THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN RECONSTRUCTING A MURDER SCENE

by

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DECLARATION

I, Maropene Arbinah Mukhombo, student number 36964069, declare that this research dissertation “The Significance of bloodstain pattern analysis in reconstructing a murder scene” is my own work and all sources used or quoted have been reflected and acknowledged by means of complete referencing.

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 higher education institution.

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ABSTRACT

Murder is one of the most prevalent criminal acts in South Africa, and it has become a key focal point to the criminal justice system. It is, therefore, the responsibility of investigators that there is recourse for victims of murder by bringing suspects to justice. This can be achieved through exploring various forensic techniques in order to ensure that criminals are successfully identified.

In an event where the crime scene involves the shedding of blood, it generally contains an abundance of information in the shape of bloodstain patterns, the scene and its cause. It is not mandatory for investigating officers to possess specialized skills in bloodstain pattern analysis, but it is essential for investigators to have analytical skills to enable them to identify whether there is a need to request the work of experts at the scene.

The purpose of this research study is to explore the significance of bloodstain pattern analysis in reconstructing a murder scene at the Tembisa cluster. In order to ensure that an investigation is successful, it is important that the investigator bears the objectives of criminal investigation in mind.

In the investigation of crime, the method that is applied by investigators to collect and document evidence, and to gather and package physical evidence plays an important role in crime investigation. It is essential that the investigator approach the crime scene with impartiality in order to link the evidence to the suspect. It is important for investigators to be familiar with the concept of bloodstain pattern analysis. The aim of this research study is to provide practical recommendations on the best practice for the use of bloodstain pattern analysis at a murder scene.

Key words: Crime scene investigation, bloodstain pattern analysis, contamination of evidence, chain of evidence, murder scene and crime scene documentation.

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ABBREVIATIONS AND ACRONYMS

BPA	:	Blood Pattern Analysis
CJS	:	Criminal Justice System
CPA		Crime Pattern Analysis
CSI	:	Crime Scene Investigator
CSR	:	Crime scene Reconstruction
DNA	:	Deoxyribonucleic Acid
FSL	:	Forensic Science Laboratory
HVIS		High-Velocity Impact Spatter
IO	:	Investigating Officer
LVIS		Low-Velocity Impact Spatter
MVIS		Medium-Velocity Impact Spatter
SAPS	:	South African Police Service
UNISA	:	University of South Africa

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CHAPTER ONE: GENERAL ORIENTATION

1.1 INTRODUCTION

The success or failure of any criminal investigator often depends on the recognition of physical evidence left at the crime scene and the proper analysis of that evidence. Crime scenes that involve bloodshed often contain a wealth of information in a form of blood patterns, the location, and its cause. Therefore, forensic analysts are needed to analyse the crime scene (Denscombe, 2002:3).

When determining the perpetrator through Deoxyribonucleic Acid (DNA), it is important to take the following into consideration: the movement and directions of persons; the sequence of events where the pattern originated; impact during the incident; and the object used to commit crime. All these can assist in proving or disapproving the statement made by victim(s), the perpetrator(s) and or witness (es) (Fisher & Fisher, 2012:194). Osterburg and Ward (2010:68) make similar inferences, stating that the flight behaviour and the stain pattern of spattered blood can be used to determine, among other things: the movement and direction of the person(s) and or object(s) during the shedding of blood; the type of the impacting object (bludgeon or gunshot) that produces bloodstains; and the direction of its force and the point(s) of the origin of the blood. Despite the value of DNA found at a murder crime scene, the value of bloodstains recovered at the scene of murder plays a significant role in terms of analysing the crime scene as well as the subsequent reconstruction of such a scene. Bloodstains at the scene of crime can ‘speak’ a million words without anyone verbally interpreting what had occurred, but it needs an educated eye to analyse them. In many instances, investigators have claimed that there is no evidence at murder scenes since they cannot see any physical evidence, only to find that evidence that leads to a murder is in abundance in the form of bloodstains. According to Marais (1992: 111), it is a common practice for investigators to search for blood in places where it is least expected. For instance, investigators can trace the presence of blood at the scene of crime despite an attempt to wash away evidence by the suspect. In this research study, the researcher seeks to explore the significance of bloodstain pattern analysis in reconstructing a murder scene.

1.2 PROBLEM STATEMENT

Creswell (2014:65) agrees with Clark (2013:112) by stating that a good problem statement describes what is wrong in clear terms. A research concept can provide the researcher with an idea of what the study will focus on. The key aspect to consider for researchers is that a research concept needs to be translated into a research problem. Berg (2004: 28) indicates

that the research problem is a core trajectory for the whole research process. The method that is applicable in conducting a research study is mainly dependent on how one's research questions are structured. Taking into consideration that the research process starts with an idea and only a concept of what need to be researched. By reading and the collecting of data from the literature, the idea and concept become clearer and theoretically more defined. In essence any concept or assumption that a researcher seeks to investigate can become a research problem for a study (Kumar, 1999: 35).

However, the researcher observed in her capacity as police official at Tembisa police station that cases that are investigated at the South African Police Service (SAPS) Tembisa policing cluster in Gauteng, specifically at the three main police stations, namely Tembisa police station, Ivory Park police station and Rabie Ridge police station, are often closed as unsolvable as a result of investigators' inability to analyse bloodstain patterns properly when reconstructing murder scenes. As a result of regular interaction with investigators responsible for investigating murder cases, it was further established that a substantial number of investigators responsible for analysing bloodstain patterns at the scene of murder experience shortcomings in terms of a lack of the necessary skills to analyse bloodstain patterns and do not have the necessary qualifications and experience to carry out their function effectively.

Eldefonso, Coffey and Grace (1968: 206) emphasise that it is important for investigators to undergo proper training to enable them to execute their investigation responsibilities effectively. According to Girard (2011:49), the court recognises the physical evidence presented before it by forensic scientist with extensive knowledge on how the evidence was analysed and outcome of analysis may be interpreted in a context of a crime scene. In essence, for investigators to analyse bloodstain patterns at a murder scene effectively they should be skilfully and scientifically trained in this specialised field of investigation.

According to SAPS Annual Report for 2013/14 (South African Police Service, 2014), the Tembisa SAPS cluster which comprises of three police stations, recorded a total of 384 reported murder cases for the period of 1 January 2013 to 31 December 2014. From the statistics it is evident that the Tembisa cluster is experiencing a high rate of violent crime with reference to murder. Most of these murder cases are as a result of stabbing with a knife and shooting with a firearm. "However, murder cases that appear before the court end up without conviction mainly owing to, among other factors, the inability of investigators to analyse bloodstain patterns properly when reconstructing murder scene".

Table 1.1 Reported murder cases at Tembisa, Ivory Park and Rabie Ridge police stations

Year	Police Station	Cases Reported	Cases to Court
2013	Tembisa	87	52
2013	Ivory Park	81	31
2013	Rabie Ridge	20	10
2014	Tembisa	76	42
2014	Ivory Park	87	36
2014	Rabie Ridge	33	14

(Tembisa Cluster, 2013-2014).

According to the researcher's interactions with the Tembisa cluster commander with reference to the murder cases reported as per the table above, the cluster commander raised a concern about the high number of murder cases that were closed as being unsolvable. According to the cluster commander, one of the key reasons for the failure to secure convictions was the failure by the investigators to analyse bloodstain patterns in order to reconstruct a murder scene. The Tembisa cluster commander came to conclusion that most of the murder cases failed to be placed on the roll since investigators conducted improper investigations in order to solve murder cases. As a result, an investigating officer was appointed specifically to peruse the undetected murder case dockets. The outcome of the perusal of undetected murder case dockets was that suspects cannot be identified, are not known and/or cannot be linked with the murder scene.

1.3 RESEARCH AIM

Collins (2010:76) is of the view that an aim is a general statement reflecting the intention or purpose of one's chosen area of research. He further highlights that an aim is formulated to state what one wants to achieve. Oliver (2004:102) makes similar inferences that the research aim is to highlight what the researcher seeks to gain from the study being undertaken. The aim of this research study is to explore the significance of bloodstain pattern analysis in reconstructing a murder scene at Tembisa cluster. At the end of this study, recommendations will be made based on the findings that could be used as point of references for future studies, benchmarking and developing good practices by the

practitioners in the field of forensic investigations when analysing bloodstain patterns in the reconstructing of a murder scene.

1.4 RESEARCH PURPOSE

Denscombe (2002:25) states that it is essential for the researcher to have a reason for undertaking the research study. If the researcher undertakes the research study without a purpose, it will result in spending money, time and effort by unnecessarily conducting such research. This research study will be conducted in terms of exploratory research. According to Kumar (2005:10), exploratory research is aimed at either seeking knowledge in the area when little is known or investigating the probabilities of value from conducting a certain research study. The researcher will seek to obtain knowledge about the significance of bloodstain pattern analysis in reconstructing a murder scene in the Tembisa cluster.

