevant sources, it was established that AFIS is a system that can capture the particulars of an individual from their birth certificate automatically and verify them. It can easily capture and verify fingerprints; it cannot interact with other systems. Missed identifications are more likely to be caused by operators than the system.

How can the ten-point AFIS improve the voters' roll in Lesotho?

It was found that the system could assist the IEC to carry out data cleansing, identify fraudulent voters that had registered more than once, and establish the underage, deceased and non-citizens of Lesotho.

How will the ten-point AFIS contribute to the investigation of voter fraud?

The contribution of AFIS to the investigation of crime is enormous, not only to particular aspects of voter fraud such as identification of suspects, elimination of suspects, location of the correct address of wanted persons, and identification of the correct constituency of a voter but also to the investigation of voter fraud in general.

4.3 RECOMMENDATIONS

The following recommendations are made based on the facts discovered during the research in order to address the shortcomings with regard to the application of AFIS at the IEC and other private and public institutions:

- The IEC of Lesotho should consider converting the four-point AFIS system by the addition of relevant software to enable it to capture ten fingerprints.

- The AFIS technicians at the IEC should be trained in the basics of operating the ten-point AFIS system and in fingerprint science, which includes patterns and classification.

- The IEC should intensify voter education on AFIS

- The IEC should use a ten-fingerprint identification technique to identify fraudulent voter registration and start registration of eligible voters from the scratch.

- The AFIS system at the IEC should be interfaced with the system at the Ministry of Home Affairs – NICR that is used for registering citizens and non-citizens throughout the country.

- The LMPS and other law enforcement agencies and the financial institutions, such as the banks, insurance companies and the Lesotho Revenue Authority should consider procuring the services of AFIS and interfacing the system with the Department of Home Affairs to access data for "Read-Only" purposes.

- The police and financial institutions of Lesotho, such as the Lesotho Revenue Authority, the Banks and Insurance Companies, should develop a Memorandum of Understanding with the Department of Home Affairs to access "data" regarding taxpayers and their customers.

- The Government of Lesotho should train fingerprint experts, focusing on the application of AFIS (at present there is no fingerprint experts in Lesotho, as it was established during the research that even if the system could assist to match fingerprints at a fast rate, it is still a prerequisite that a fingerprint expert makes a positive identification. The

fingerprint expert would also possibly write fingerprint identification reports, charts and testify in courts of law.

4.4   CONCLUSION

The use of AFIS globally has increased, even in the least-developed countries. It has been found to be a simple, reliable and user-friendly method of positively identifying individuals. The use of the ten-point AFIS system as a forensic method is useful for application by law enforcement agencies; private and public entities; financial institutions. For example, the banks and insurance companies; and other government departments in the Kingdom of Lesotho, such as the Department of Social Development to identify beneficiaries of social grants and IEC in identifying fraudulent voter's registration in Lesotho.

The research further found that the application of AFIS is not complicated; what is required is equipping end-users with the basic knowledge of fingerprints and proper training, and the backup of fingerprint experts with knowledge of the system.

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ATTACHMENT "A": INTERVIEW SCHEDULE (SAMPLE "A" & "B")

Interview schedule for Independent Electoral Commission AFIS Technicians (Constituency Electoral Assistant) and Lesotho Mounted Police Service Fingerprint Experts.

TOPIC: THE USE OF THE AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM IN IDENTIFYING FRAUDULENT VOTERS' REGISTRATION IN LESOTHO

RESEARCH AIMS

The aim of this research is firstly to determine the strengths and weaknesses of four-point AFIS system, and secondly to explore the strengths and weaknesses of the ten-point AFIS system to identify fraudulent voter registration in Lesotho.

RESEARCH QUESTIONS

- What are the objectives of investigation?
- What are the strengths and weaknesses of the four-point AFIS system?
- What are the strengths and weaknesses of the ten-point AFIS system to identify fraudulent voter registration in Lesotho?

The researcher is bound to his assurances and guarantees by the ethics code for research of the University of South Africa. The information you provide will be used in a research project for a Master of Technology degree registered with the Department of Police Practice at the University of South Africa. The analysed and processed data will be published in a research report.

Your answers will be noted by the interviewer himself, on paper. Should any question be unclear, please ask the researcher for clarification. Only one answer per question is required. When answering the questions, it is very important to give your own opinion.

Written permission has been obtained from the Independent Electoral Commission in advance, for the interview to be conducted and the copy of letter from the Commission is attached.

I hereby give permission to be interviewed and that information supplied by me can be used in this research.
YES / NO

SECTION A: HISTORICAL INFORMATION

A.1 Were you an AFIS technician during 26th May 2012 general elections?
YES / NO

A.2 How long have you been an AFIS technician?

1 – 5 yrs   5yrs – 10 yrs   10yrs and above

A.3 Do you make use of AFIS system?
YES / NO

A.4 How many voters did you registered per day?

0 – 50 Voters   50 – 100 voters   100 and above

A.5 Did you receive training in AFIS system?
YES / NO

A.6 Give a summary of the content of the AFIS training you had received;

SECTION B: WHAT ARE THE OBJECTIVES OF INVESTIGATIONS?

B. 1 Based on your knowledge, what is your understanding of the concept investigation?

B. 2 Define the concept 'criminal investigation'?

B. 3 What according to your understanding is the objectives of Investigation?

B. 4 According to you, what is forensic investigation?

B. 5 According to your understanding, what is the difference between criminal investigation and forensic investigation?

B. 6 Based on your experience and knowledge, what is the meaning of identification?

B. 7 Based on your experience and knowledge what is the meaning of individualisation?

B. 8 According to your understanding, what is a fingerprint?

B. 9 According to you, what is a latent fingerprint?

B. 10 In your opinion, what is fingerprint identification?

B.11 In your opinion, what is the purpose of using fingerprints identification in forensic investigation?

B.12 To your knowledge, what makes a fingerprint unique as an identification technique?

SECTION C: THE STRENGTHS AND WEAKNESSES OF FOUR-POINT AFIS SYSTEMS TO IDENTIFY FRAUDULENT VOTERS' REGISTRATION IN LESOTHO?

C. 1 According to your knowledge what is the AFIS system?

C. 2 What is AFIS functions and capabilities?

C. 3 Explain according to your knowledge how the Four-point AFIS system works.

C. 4 What, according to your knowledge, is the limitations of using the FOUR-POINT AFIS system?

C. 5 What according your knowledge are the strengths of the four-point AFIS system?

C. 6 What according to your knowledge are the weaknesses of using the four-point AFIS system?

C. 7 How could the FOUR-POINT AFIS system be used to identify fraudulent voter registration in Lesotho?

ATTACHMENT "B": INTERVIEW SCHEDULE (SAMPLE "C"): INTERVIEW SCHEDULE FOR DATA PROCESSORS

TOPIC: THE USE OF THE AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM IN IDENTIFYING FRAUDULENT VOTERS' REGISTRATION IN LESOTHO

Interview schedule for ten-point AFIS data processor National Identity and Civil Registry at Department of Home Affairs in Lesotho

RESEARCH AIMS:

The aim of this research is to explore how the four-point AFIS system could be effectively used to identify illegal voter registration in Lesotho.

RESEARCH QUESTIONS:

What are the objectives of investigation?

What are the strengths and weaknesses of the four-point AFIS system?

What are the strengths and weaknesses of the ten-point AFIS system to identify fraudulent voter registration in Lesotho?

The researcher is bound to his assurances and guarantees by the ethics code for research of the University of South Africa. The information you provide will be used in a research project for a Master of Technology degree registered with the Department of Police Practice at the University of South Africa. The analysed and processed data will be published in a research report.

Your answers will be noted by the interviewer himself, on paper. Should any question be unclear, please ask the researcher for clarification. Only one answer per question is required. When answering the questions, it is very important to give your own opinion.

Written permission has been obtained from the ten-point AFIS experts in advance, for the interview to be conducted and the copy of letter from is attached.