Furthermore, Denscombe (2002:26) is of the opinion that a research purpose may be grouped into four categories, namely:

- Evaluate the current state of knowledge among investigators concerning bloodstain pattern analysis at the scene of murder in the Tembisa cluster.
- Explore how the forensic investigators can benchmark from other countries in following the correct protocol in analysing bloodstain patterns in reconstructing a murder scene.
- Apply acquired knowledge from the findings with special emphasis on the Tembisa cluster; and
- Capacitate the researcher and Tembisa cluster forensic investigators through improved knowledge of analysing bloodstain patterns in reconstructing a murder scene.

1.5 RESEARCH QUESTION

According to Punch (2014:57), a research question is a clear, focused, concise, complex and arguable question around which one centres one's research. Gast (2010:70) outlines the role of research questions as the means for directing the researcher regarding the purpose or goal of the study.

For the purpose of this study, the researcher identified one primary research question:

What is the significance of bloodstain pattern analysis in the reconstruction of a murder scene?

1.6 DEMARCATION OF THE STUDY

This study will be limited to forensic investigators attached to Tembisa, Ivory Park and Rabie Ridge police stations within the Tembisa cluster in Gauteng. These forensic investigators'

responsibilities, among other things, are the analysis of bloodstain patterns to reconstruct a murder crime scene.

1.7 KEY THEORETICAL CONCEPTS

According to Creswell (2013:143), the rationale for researchers to clarify terms is to provide readers with their exact meaning, mainly in the instance where the reader does not have sufficient knowledge nor is an expert within the area of study. The following concepts will form the basis of this study.

1.7.1 Blood

The word 'blood' refers to a highly complex mixture of cells, enzymes, proteins, and inorganic substances (Singh, 2004:329).

1.7.2 Murder

Murder is the unlawful and intentional causing of the death of another human being (Snyman, 2008:447).

1.7.3 Bloodstain pattern

According to Chissum and Turvey (2007:314), bloodstain patterns are the visible record of the bloodshed at a crime scene.

1.8 VALUE OF THE RESEARCH

According to Denscombe (2002:45), the research study must be relevant in terms of contributing to existing knowledge, solving practical needs and being of relevance to current issues. The value of the research study is that it aims to outline the standard of knowledge and ability to solve problem and, in some instances, contribute to the body of knowledge in the scientific fraternity (Welman & Kruger, 2002:256). As a result, this study will strive to:

- Enhance existing knowledge and competence regarding the analysis and application of bloodstain pattern in the reconstruction of a murder scene in Tembisa cluster.
- Capacitate the Tembisa cluster's forensic investigators with the ability to analyse bloodstain patterns sufficiently when reconstructing a murder scene.
- Optimise the forensic investigators' ability in the Tembisa cluster to improve the rate of murder convictions.
- Contribute to the existing body of knowledge as an academic source for students and prospective researchers, and
- Contribute to the broader South African public and the field of forensic investigation (with specific reference to those investigators responsible for analysing bloodstain patterns in the reconstruction of a murder scene).

1.9 PRELIMINARY LITERATURE REVIEW

Denscombe (2002:50) indicates that a literature review shows the importance of the research by illustrating how it will deal with questions that have emerged from carefully assessing what has already been researched to fill the voids. According to Bachmann, Russel and Schutt (2003:377), the researcher must explain the problem in greater detail and build on what has already been reported in the literature on the topic. The researcher searched for information pertaining to the topic under the fields of policing, law, criminal investigation, and forensic science. When none of the above-mentioned was found, the researcher, therefore, saw the need to continue with the research, since her topic is based on the analysis of bloodstain patterns in reconstructing a murder scene. The researcher researched literature in relation to keywords, such as “Bloodstain pattern analysis” and “reconstructing a murder scene” to find relevant literature.

1.10 RESEARCH DESIGN AND APPROACH

According to Mouton (2002:175), a research design is an exposition or plan of how the researcher plans to execute the research problem that has been formulated. The researcher will employ empirical research as this study will ascertain the personal experience and knowledge of the participants (Mouton 2001:149). Empirical research is an approach to social research that stresses, and tends to be focussed on, producing data from a real-world observation (Denscombe, 2007:31).

The researcher will gather data by means of semi-structured interviews with forensic investigators attached to Rabie Ridge, Ivory Park and Tembisa SAPS in the Tembisa cluster. The researcher will use a qualitative approach in the study. Qualitative research will afford the researcher an opportunity to acquire relevant pieces of data from literature. This will put the researcher in a position to have a supreme understanding of the problem under investigation. Qualitative research starts with an assumption and the use of interpretive frameworks that inform the study of research problems by addressing the meaning individuals or groups ascribe to a social problem (Creswell, 2013:44). The nature of the research problem means that the researcher uses qualitative research in order to gain a clear understanding of the significance of bloodstain pattern analysis during a reconstruction of a murder scene. In the qualitative approach, researchers use data sources, and this does not normally mean the use of numbers (Westmorland, 2011:23). Rosnow and Rosenthal (2013:63) state that in qualitative research the focus is on spoken words, prose description of behaviour and pictorial records. The researcher considers the qualitative approach to be the best for this research study.

1.11 POPULATION AND SAMPLING

According to Punch (2011:10), the total target population would, in the real world, be the subjects of research about all of whom one is trying to say something and the sample, the actual group included in the study, from whom the data is collected. Mouton (1996:134) similarly explains the term population as the gathering of objects, events or individuals sharing common characteristics that the researcher is interested in studying. The ideal population in this study refers to all forensic investigators of the SAPS who are responsible for analysing bloodstain patterns at a murder scene. It is, nonetheless, not feasible for the researcher to consult this wide population. Owing to the large geographical area of the Tembisa cluster and the lack of feasibility of interviewing the entire population, the researcher will draw the sample from the target population. This argument is supported by Bachmann and Schutt (2003:87) who state that there is neither time nor resources to study the whole population, all the elements in which we are interested. We solve the problem by studying a sample, a subset of this population.

As a result, the researcher will have to limit her study to the target population at the three main police stations at the Tembisa cluster, namely Tembisa, Rabie Ridge and Ivory Park. In terms of the statistics, these three police stations in the Tembisa cluster record high numbers of murder cases. The investigators located at these police stations will provide a valuable source of information for this research study owing to their exposure to murder crime scenes and their experience in investigating murder cases.

The researcher will apply simple random sampling to select participants. In terms of simple random sampling, the probability of selection in a true simple random is equal for each element (Bachmann & Schutt, 2003:100). This method is also outlined by Dantzker and Hunter (2006:126) who state that, in simple random sampling, all members of the given population have the same chance of being selected. Participants will be assigned numbers from one to the last number. The researcher will blindly select the numbers of those participants to be included in the study. Sampling will continue until data saturation has been reached.

1.12 DATA COLLECTION

Qualitative research approach involves different methods of data collection. Marshal and Rossman (2011:59) indicated that qualitative research can also be based on the experience of the researcher. David and Sutton (2011:297) are of the opinion that triangulation can be understood in terms of inter-methods triangulation using two or more different qualitative or

quantitative methods. Mouton (2002:156) states that a first general principle in data collection is that the inclusion of multiple sources of data collection in a research project is likely to increase the reliability of the observations. The use of multiple sources of data will enrich this study and make it reliable prior to the interviewing of witnesses. The researcher will make use of the following data collection methods.

1.12.1 Literature Review

Before the start of the main research, and when defining the demarcation of the study, it would be imperative to check whether any research has previously been done into the subject (Verhoeven, 2011:144). The researcher would visit the national library in Pretoria as well as the library at the University of South Africa (UNISA). The headings and keywords under which relevant literature related to the topic were classified will be searched for in the library catalogue system. The library catalogue remains an important and essential first stop for most research students (Mouton, 2001:88).

1.12.2 Semi-structured Interviews

Interviews allow researchers to gather data about their respondents' experience, opinions, attitudes, beliefs, behaviour and values (Tewksbury & Mustaine, 2004:117). With semi-structured interviews the researcher may follow the standard questions with one or individual tailored questions to get clarification or to probe a person's reasoning (Leedy & Ormond, 2010:188). In semi-structured interviews the participants were asked a series of pre-established questions (Punch, 2011:170). This author went on to say that all participants received the same questions in the same order, delivered in a standard manner. The researcher used the same interview schedule for participants from the same police stations since they were from the same population. The researcher was aware of the Unisa position regarding research owing to the Covid-19 pandemic. As a result, alternative means of collecting data, such as Microsoft Teams, Zoom, Skype, telephone and other social media platforms, were used, taking social distancing into consideration.

In accordance with Leedy and Ormrod (2005:147-149), the following guidelines will be adhered to:

- Identification of some questions in advance. Interview schedule with relevant questions will be constructed prior to the interviewing of participants.
- Making sure that the interviewees are representative of the group. sampling methods will ensure that target populations are represented.

- Finding a suitable venue. The interviews will take place in a private and quiet environment to avoid distraction.
- Getting written permission: written permission will be obtained from SAPS to conduct interviews.
- Establishing and maintaining rapport: the researcher will treat every participant with respect in order to maintain rapport.
- Only questions related to the research will be asked by researcher.
- Words will never be put into people's mouths: the researcher will record exact answers of the participants.
- Keeping your reactions to oneself: the researcher will keep personal impressions of the participants to herself.
- Remembering that you are not necessarily obtaining the facts: the researcher will be aware that the interview session will not necessarily be about obtaining facts but exploring the participants' experiences and viewpoints.

1.13 DATA ANALYSIS

According to Sarandakos (1998: 313), the rationale for data analysis is to identify and clarify information collected through the previous stages of research. Creswell (2013:180) indicates that data analysis in qualitative research consists of preparing and organising data for analysis and then compressing data themes by coding and condensing the codes and concluding by allotting the data to figures, tables and/or discussion. The data collected for qualitative study most often are notes in the field or taken during interviews, and, from these notes, the original comments are reconstructed, or the text is transcribed from audio recordings (Bachmann, 2003:244).

The researcher will apply the data analysis spiral technique, which can be utilised in a range of qualitative studies (Leedy & Ormrod, 2001:161). The spiral procedure implies that data is analysed through the following steps:

- Organisation: the researcher will verify and authenticate transcriptions of interviews.
- Perusals: The researcher will spend substantial time digesting what is contained in the transcriptions.
- Data classification and analysis: Data will be classified according to themes and sub-themes.
- Synthesizing the data: The researcher will collate and summarise the data that will offer a reliable and detailed interpretation of the research.

1.14 METHODS TAKEN TO ENSURE VALIDITY

According to Denscombe (2002:100), validity concerns the accuracy of the questions asked, the data collected, and the explanation offered. The researcher will have designed relevant questions that directly address the research problem under investigation. These research questions verifying or substantiating data from literature. The researcher will compare information from the literature to find out whether it supports or contradicts the data received from answers to the questions. According to Chamberlain (2013:58), validity is concerned with making sure your study measures what it sets out to measure. A study is said to be valid if it accurately reflects the reality of the beliefs or behaviour of those from whom the data were collected. Validity is concerned with the measurement of the extent to which a research is accurate, that it measures what was intended, and the extent to which truth-claims can be made (Punch, 2011:290).

1.15 METHOD TAKEN TO ENSURE RELIABILITY

Research must yield the same results when replicated under the same conditions. This argument is supported by Bernard (2013:46) when he states that it is reliable when you obtain the same results by using an instrument to measure the same thing more than once. Bachman et al., (2003:72) explain that reliability means that the measurement procedure yields consistent scores when the phenomenon being measured is not changing. Reliability refers to how consistent the measuring device would be over time, in other words, if the study is replicated, will the measuring device provide consistent results? (Dantzker & Hunter, 2006:31). According to Chamberlain, (2013:57), reliability refers to weather a test, procedure or question will give the same results if repeated. For the purpose of ensuring reliability in this study the research methodology and procedures will be meticulously recorded for other researchers to replicate.

1.16 ETHICAL CONSIDERATIONS

According to Dawidowics (2010:117), the way in which the research was conducted should have complied with the civil code of behaviour. According to the Policy on Research Ethics of the University of South Africa (University of South Africa, 2007:7), a researcher is obliged to protect and respect the privacy, dignity, and confidentiality of the interviewees. In this research study UNISA's code of conduct was adhered to by the researcher. Leedy and Ormond (2005.101) further outline ethical considerations that would be followed by the researcher as outlined below.

1.16.1 Protection from harm

The participants taking part in this study would in no way be subjected to any emotional, psychological, physical embarrassment or loss of self-esteem and mental harm by the researcher. The names of participants would not be revealed.

1.16.2 Informed consent

The participants would be informed in advance of the particulars of the study to be conducted and afforded an opportunity to decide whether to participate or not. The researcher would inform the participants that the interviews would be conducted on a voluntary basis and not to expect compensation, reimbursement, gifts or services. Each participant would be expected to provide written consent. The interviews would be conducted at an appropriate venue identified by the researcher. The participants would have the right to withdraw from the interview without providing the reason for withdrawal. In a case where the participants withdraw with no penalty or loss of benefits, all the information already recorded from the participants would be destroyed and not incorporated in the research. The researcher would report findings honestly as they were obtained from the participants.

1.16.3 Right to privacy and confidentiality

The right to privacy of participants would be maintained by ensuring that the names of participants and their identity are protected. Interviews would be individually conducted at the participant's place of work.

1.16.4 Honesty with professional colleagues

The researcher would report the research findings honestly and in a manner that would not mislead others. The researcher would not manipulate information or data to enhance research findings or conclusions. Furthermore, the researcher would not fabricate information to support a particular agenda. The researcher would take cognisance of plagiarism and would acknowledge each source used in the body of the discussion as well as in the list of references. Welman, Kruger and Mitchell (2005:182) state that plagiarism is the use of the data or ideas without due acknowledgement and permission where appropriate

1.17 SUMMARY

This chapter presented general orientation and the researcher introduced to the reader, contextual insights, described problem statement, research aim, research purpose,

research question, demarcation of the study. Furthermore, the chapter outlined key theoretical concepts for ease of reference. Moreover, in this chapter, preliminary literature, research design and approach, population and sampling were presented. Lastly, data collection methods as well as ethical considerations were presented.

CHAPTER TWO: INVESTIGATION OF CRIME

2.1 INTRODUCTION

The impact of the criminal justice system in fighting crime in society is centred on crime investigation. It then becomes the responsibility of the crime scene investigator to keep abreast with the current methods and techniques of investigation to stay ahead of the new methods applied by criminals. In this regard, crime investigators need regularly to upscale their skills and techniques. Gilbert (2006:238) states that it is essential that all police officers are trained in murder investigation despite its relatively low frequency, for no other criminal offences have either the real or imagined impact of murder. The loss of life as result of criminal conduct is without any doubt the wicked act in the mind of the average individual.

The gathering of evidence forms a crucial role in crime investigation. The crime investigator needs to ensure that all forms of evidence at the scene of crime are collected and documented legally to be presented before the court for the purpose of prosecution. In essence, crime investigation seeks to establish whether a criminal act has been committed, to trace evidence, to identify and arrest the perpetrator, to recover stolen property and to be involved in the prosecution process (Lyman, 2011:15).

In order to obtain the maximum amount of evidence, a crime scene investigator needs to possess the necessary experience and skills to be able to identify and classify the crime scene and to ensure that the crime scene is not contaminated. In gathering and preserving the evidence, it is important for a crime scene investigator to maintain the chain of custody to prevent the contamination of evidence at the crime scene and to ensure successful prosecution. This chapter will deal in depth with crime investigation.

2.2 INVESTIGATION OF CRIME

The investigation of crime is one of the most crucial aspects in the criminal justice system (CJS). For any discipline to remain relevant to practitioners and society in general, it must evolve to be able to address the problems of the day. The investigation of crime, like any other discipline, has also evolved to be regarded as a profession which require specialised training and a certain set of skills.

According to Becker (2009:19), the investigation of crime as a profession has grown to being regarded as a highly respected discipline as is evident from its inception in the early 13th century to date. Furthermore, Dutelle and Becker (2019:3) indicate that, in 1849, Chicago appointed its first detective, Alan Pinkerton from Scotland who was also a cofounder of the

North-western police agency which is credited with developing the investigative technique and the surveillance technique which is applicable even today.

Similarly, the concept of the investigation of crime has also evolved over time. Benson, Jones and Horne (2015:19) and Lochner (2014:6) agree that the investigation and the interpretation of crime definitions were formulated over a long period of time. According to Hess, Orthman and Cho (2017: 8), criminal investigation is the process of discovering, collecting, preparing, identifying, and presenting evidence to determine what had happened and who was responsible. Hess et al., (2017: 8) further highlights the fact that criminal investigation is a reconstructive process that uses deductive reasoning, a logical process in which a conclusion follows from specific facts. Fish et al., (2014:61) indicate that one of the main objectives of crime scene investigation is to identify, document, collect and preserve the physical evidence of the crime. Criminal investigation is a systematic objective, legal inquiry involving a possible criminal act (Gilbert, 2010:37).

Criminal investigation is a multi- faceted, problem-solving challenge. It is not simply a set of task skills; it is equally a set of thinking skills, and these skills need to be cautiously understood and developed. It is reasoned that criminal investigation can be used to determine what had happened (Gehl and Piecas, 2017:1). Lochner (2014: 4) states that the process of criminal investigation does not occur in a vacuum. According to the author, it requires a knowledgeable and skilful individual to carry out any form of investigation to determine what had happened in the past. Marais (1992:1) further indicates that investigators can solve a far greater number of crimes by searching for, preserving and analysing physical evidence, splashes or imprints found at crime scene, rather than relying only on their skills as interrogators. It is argued by Lochner (2014:4) that the crime investigation process involves the investigation of a crime and the crime scene itself.