I hereby give permission to be interviewed and that information supplied by me can be used in this research.

YES / NO

SECTION A: HISTORICAL INFORMATION

1 Are you an AFIS Expert?

YES / NO

2 How long have you been a fingerprint expert?

1 – 5 yrs   5yrs – 10 yrs   10yrs and above

4 What is your expertise as far as AFIS is concerned?

5 Did you receive training in the AFIS system?

YES / NO

SECTION B: THE STRENGTHS AND WEAKNESSES OF THE TEN-POINT AFIS SYSTEM

B. 1 What is the TEN POINT-AFIS SYSTEM?

B. 2 What is AFIS functions and capabilities?

B.3 According to you, is there a difference between the FOUR-POINT and TEN-POINT AFIS system?

B.4 According to your experience are there limitations to the TEN-POINT AFIS system?

B.5 What are the strengths of the ten-point AFIS system to identify fraudulent voter registration

B.6 According to your understanding and experience, what are the disadvantages of the TEN-POINT AFIS system?

B.7 How does the TEN-POINT AFIS work?

B.8 How could ten-point AFIS improve the voters-roll in Lesotho?

B.9 How will ten-point AFIS contribute to the investigation of voter's fraud?

LMPS 13

Tel. No :- Maseru (09266) 22317262
Telegraphic :- Compol
Fax :- (09266) 22310045

Lesotho Mounted Police Service
Police Headquarters
P.O Box 13
Maseru 100
Lesotho

Ref:
CP/C/HQ/51

04 JANUARY 2013

MR. LESOLE. J. CHIGANDO
P.O.BOX 1633
MASERU, 100

Dear Mr. Chigando,

REQUEST TO CONDUCT RESEARCH

Reference is made to your letter dated 06.12.2012 requesting to conduct a research on," The two point AFIS system as a technique to identify illegal voters' registration in Lesotho."

It gives me a great pleasure to inform you that your request has been approved and you can contact our Forensic Laboratory office for assistance.

Regards,

S/INSP. K. HALAHALA
HUMAN RESOURCES OFFICER

2013 -01- 04
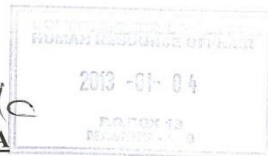
ANNEXURE B: APPROVAL TO INTERVIEW INDEPENDENT ELECTORAL COMMISSION – CONSTITUENCY ELECTORAL ASSISTANTS

INDEPENDENT ELECTORAL COMMISSION

P.O. Box 12698, Maseru 100. LESOTHO. Tel: +266 22 31 4991 Fax: +266 2231 0398

22nd **January 2013**

Mr. Lesole Chigando
P.O. Box 1633
MASERU 100

Dear Mr. Chingando

Re: Permission to Conduct Forensic Research on Voter Registration

This letter services as an acknowledgement of your letter dated 6th December 2012, whereby you had requested to conduct a research on the following topic: *"The two-point AFIS as a Technique to Indentify Illegal Voters' Registration in Lesotho".*

The Commission has found that the research topic to be relevant to their functions and the aim of the research is even more profound if it would detect multiple registrations of voters which currently have been an outstanding challenge with the current voters' registration. Finally I understand the research will also determine the scale of fraud in elections, I hope a conclusion which will be reached on this issue would have been scientifically tested so that the conclusion could stand the test of litigation.

You are therefore allowed to conduct research as had been requested; you will be given all the necessary assistance you need to ensure that your programme processed smoothly.

Yours faithfully

Mphasa Mokhochane
Director of Elections

ANNEXURE C: APPROVAL TO INTERVIEW DATA PROCESSOR AT MINISTRYOF HOME AFFAIRS – NATIONAL IDENTITY AND CIVIL REGISTRY

LESOTHO

MINISTRY OF HOME AFFAIRS

P.O.BOX 174

MASERU

TEL: + 266 28314034   DATE: 23 DECEMBER, 2016

REF: MOHA/ADMIN/1

LESOLE JOHN CHIGANDO
P.O.BOX 1633
MASERU 100

Dear Sir

RE: APPLICATION TO CONDUCT RESEARCH

Reference is made to your letter dated 22 December 2016 on the above captioned matter.