Crime scene investigation is the most crucial step in any criminal investigation. Lee, Palmbach and Miller (2001:1) explain that the crime scene is a place where the investigator seeks to discover all the aspects of the criminal activities, while a crime scene investigation is a process to locate and gather physical evidence from that scene. During the preliminary investigation phase, Benson et al., (2015:21) and Lochner and Zinn (2015:114-115) reasoned that the gathering of information and evidence to investigate a reported crime and reconstruct a crime scene is done with the purpose of identifying, arresting and convicting suspected offenders. Wood (2013:5) makes similar inferences that criminal investigation involves the collection of facts to identify, locate, and prove the guilt of perpetrators.

2.2.1 The legal, orderly and systematic reconstruction of past events

Criminal investigation in its nature seeks to reconstruct the event of the past with the main objective being to link the perpetrators to the crime scene. In doing this, the crime investigator needs to adhere to crime investigation principles to ensure that the evidence gathered at the scene stands the test in court. Gilbert (2010: 34) highlights that the orderly manner of reconstructing past event starts at specified area and proceeds to the unidentified, shifting backwards at times. Benson et al., (2015:11) consider criminal investigation as the gathering of information that is required to reconstruct the past. Lochner (2016:43) argues that the criminal investigation cannot be conducted in an unplanned, disorganized, unstructured, haphazard and random manner. They explain that the outcome of the investigation will be seriously tainted if this happens, and it might have a negative impact on the reputation of the investigator.

2.2.2 Reconstructive process

The key element in the reconstructive process of the crime scene is the physical evidence. Physical evidence does not entirely determine the actual events at the crime scene, but it can play a crucial role in the determination of the outcome of the prosecution. According to Gilbert (2010:34) and Osterburg and Ward (2010:1), the identification and collection of information and evidence is an integral part of the reconstruction process. Greene (2007:356) point out that investigators consider numerous factors when they use the reconstructive process to reconstruct the past events. Stelfox (2009:1) warns that it is essential for the reconstruction process to be successful that the discovering, identification, collecting, preparing, and presenting of evidence should be carried out in a legal manner. When analysing the explanations of crime investigation of Bila (2018:324) Lochner (2014:67), Mofokeng (2018:349) and Stelfox (2009:1), their reference to criminal investigation is about reconstructing past events with the purpose of establishing the truth.

2.2.3 The truth

In essence crime investigation merely seeks to unearth the truth surrounding the crime scene. Dutelle and Becker (2019:3) state that criminal investigation is not concerned with guilt or innocence but rather with the determination of the truth, attempting to determine the truth behind what had occurred or whether such an event was criminally in nature and this determination has been occurring for thousands of years. The above clearly demonstrates that the investigation of crime aims at unearthing the truth, Van Rooyen (2008:13) state that investigation of crime is a systematic, organized search for the truth. Stelfox (2009:174) further highlights that the primary aim of an investigation is to uncover the truth about what

happened by discovering facts and evidence to reveal the truth. According to Lochner (2014:6), it would be wrong to assume that truth refers only to a guilty outcome; the truth also serves to declare the innocence of a person. The mission of criminal investigation is to uncover evidence to help determine the truth, and not automatically to assume a verdict of guilt (Woods, 2013:10).

From the above, the researcher will argue that crime investigation deals with the reconstruction of past events to find the truth by collecting objective and subjective clues during an investigation. This is discussed below. The next section presents the process of gathering evidence.

2.2.4 Gathering of objective and subjective evidence

The gathering of evidence is one the fundamental factors in crime investigation. It is a responsibility of a crime scene investigator to ensure that different forms of evidence are identified and classified accordingly. A crime scene investigator will then have to mobilise the relevant expertise that can assist in the gathering of such evidence. Lochner et al., (in press) explain what type of evidence can be found at a crime scene or during the investigation of a crime. They divide evidence into two categories, namely objective and subjective evidence. Gilbert (2010:34), Lochner et al., (in press) and Osterburg and Ward (2010:1) state that objective evidence is regarded as indirect or physical evidence.

Benson et al., (2015:11) state that the reconstruction of the past will be determined by the information available through people (subjective evidence) and physical evidence (objective evidence). Saferstein (2011:375-377) is of the opinion that, by the systematic gathering of physical evidence and the proper documentation of the crime scene, the investigator can initiate probing the sequence of events that had occurred at the time when the crime was committed. In the gathering of bloodstain evidence, the investigator will bring in a skilled person to assist in reconstructing the crime scene, for example a Blood Pattern Analysis (BPA) expert because bloods patterns are objective evidence that cannot be changed (Saferstein, 2013: 123).

Bennett and Hess (2001:3) state that the investigation of a crime is primarily concerned with the gathering of evidence. However, they do not refer to the type of evidence. Bila (2018:324), Lochner (2014:7) and Palmiotto (2013:4) reiterate that the main objective of criminal investigation is to collect evidence relating to a criminal situation. One of the primary concepts and research questions of this study was to determine what blood pattern analyses

is. This means that blood is the focus point. In this section, it is significant to determine what type of evidence blood is. It can be either objective or subjective. Objective evidence is real evidence. It speaks for itself, does not lie, does not have a memory failure, and it can be seen, touched and smelled. Blood spatter is also evidence. The researcher argues that blood spatter analysis is key in determining the severity of violence and it may assist in linking the suspect to the crime scene. In the investigation, it must be clear what type of evidence blood is, and this may be evidenced by the following.

- **Shape and Size**

Objective evidence is described as any form of evidence that has an objective existence, meaning anything with size, shape, and dimension. Objective evidence presents itself in various forms; it can be large as a house or as tiny as a blood spatter on a wall (Dutelle, 2014:15). Objective evidence is anything that one can carry into a court room and place on a table in front of a presiding officer where it can speak for itself. Objective evidence is solid, semi-solid or liquid, large or tiny. If the evidence is too big, fragile or there is the possibility that it can be contaminated or destroyed, it is documented to be presented in court (Lochner and Zinn, 2015:39).

- **Human sense**

In order to identify and collect objective evidence at a crime scene, a crime investigator needs to mobilise relevant experts to identify and analyse blood. Lochner and Zinn (2015:40) explain that objective evidence is anything real; it has substance that helps to establish the elements and facts of the case. It can be observed by the human senses, namely heard, touched, smelled or tasted. In relation to blood as physical evidence, Dutelle and Becker (2019:102) explain that blood is a common source of evidence at a crime scene; it must be handled as physical evidence to be tagged and bagged. Dutelle (2014:265) maintains that, through the careful examination of the physical evidence (bloodstain), the investigator will be able to deduce specific information regarding the event that had occurred during the bloodshed event**.** Baxter (2015:225) and Lochner and Zinn (2015:40) state that objective evidence serves one main purpose, which is to respond to investigative questions, namely who, what, when, and where, why and who? It is also considered to be the most reliable and most precise of all forms of evidence and does have investigation value.

- **Value of physical evidence**

Physical evidence plays a crucial role in a criminal trial as it provides the court with facts that do not necessarily need support. Physical evidence speaks for itself; if the evidence is too big to present to the court, the court will visit the place where evidence is kept (Lochner and Zinn, 2015:39). Lochner and Zinn (2015:40) further state that, if physical evidence is

properly managed according to investigative principles and doctrine, it can provide information about the facts of the crime. Dutelle (2014:16-17) explains the value of physical evidence as follows:

- It can prove that the crime has been committed or establish key elements of crime.
- It can establish the identity of persons associated with the crime.
- It can place the suspect in contact with the victim or with the crime scene.
- It can exonerate the innocent.
- It can corroborate the victim's testimony; and
- A suspect confronted by physical evidence may make an admission or confession.

Fish, Miller, Braswell and Wallace Jr (2014:407) state that physical evidence also provides the court with something tangible to establish linkages amongst the victim, the suspect and the crime scene. Lee et al*.,* (2001:26) indicate that physical evidence can provide useful information for investigation in solving cases. Marais (1992: 6) makes a compelling analysis that physical evidence on a person can positively connect him or her with the crime scene; this includes tissue, bloodstains and the hair of the victim. Birzer and Roberson (2012:85) state that blood as physical evidence is valuable because it establishes not only the individual's presence inside a crime scene but his or her active participation in a violent crime.

Zinn and Dintwe (2016:109) state that investigators must focus not only on ensuring that physical evidence is collected from the victim but must also consider that physical evidence from the victim may have been left on the perpetrator. Fish et al., (2011:2) and Lochner et al., (in press) see the identification, collection, protection, preservation and recording of objective and subjective evidence as the responsibility of crime investigators. The sole purpose is to answer the investigation question whereby the objective evidence will be presented in court.

2.3 THE OBJECTIVES OF CRIME INVESTIGATION

Crime investigation seeks to establish whether a criminal act has been committed, to trace evidence, to identify and arrest the perpetrator, to recover the stolen property and to ensure its involvement in the prosecution process. Bennett and Hess (2004:5) state that the objectives of criminal investigation are to determine whether a crime has been committed, to obtain information legally, and to identify the responsible person, to arrest the suspect, to recover stolen property and present the best possible case in court. Dutelle and Becker (2019:43), Fish et al., (2019:61) and Osterburg and Ward (2014:5) agree with Bennett and Hess (2004:5) and add that, from a crime scene investigation viewpoint, the primary goals

of criminal investigation are to determine whether a crime has been committed, to obtain information and evidence legally, to identify the responsible person, to arrest the suspects, to recover stolen property, and to present the best possible case to the prosecutor. Blood spatter analyses is done by an expert, but it is the responsibility of the investigator firstly to identify the blood spatter and then to preserve it. The expert documents the scene and then analyses the scene in his/her office by analysing the documented information. The process surrounding physical evidence consist of six steps (Lochner and Zinn 2015: 40). From experience, the researcher knows that the I/O responsibility when it comes to blood spatter evidence on a scene is to recognise, protect and record the scene.

Benson et al., (2015:13) and Palmiotto (2013:4) state that the key objective of criminal investigation is to gather evidence in a manner that is legally acceptable so that it can be presented as proof that a past event had occurred. Lochner and Zinn (2015:33-34) express similar sentiments and include a warning for investigators that the gathering of evidence should be done in an orderly and organised manner. These objectives are outlined below.

2.3.1 To determine whether crime has been committed

Dutelle (2014:8) states that, once a crime has been reported, it must be established whether indeed the crime had been committed. Determining whether a crime has been committed necessitates an understanding of criminal law and the elements of each criminal act (Palmiotto, 2013:6) and (Osterburg and Ward, 2010:6). Evidence is needed to prove the elements of the crime, and it will serve as the link between the perpetrator and the crime, crime scene or victim (Lyle, 2012:21).

2.3.2 To find evidence

A seasoned crime investigator should be able to obtain evidence in instances where there was personal contact as such contacts result in traces of visible or non-visible evidence. According to Dutelle and Becker (2019:3), a person cannot commit a crime or perform an action on a crime scene without leaving objective evidence at the crime scene. This objective evidence will connect the person with the crime, crime scene or victim. This will act as a silent witness against the person (Baxter, 2015: 222). The viewpoint of Baxter (2015:222) is based on the Lockard's exchange principle known as the contact theory. Bertino (2012:22), Marais (1999:23) and Lochner and Zinn (2015:12) share the same sentiments with Baxter (2015:222) and Van Graan and Budhram (2015:45) that this theory states that when two objects come into contact with each other, the one will leave a trace on the other. Evidence can also be found through change induced at a crime scene and

deposited material. According to Harris and Lee (2019: 33), the change could take the form of depositing something not previously there, or an alteration of something that was there. For example, finding a blood spatter pattern in a particular area will often reveal something important about what had occurred at that location. Furthermore, Harris and Lee (2019: 34) state that a deposit can be made up of large quantities of material, such as blood or paint travelling through and splattering on a surface, or they can be small quantities of particles and thus much less obvious. Blood analysis has great evidential value when it allows the investigator to demonstrate a transfer between a victim and suspect. For this reason, all clothing from both the victim and suspect should be collected and sent to the laboratory for examination, even when the presence of blood on the garment does not appear obvious to the investigator (Saferstein, 2013:88-89). The researcher agrees with the above authors that this theory can help to identify the suspect.

2.3.3 Suspect Identification

The role of physical evidence in helping to identify a victim or a suspect is central to forensic evidence (Harris and Lee, 2019:39). Van der Westhuizen (1996:7) and Woods (2013:11) explains that the identity of the criminal is discovered in one or more of the following ways: confession; eyewitness testimony; or evidence. After identifying the perpetrator, it is then a responsibility of the crime investigator to ensure that the perpetrator is arrested.

2.3.4 Arrest the perpetrator

One of the objectives of criminal investigation is to arrest the perpetrator in order to show the presence of the perpetrator at the trail (Marais, 1989:19). When arrest has been made, it should have been done in terms of the law and decided case (Pena ,2000:6).

Marais (1989:19) states that arresting the perpetrator is one of the objectives of crime investigator in order to ensure the presence of the accused at the trail. Lyman (2011: 22-23) is of the opinion that making an arrest is a significant objective for investigators because investigators spend so much time collecting and evaluating evidence.

2.3.5 The recovery of stolen property and its involvement in the prosecution process

The recovery of stolen property is the most significant task in criminal investigation. Such evidence plays a key role in linking the perpetrator and the crime scene during prosecution. Palmiotto (2014:8) states that an investigator is required to: recover stolen property; arrest a suspect. Prepare the case for the court; and testify in court. The description and

identification of stolen property are important aspects of an investigation. It can then be stated that the objective of crime investigation is to determine the truth. It is against this background that crime investigators are capacitated with the relevant skills and expertise to execute their duties diligently. Stolen property may turn up at pawn shops, in the hands of second-hand dealers, or be offered for sale on the internet (Osterburg and Ward, 2014:8). For a criminal prosecution to be successful, it starts at the crime scene. It is the responsibility of a crime investigator to secure the crime scene and collect and document evidence in line with investigative principles. The following section presents the crime scene process.

2.4 CRIME SCENE

For a crime scene to exist a crime must have been committed. A crime scene is a location where a crime is committed, and it contains evidence that can link the perpetrator to a crime. This is supported by Fisher and Fisher (2013: 29) and Gilbert (2010:80) who state that a crime scene is the location at which suspected criminal offences have occurred. Palmiotto (2014:97) and White (2014:26) agree with Fisher and Fisher (2013: 29) and Gilbert (2010:80) and add that a crime scene is proof that a crime has been committed, and it serves as the initial point of a criminal investigation in that it contains evidence connecting suspects with the crime. There are various definitions of a crime scene. Lochner and Zinn (2015:33) refer to the scene of crime as a “field laboratory” where objects of disputes can be located for laboratory tests at a later stage. According to SAPS National Instruction 1 (2015: 2) on crime scene management, a crime scene means the place, including the surrounding area, where an alleged offence was committed or where items with potential evidential value may be collected. The working definition of a crime scene (both the primary and secondary), is anywhere evidence may be located that will help to explain the events.

2.4.1 Methods used to collect and document evidence on a crime scene

The collection and documentation of evidence is one of the most important steps in the investigation of any crime and they should be done with an open mind with regard to linking the evidence with the suspect. This is illustrated by Harris and Lee (2019:226) who state that blood as evidence may be collected from suspects, from victims, from nonsexual partners in sexual assault cases, or from dead bodies in homicide cases. Improper collection can diminish the suitability of evidence for analysis (Lochner and Zinn, 2015:114). Girard (2018:6), Orthman and Hess (2017:43), Lochner and Zinn (2015:45), and Sweeney (2017:109-110) explain that a crime scene can be documented by field notes, photography and videography and sketches. Lochner and Zinn (2005:45) maintain that none of these

methods of documentation is superior to, or a substitute for, the other and each should be done systematically and in an organised manner.

Dutelle (2014:26) states that it is sometimes impossible to return to a crime at later time to collect additional evidence, so, therefore, it is suggested that crime scene investigator ensure a thorough and systematic processing of the crime scene to be certain that all necessary evidence, in the correct quantity, has been collected as more is better than less. Girard (2018:66) and Lochner and Zinn (2015: 45) explain that the state of the crime scene must be thoroughly documented to record permanently the condition of that crime and its physical evidence. Documentation is the most important and most time-consuming activity at the scene. The most important aspect of crime scene documentation is that the documentation "fixes or "memorizes" the scene at specific moment in time, that specific moment in time being the time the scene was actually processed (Baxter, 2015:3-4).

Fish et al., (2014:169) state that, when documenting bloodstain pattern evidence, often an analyst will not be available to analyse the scene so the documentation must allow the analyst to be familiar with the location through the investigator's work, and accurate measurements and photographs may permit the analyst to develop a reconstruction of the sequence of events that created the bloodstain pattern. It is significant to know which documentation methods are available as sources of evidence as outlined below.

2.4.1.1 Field Notes

One of the critical factors in crime scene investigation is to ensure that field notes are captured in a manner that they explain what had occurred on the crime scene. The note taking begins with the call to the crime scene investigator to report to a crime scene. The first notes should identify the person who contacted the investigator and record the time of the contact as well as any preliminary information disclosed, including the case number (Saferstein, 2013:51). According to Dutelle and Becker (2019:71), field notes are the building blocks that the investigator uses to develop a hypothesis and later a theory of the crime. Field notes can also stimulate the investigator's memory when the case goes to court. It is against this background that all significant details of the crime scene must be recorded and documented, such as blood spatter and blood flow patterns (Saferstein, 2013:122). Woods (2013:23) indicate that effective notes are complete, accurate, specific, legible, clear, arranged in chronological order and well organized. Girard (2018:7) and Lochner and Zinn (2015:114) further explain that note taking must be done immediately. From the above, field notes play a key role in the crime investigation process as they provide the crime

investigator with the memory bank, and they provide the courts with the necessary information for successful prosecution.