Please be informed that your request has been approved with pleasure and you can proceed to conduct the research on the use of automated fingerprint identification system in identifying fraudulent voter's registration in Lesotho.

Regards

Yours Faithfully

TUMELO RABOLETSI (Mr.)

DIRECTOR

NATIONAL IDENTITY AND CIVIL REGISTRY DEPARTMENT

ANNEXURE D: LETTER FROM DEPARTMENT OF HOME AFFAIRS

DHA-57

home affairs

Department:
Home Affairs
REPUBLIC OF SOUTH AFRICA

230 Johannes Ramokhoase Street, Private Bag X114, PRETORIA, 0001
Paliamentary Office, 120 Plein Street, Private Bag X9048, Cape Town, 8000

Enquiries: Lettie Masilo   **Tel:** 012 406 4096   **Email:** Lettie.Masilo@dha.gov.za

Dear Mr. L.J Chigando

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN THE DEPARTMENT OF HOME AFFAIRS ON "THE USE OF AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM (AFIS) IN IDENTIFYING FRAUDULENT VOTERS' REGISTRATION IN LESOTHO".

Thank you for the expression of interest to conduct your research in the Department of Home Affairs. However, after carefully reviewing your request, we regret to inform you that the department is unable to approve your request for the reasons outlined below:

(a) The proposed research study on the use of Automated Fingerprint Identification System (AFIS) in identifying fraudulent voters' registration in Lesotho is considered to be a sensitive matter that has legal obligations and as such, cannot be authorized.

(b) The proposed research study will pose risks to the departmental information when compared to potential benefits, considering that the Department of Home Affairs is one of the security clustered departments and is mandated to ensure the national security of the country; by protecting its information interface, loss and from unauthorized access, modification or disclosure.

The department wishes you the best in your future research.

Nkidi Mohoboko

Deputy Director General: HRM&D

Signature

Date: 24/02/2017

Department of Home Affairs - Lefapha la Merero ya Selegae - Lefapha la Dilaba tsa Lelae - uMnyango wezaseKhaya - Muhasho wa zwa Mune - Departement van Binnelandse Sake - Ngwro ya Merero ya Selegae - Ndzawulo ya ta le Kaya - LiTiko leToekeKhaya - ISebe lezaseKhaya - UmNyango wezangekhaya

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ANNEXURE E: INFORMED CONSENT FORM

Affiliation: STUDENT AT UNISA

Researcher: Lesole John Chigando a Mosotho male adult with student number 46267050.

Qualifications of Researcher: BACCALAUREUS TECHNOLOGY: POLICING

Purpose of the Research:

In conducting this research the researcher proposes that the aim of this research study is to: determine the strengths and weaknesses of two-point AFIS system, and secondly to explore the strengths and strengths and weaknesses of the ten-point AFIS system to identify fraudulent voter registration in Lesotho.

Duration of the Study:

It is projected that the proposed study will take two years.

Participant's Role:

The role of participant is that of a source of information to provide data through the data collection method of interviews between the researcher and the participants answering questions formulated in an interview schedule, which is aimed at answering the research questions applicable to the proposed study. It is anticipated that the duration of the interview will be approximately one hour, but may end sooner by the interview running its course or by request of the researcher or participant, depending on the circumstances.

Selection of Participants:

The selection of participants is reliant upon a combination of probability and non-probability method of sampling. Participants will be selected according to their involvement in application of Automated Fingerprint Identification System concerned with the registering of voters and issuance of identification for citizen respectively.

Risks and Discomfort:

It is not foreseen that by participating in this research the participants face any specific risks. The researcher has obtained permission or is in the process of obtaining permission from the Lesotho Mounted Police Service, Independent Electoral Commission and Department of Home Affairs (RSA) to conduct interviews with its members. The researcher will adhere to secrecy and confidentiality provisions to which the participants may be subject to and will not solicit any such information from them.