2.4.1.2 Photography and Videography

Photography and videography at the crime scene provide an additional dimension to the evidence collected at the crime scene and give an accurate depiction of the crime scene. According to Orthman et al., (2017:47), a picture is indeed worth a thousand words and investigative photographs and videos are essential to proper crime scene documentation. Video recording is now well established as an investigative tool. This is illustrated by Dutelle and Becker (2019:77) who state that the crime scene is first recorded through photography or videography or both. Dutelle and Becker (2019:77) further explain that the purpose of crime scene photography is to capture adequate images for the best possible documentation and reproduction of the reality present at the moment in time when the scene was photographed. Birzer and Roberson (2012:39) agree with Dutelle and Becker (2019:77) that the aim of photographing the crime scene is to capture the most useful amount detail possible.

Girard (2018:10) further explains that video recording may be used to complement photography, and that video is the best way to document the overall view of the scene because it shows the relationship of various pieces of evidence both to one another and to the scene. Saferstein (2013:53) states that the goal of photography at the crime scene is to produce examination quality photographs. Baxter (2015:53), Hess and Orthman (2017:47) and Miller Massey (2016:49) state that rules of evidence dictate that photographs must be material, relevant, competent, accurate, and free from distortion. Lochner and Zinn (2015:114) state that photographs are the best way of quickly and accurately documenting evidence at the scene, and a photograph can be seen as a permanent provable record of the facts, including the possession of evidence of the scene. Investigators must know how to photograph blood spatters.

Photographs of the crime scene must be taken without the photographer or anyone else disturbing the elements of crime; all items should be in their original, undisturbed state and any changes made to the items must be documented in the notes (Girard, 2018: 7). Photographs can be used later in the case to refresh the memory of the investigator or as demonstrative evidence to show the judge the relation between the victim and the evidence (Erickson, 2014:31). Fish et al., (2014:169) mention that a video can provide an overall spatial relationship for documentation purposes and allow the viewer to observe the crime

scene in a more dimensional perspective. It is stated by Dutelle (2014:120), Erickson (2014:31) and Fish et al., (2014:171), that there are three types of photographs overall or establishment, mid-range and close-up.

The value of using appropriate photography in capturing bloodstain evidence is clearly illustrated by Saferstein (2013:64) that overview and medium-range photographs should show the orientation and location of bloodstain evidence. Overview photographs are taken of the entire crime scene, including overviews of the bloodstain pattern within the scene. Saferstein (2013:245) further states that, in general, with crime scene photography the investigator should create photographs and sketches of the overall pattern to show the orientation of the pattern to the scene. From the above it is clear that photography and videography are an integral part of crime investigation mainly regarding the documenting of evidence which would not ordinarily be easily captured manually. Images of both photography and videography are universally accepted by the courts.

2.4.1.3 Sketching

Sketching of a crime scene can provide an enormous amount of data about the circumstances that had taken place at the crime scene. Dutelle and Becker (2019:70) state that crime scene sketching is a permanent record of the size and distance relationship of the crime scene and the physical evidence within it. Birzer and Roberson (2012:39) support Dutelle and Becker (2019:70) that a sketch of the crime scene establishes a permanent record of items, conditions and size relationships.

According to Girard (2018:8), the purpose of the sketch is to record distances between objects at the scene accurately, and it allows investigators to emphasize the most relevant objects and features. Baxter (2015:77) and Woods (2013:22) state that sketching should both support and complement the photographs and notes; a sketch makes it easier to show relationship of an item of evidence within a scene. Baxter (2015:80) further explains that sketching is admitted in court generally through the individual who created the sketches.

Dutelle and Becker (2019:86) state that there are two types of sketches, rough and final sketches. Dutelle and Becker (2019:86) go further and state that rough sketches are developed while on the scene, during the crime scene assessment/preliminary scene evaluation phase to assist with the development of a strategic plan for processing. Hess and Orthman (2017:59) state that a rough sketch is the first pencil drawn outline of a scene and the location of objects and evidence within the outline. Final sketches are a finished rendition of the rough sketches, and they are usually prepared for courtroom presentation and will not

show all measurements and distances recorded on the rough sketch (Dutelle and Becker 2019:86). A crime investigator needs to possess the experience and be able to utilise the skills in documenting and collecting evidence at a crime. These attributes will enable the crime investigator to classify the crime scenes.

2.5 CLASSIFICATION OF CRIME SCENE

For the crime investigator to carry out his/her investigation successfully, it is essential that the crime scene is classified according to the location of the original criminal activity. Lochner and Zinn (2015:34) and Van der Watt (2015:162) explain that a scene can naturally be classified into five types, namely primary, secondary, extended, macroscopic and microscopic. For the purpose of this research study only the primary and secondary crime scenes will be discussed. It is evident that the crime scene is the place where one will find all types of evidence.

2.5.1 Primary crime scene

Crime scene is the starting point of investigation. A working definition of a crime scene (both primary and secondary) is anywhere evidence may be located that will help to explain the events. Furthermore, a single crime scene may have various locations (Dutelle, 2011:13). Palmiotto (2013:164) describe a primary crime scene as a place or area where an incident has occurred and where the majority, or a high concentration, of physical evidence proving most of the elements of the crime under investigation would be found. For example, if a child had been raped in the suspect's flat, that flat would constitute the primary crime scene. Lochner and Zinn (2015:34), Lyle (2012:28) and Palmiotto (2013:164) further explain that the primary crime scene is the place or area in the immediate vicinity of the occurrence or incident and where most of the physical evidence would be found.

According to Bertino (2012:25), a murder may have taken place at one location (the primary crime scene) and the corpse found at another place (the secondary scene). The primary crime scene is where the initial crime occurred, but it could also be implied to mean where a major part of the crime occurred. There is a main crime scene, and any other scenes are known as secondary crime scenes (Sullivan III, 2007:22).

2.5.2 Secondary crime scene

Lochner and Zinn (2015:34) state that a secondary crime scene can be another location not in the same vicinity as the primary scene and at some distance from the primary scene. It can be even a vehicle that had been used to transport the victim of a murder from one

location to another. They further explain that, when entering a secondary crime scene itself, the investigating officer must proceed with extreme caution and concentrate on possible evidence that might be on the scene. Nothing at the scene should be moved unless necessary.

Bertino (2012:21) and Horsewell (2004:3) explain that the secondary crime scenes are places or things where physical evidence relating to the incident may be found, the concept of a secondary crime scene can be explained more effectively by means of the following examples. If a vehicle was used by the suspect to transport the child to a place where the rape occurred, the vehicle ought to be a secondary crime scene and it should, therefore, also be processed in the same way as the primary crime scene to gather physical evidence.

The secondary crime scene is all the surrounding area outside of the primary crime scene (Lochner & Zinn, 2015:34). The authors further explain that, if the crime took place in the bedroom of a home, the secondary crime scene would be all the other rooms of the home as well as the entry and exit area in which the suspect may have left fingerprint or footprint evidence. It is, therefore, essential that a crime scene investigator possesses the necessary experience and skills to classify and secure the crime scenes to ensure that evidence is not contaminated.

2.6 CONTAMINATION OF EVIDENCE

It is important for the crime scene investigator to handle and process physical evidence with the utmost care for it to remain in its original form from the time it is collected from the crime scene until it is handed to the crime laboratory. Dutelle (2014:248) and Lochner and Zinn (2015:20) state that it is vitallly important to ensure that evidence that is to be handed to crime laboratory is packaged in such a way as to prevent breakage, spoilage or contamination that will destroy the evidence. Contamination can also happen between two or more items of physical evidence; it can occur from the time the evidence is seized until the actual analysis or presentation of the physical evidence in court. Additional causes of contamination can be weather conditions, uncontrolled activities at the scene of evidence and in improper handling of physical evidence (Lochner and Zinn, 2015:20). Fisher (2013:86) and Zinn and Dintwe (2016:103) state that evidence which is handled without protective clothing will top the list of contaminated evidence. Similarly, Lochner and Zinn (2015: 20) indicate that weather conditions and uncontrolled activities at the scene can also be classified as conditions with the potential of causing contamination. If biological materials, such as blood, are stored in airtight containers, the accumulation of moisture and the growth

of mould can destroy their evidential value (Saferstein, 2013:87). It is, therefore, important to determine the chain of custody to avoid the contamination of evidence.

2.7 CHAIN OF CUSTODY

It is the duty of the crime investigator to keep a record of all persons who handled or examined the evidence in order to establish the chain of custody. Girard (2018:18) explains that, once the case has moved to court, all evidence will be subject to questions about the maintenance of the chain of custody, which is a written chronological record of each person who had had an item of evidence in his or her possession.