The questions formulated in the interview schedule to provide data to answer the research questions is not of a personal nature and should not pose a risk of discomfort. During the interview, the participants may become tired or feel uncomfortable at which point the participant may request a break or request that the interview be postponed to a later date or terminated if so desired. The researcher will make an effort to ensure that the participant is comfortable and at ease to mitigate such a risk.

Protection of Privacy:

The identity of participants will be kept strictly confidential. Only the researcher knows the personal details of the participant to whom a research code has been allocated. The personal details of the participant remain confidential and are not disclosed. They are kept separate from the research results by the researcher.

Benefits to Participant:

The researcher hopes that by participating in the study the participants will experience the satisfaction of solving a problem that is causing multiple registrations by contributing their skills knowledge and experience to the study that may also benefit their colleagues and future colleagues by understanding the problems and possible solutions. The participants will assist in providing insight into the problem that may stimulate future research and thus be of even greater benefit in the future.

Benefit to Others:

Empower and shed a light to fellow law enforcement agents about Automated Fingerprint Identification System as a technique that can assist to fight corruption.

Maintaining Confidentiality:

The researcher will not violate rights or privacy as individuals may risk losing their jobs, family difficulties. The assurance will be made to the participants on their letters and that everything will be kept confidential, if needed to be disclosed it shall be made through their approval.

Statement regarding Gifts and Compensation / Reimbursements:

Participation in the research is voluntary and without and compensation, reimbursement, remuneration reward or inducement whether prior or during the research or in future.

Research Related Inquiries:

Participants are free to contact the researcher at the contact details provided on this form, at a reasonable hour, in connection with the interview particulars if they so wish.

Voluntary Participation without Prejudice for Non-participation:

The participant is under no obligation or duress to participate in this research and does so out of his/her own free will does so out of his/her own free will study and can withdraw from it at any time prior to or during the interview without any risk of prejudice for non-participation or withdrawal.

Withdrawal from Research:

The participants will be informed that they can voluntary withdraw at any stage of the interview.

Informed Consent ensures Autonomy:

An informed written consent will be obtained from each participant before the commencement of the interview.

Security of Data:

The data collected digitally during the interview will be stored on an electronic storage device protected by a password that will be kept separate from the researchers research work and stored in a safe. The transcripts will be kept separate from the disk in a separate safe. A backup copy of the electronic data will be kept separate from the original, also password protected in a different location.

Feedback on Findings of Research:

The findings and recommendations will be made available to the, Independent Electoral Commission, National Identity and Civil Registry and Lesotho Mounted Police Service in Lesotho and the Department of Home Affairs in Republic of South Africa.

Access to Developed products and Sharing of Benefits derived from Products:

It is anticipated that the products developed from this research will constitute a property of UNISA that can possibly be developed into academic material. The findings regarding such report will be published by UNISA once this research has been finalised which can then be accessed by parties who might have an interest therein.

Reporting to Ethical Research Committee:

Report will be provided when required.

Disclosure of Conflict of Interest:

No conflict of interest is foreseen.

Benefit to Local Community and Society at large:

The Basotho Nation will benefit by holding fair elections with clean voter's roll without duplication.

Adverse impact on the Community:

The researcher does not anticipate that the research or its findings may have an adverse impact on the community.

Dissemination of Results:

The results of the study, findings and recommendations will be communicated the Independent Electoral Commission of Lesotho and the research will be available in the Unisa repository and library.

THANK YOU FOR PARTICIPATING IN THIS RESEARCH STUDY.

DECLARATION OF INFORMED CONSENT BY PARTICIPANT:

I, the undersigned, (First full names) …………………………………………………… (Surname)……………………………………………., having been made aware of the information provided herein; agree to participate in this research study voluntary, without compensation, and under any obligation.

Signed at ……………….......... on this ……… day of ……………… 20…..

Signature: ………………………. (Name in print) …………………………………….
Name
M student
UNISA
Tel: …………
Mobile: ……………
e-mail: ………………..