In terms of preparing evidence to be presented in court, Dutelle (2014:27), James, Nordby and Bell (2014:54) and Van der Watt (2015:163) state that, from the initial stage of the collection of evidence leading to the moment the evidence is presented in court, it is essential that there must be an unbroken chain of custody of evidence. Chissum and Turvey (2014: 652) and Van der Watt (2014:117) make similar inferences that the sequence of evidence is a track of every person or agency that has claimed custody of tested evidence or had any form of contact with the evidence from the moment it was located to the present date.

Woods (2013:130) states that the chain of evidence is a record of the care and custody of evidence from the time it is discovered until its ultimate disposal. The number of persons who handle evidence should be kept to a minimum and each transfer of evidence should be acknowledged by signature. A detailed record of the investigation should be maintained which may be subject to judicial review in any court case (Sweeney, 2017:107-108). According to James et al., (2014:566), if the sequence of custody is preserved, it will prove that evidence has not been spoiled. Sweeney (2017:107-108) states that, once evidence is obtained, it is vital that there is no interference with the evidence unless that is authorised and recorded. The key to retaining the sequence of evidence is to ensure that evidence remains unspoiled and is presented in court in a similar form as it was when collected. In order to ensure successful prosecution, a crime investigator is expected to manage the chain of custody protocol in line with investigative principles.

2.8 SUMMARY

The researcher has highlighted how criminal investigation has played an important role in fighting crime from as early as the 13th century. The researcher was able to indicate the objective of criminal investigation. The objective of criminal investigation is to trace the truth

in relation to an alleged crime in an orderly fashion, and the term is further applied to the re-enactment the past events. The researcher further highlighted how criminal investigation as a discipline has changed in recent times. The researcher further demonstrated that the information acquired from the literature points the facts that investigators require an understanding of law, investigative techniques and investigative strategies to understand how to execute their knowledge and skills to address problems which they may encounter. In the end, the research reveals that the handling of crime scene is one of the most vital stages of investigation, and it requires an experienced investigator with logical and critical power of reasoning in order to yield positive outcome from the investigation of the scene for evidence. The researcher also established that the application of scientific methods to the gathering of evidence ensures that the cases yield better conviction rates. The researcher also established that it is prudent to ensure that, when gathering evidence, investigators must ensure that the sequence of evidence is preserved, and the evidence properly contained. Based on the study, crime scene reconstruction allows the investigator to determine the accuracy of statement provided by witness. This will be discussed in depth in the next chapter.

CHAPTER THREE: THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN A MURDER SCENE

3.1 INTRODUCTION

Bloodstain pattern analysis (BPA) is a specialised field where trained and experienced experts can assist an investigating officer at a crime scene. Fish et al., (2014:162) describe BPA as the determination of the shape, position and spreading patterns of bloodstains to explain the physical activities that occurred at the crime scene. Information of simple blood spreading pattern will assist in retrieving of other items of evidence since the order of activities that resulted in a specific spreading at the scene of crime can always lead any search of evidence to relevant areas. The study will outline the significance of blood evidence in the investigation of a crime scene and explain its role in the successful prosecution of offenders. As explained by Dutelle (2011:237) BPA, the science of examining and interpreting present at a bloodshed event in order to determine what events occurred, in what order, and who possible left the stains. This chapter *inter alia* focusses on bloodstain analysis in a murder scene, the role of investigators, the reconstruction of a crime scene and the gathering of evidence.

3.2 CRIME SCENE RECONSTRUCTION

Crime scene reconstruction (CSR) is one of the most critical aspects of the investigation of crime as it categorically seeks to bring the event that took place at a crime scene back to life. It can further be argued that crime scene reconstruction is the process that requires a multi-disciplinary effort to realise its objective. The methods of CSR are not new to the investigation of crime. The basic method of crime scene reconstruction has been included and described in investigative texts for over 100 years. As early as 1900, Harris Gross spoke of the necessity of reconstructing the crime through a meticulous examination and collection of facts (Gardner 2012: 416). The statement is supported by Williams (2015:244) who stated that for around 100 years many criminalistics, forensic scientists and criminal investigators have been using the microscopic analysis of trace evidence to aid in the reconstruction of a crime.

Harris and Lee (2019:24) describe reconstruction as the use of physical evidence and its analysis to try to understand the events that produced that evidence. Saferstein (2013:151) makes a similar assertion that reconstruction has the best chance of being accurate when investigators use proper documentation and collection methods for all types of evidence. In relation to crime scene reconstruction *per se*, Saferstein (2013:151) describes it as being the method used to develop a likely sequence of events at a crime scene by observing and

evaluating physical evidence and statements made by individuals involved with the incidents. According to Gilbert (2007:272), the final activity in the forensic examination process is crime scene reconstruction. The investigator's focus in this instance is on the manner of how the crime occurred in contrast to paying attention to identifying or individualizing the evidence of where the crime occurred whereby the "how" of the evidence is more significant than identifying the perpetrator.

Ogle (2012:5) state that crime scene reconstruction must be based upon scientific method. The author further indicate that the reconstruction of crime scene is one of the major purposes for the collection of physical evidence. Brown and Davenport (2012:370) further argue that the reconstruction may need readjustment if the evidence and data do not compliment the hypothesis. According to Saferstein (2011:377), crime scene reconstruction is the procedure applied to complement a possible series of activities at a crime by noting and analysing physical evidence and any statement presented by individuals linked with the incident. The reconstruction of the scene is attained by systematically observing where evidence is located as far as its original position is concerned (Gilbert, 2010:81).

Saferstein (2013:151) further explains that a crime scene reconstruction investigator needs to apply deductive reasoning, inductive reasoning and falsifiability to formulate a systematically reconstruction of crime scene activities. Reconstructionist depends on crime scene evidence to assist them in deciding of the timeline of activities and the correlation between the evidence and the victims and suspects connected to the crime (Brown & Davenport, 2012:372). The evidence is consistent; however, it can be manipulated, and, therefore, it is important that investigators maintain an open mind as they explore all possibilities (Bertino, 2012:29). After recording the crime scene and the gathering of physical evidence, the investigator needs to attempt to establish the series of activities that formed the crime.

According to Ogle (2007:2), the reconstruction of the crime scene is one of the main objectives of the gathering of physical evidence. The reconstruction of the crime scene regularly permits the investigator to establish the correctness of statements issued by witnesses. A statement made by witnesses may be augmented by the reconstruction of the crime scene, or the witnesses' statements may be proven to be incorrect.

3.3 THE IMPORTANCE OF BLOOD

Blood plays a key role in the investigation of scenes of violent crime. Brown and Davenport (2012:164) state that blood is a circulating tissue formed by three cells: red blood cells; white

blood cells; and platelets. These cells are held off in a liquid called plasma. Blood is multifaceted matter comprised of different substances that are vital to the criminalist. Blood is a tissue composed of several types of cells in a matrix called plasma (Houck & Siegel, 2011:233). Fish et al., (2014:162) state that, since blood is one of the most regularly found matter at the crime scene, its value must not be undermined. Saferstein (2013:88) states that blood examination has huge evidential value when it permits the investigator to illustrate a transfer between a victim and a perpetrator. On that basis all clothing from both the victim and the suspect should be packaged and sent to the laboratory for analysis; this even if the presence of blood on garment is not clearly visible to the investigator. Saferstein further explain that the investigators may find blood evidence in one or more of the following general rules:

- **The victim**

A bloodstain on the victim can play an important role in the reconstruction of the activities of homicide. The movement of blood from the wound is usually a sign of the position of the victim when wounds were inflicted. It can further demonstrate movement after the wound being inflicted.

- **The suspect**

When the identity of the perpetrator has not yet been established, the categorizing of blood may prove valuable. There is no way to distinguish between the victim's and the perpetrator's blood at the scene. Illustrative sample should be collected of all types of bloodstains.

- **The crime scene**

The crime scene should be photographed with caution, ensuring that all bloodstain patterns are recorded in different distances. The blood distribution pattern may be utilized to determine the possible spot of the suspect and victim at the time of the commission of an attack. Bloodstains must be handled with caution at the time of crime scene recovery and packaging. When the officer is close to the laboratory, the same office must personally hand in the evidence for immediate analysis.

- **On a weapon**

Holden (2006:73) indicates that a razor blade found at the homicide scene is a possible murder weapon used to cut the victim's throat. Blood can also be used as perfect matter for extracting prints, and DNA analysis will reveal whether it is a victim's blood. There are two scenarios; blood may be spattered or cast off from the weapon until it reaches where the impact of the blow took place.

According to Brown and Davenport (2012:164), blood has many important functions, such as the distribution of heat and the transporting of oxygen to cells and wastes from them. A murderer may throw away the victim's body and clean up the pools of blood, but, without some commercial substances, certain traces of evidence will stay put on the surface for years.

Shaler (2012:363) indicates that there are three methods to identify blood at the scene of crime:

- Visual examination.
- chemical testing; and
- Immunological testing

A crime scene investigator applies various tests to trace and detect blood at a crime scene, including visualization with Luminol (Bertino, 2012:207). Bertino (2012:207) further states that there are numerous ways of processing a bloodstain, which are as follows.

- **Confirm the stain is blood**

It is normal that at the crime scene clothing is found with a red stain, but is it blood? It may be ketchup, ink, or any other red substance that may have caused red stains. Prior to determining whether it is blood, it is important to verify whether indeed the evidence is blood. That can be done by two tests:

- Kastle-Meyer test. If blood is present, a dark pink colour is produced.
- Leukomalachite green. This chemical undergoes a colour change, producing a green colour in the presents of blood.

- **Confirm the blood is human**

A suspect is accused of exiting the crime scene. At a later stage, the police interrogate the owner of the vehicle with similar features described by witnesses. Blood is identified below the bumper of the same car. When questioned about the presence of blood on the bumper, the owner indicates that he bumped into the dog some days previously. In order to verify his account of events, the crime scene investigator can conduct tests to establish whether it is indeed human blood.

- **Blood pattern analysis**

Blood is mainly regarded as the common source of evidence at a crime scene; therefore, it must be classified as physical evidence. According to Dutelle and Becker (2019:102), the historic origin and skill development of bloodstain pattern analysis most likely dates to the earliest of mankind's hunting efforts. Palaeolithic art documents the skill of early human hunters and shows the use of blood tracks to locate prey. Fish et al., (2014:162) state that

bloodstain pattern analysis is the determination of the shape, position and spreading patterns of bloodstains to explain the physical activities that occurred at the crime scene. Information about a simple blood spreading pattern will assist in retrieving other items of evidence since the order of activities that resulted in a specific spreading at the scene of crime can always lead any search of evidence to relevant areas. Saferstein (2013:230) indicates that crimes that involve violent contact between people are normally followed by bleeding and an eventual bloodstain pattern. Crime scene assessments have resulted in the acceptance that bloodstain dropped on the floor, walls, ceilings, beddings, and other relevant items can provide vital insight into the circumstances that happened during the commission of violent crime. Saferstein (2013:230) further explains that the evidence that the investigator is likely to discover as result of a bloodstain pattern explanation comprises the following:

- The side from where the blood emerged.
- The angle at which blood droplet stuck at a surface.
- The spot or a position of the victim at the moment the bloody wound was inflicted.
- The action of bleeding person at the crime scene.
- The lowest number of blows that hit the bleeding victim; and
- The estimated position of the person throwing blows that resulted in a bloodstain pattern.

According to Fish et al., (2014:162), blood pattern analysis is the testing of shape, location, and the distribution patterns of bloodstains to necessitate an explanation of the physical activities that took place at the crime scene. Concealed blood spatter may assist investigators in tracing the point of attack as well as the type of weapon utilized. A bullet, knives, and blunt objects make different pattern of blood spatter (Holden, 2006:74).

Jackson and Jackson (2011:144) share the same sentiment with Dutelle (2011:239) that the patterns resulting from bloodstain found at the crime scene are classified into three main categories as follows: active bloodstain; passive bloodstain; and transfer bloodstain. Bloodstain patterns regularly narrate a story of what transpired at the crime scene and, therefore, can be used at the discretion of the investigator to interpret the scene. Bloodstain examination needs considerable experience and training to ensure that the interpretation of the bloodstain pattern is accurate (Fisher & Fisher, 2012:196). The SIAK-Journal (2012:51) describes blood pattern analysis as the chronological assessment of the visual pattern of bloodstains at the crime scene informed by the nature of fluids. Bloodstain is examined in terms of shapes, size and distribution and, of vital importance, the most important use of bloodstain pattern analysis includes:

- of activities of crime or accident.

- Confirmation of statements.
- In Restoration cases where there is doubt as to involvement in a crime.
- Identification of points with possibility of perpetrator's movement for the consideration of DNA samples; and
- Makes a distinction between homicide/suicide and accidents.

Sullivan (2007:241-242) states that bloodstain pattern examination is an important tool and should never be of lesser value. The shedding of any volume of blood results in a bloodstain pattern that can be recorded and studied. Bloodstain pattern analysis can be utilized to provide various solutions, including the following:

- Where did the blood emerge from? A three-dimensional forecast can provide an indication of the distance from an object like a wall as well as the elevation above the floor.
- The data that are presented can at the same time provide possible positions of the victim, like his/her being prone, sitting, kneeling, standing, or walking.
- The actions of both suspect and victim.
- The type of weapon.
- Was a pattern the result of a gunshot, such as high velocity back pattern or forward pattern?

Sullivan III (2007:243) further explains the three various sources of bloodshed which are:

- Was the blood expectorated?
- Was the blood arterial, spurting or gushing?
- **Passive patterns** occur when blood exceeds its surface tension and falls freely from its source to impact.

- **Projected patterns** are the outcome of blood emerging form its source as the result of some force, such as blood pressure projecting from a severed blood vessel or blood projected by coughing, the impact by some instrument (e.g., a hammer), or being blown from a body by a projectile (e.g., a bullet) striking the body, possibly causing high-velocity back spatter and forward spatter.

- **Transfer patterns** are formed by something becoming contaminated with existing blood and the brushing or touching of another object. This is a basic overview, and there are many subcategories of single one of these.

According to Sullivan III (2007:243), in the instance that the blood encounters the surface, the pattern shape is the outcome of surface texture, the volume and velocity of blood, and other factors. Becker (2009:115) states that bloodstain examination is one of the key

aspects of crime scene investigation and needs a particular expertise in interpretation and collection. The responsibility of the investigator is to identify it and submit it to bear the necessary expertise to identify, interpret, and preserve bloodstain evidence. Blood spatter patterns can assist in establishing the cause of death based on the blood velocity. In an instance when a person is injured and bleeding, gravity acts on blood, extracting it downwards facing the ground (Bertino, 2012:203). Bertino (2012:208) further explains that blood-spatter examination can be utilized to recreate a crime scene.

- **Bloodstain pattern**

Bertino (2012:203) indicates that in an instance where a wound is inflicted and blood emerges from the body, a blood spatter pattern may be formed. A single bloodstain does not form a spatter, but a grouping of bloodstains formulates a blood spatter pattern. Brown and Davenport (2012:170) explain that blood spatter evidence is essential in assisting investigators to establish the position of the victim at the time of the crime, the weapon or instrument used, the number of times the victim was stuck, shot or stabbed, and the possibility of the victim having been shifted after the assault. Brown and Davenport (2012:170) further explains that, after examining the blood spatter, investigators may be able to establish what action occurred during the crime, the sequence of activities, and who was or was not present.

Becker (2009:106) states that because blood is generally the main source of evidence it must be collected as physical evidence to be tagged and bagged. Any person moving into the scene must be careful not to temper with a pattern of blood. Because blood is a very common source of evidence at a crime scene, it must be handled as physical evidence to be tagged and bagged, and everyone entering a crime scene must take care not to disturb the patterns of blood, which can expose as much to an expert as the result of laboratory testing of the blood itself. The following are the findings of the study of a bloodstain pattern:

- **Surface texture** provides the basis for blood pattern foundation for blood pattern clarification.
- If a drop of blood falls into a hard, smooth surface, it splits into smaller droplets. The same droplets move towards the same direction as the original drop, leaving marks of patter like teardrop, with the pointed end moving towards the place of origin.
- The **circular** distortion of a stain on a flat surface will allow the determination of the angle of impact. The more nearly perpendicular the angle of impact, the more circular the blood drop stain. As the angle increases, the stain becomes more elongated

Becker (2009:42) states that a video tape can be the most appropriate media to record a bloodstain at the crime scene. The importance of recording blood evidence on video is that the overarching coordination of different blood spatters and patterns can be illustrated and can reveal the coordination of patterns of different aspects of the crime scene.

3.3.1 Bloodstain mechanics

The value of developing accurate methods to identify, analyse and interpret fluid evidence, in the case of blood through the forensic sub-discipline of Blood Pattern Analysis (BPA), is important:

- **Free-falling blood**

When a drop of free-falling blood strikes a nonporous, smooth horizontal surface, the outcome is circular blood. A rough texture surface will cause the surface tension to rupture and create a stain with spines. Maximum diameters are achieved when the height of the blood source allows the blood drop to reach its terminal velocity (Dutelle & Becker, 2019:103).

- **Impact angles**

Dutelle and Becker (2019:103) state that free-falling blood dropping vertically and striking a horizontal surface at 90 degrees will result in a circular bloodstain. Blood dropping on non-horizontal surface results in an extended, oval-shaped strain. The angle of impact calculations is performed with aid of computer software. Impact patterns are bloodstain patterns formed when blood obtained from an impact or force results in the regular dispersion of smaller drops of blood (Sullivan, 2007:249). According to Saferstein (2013:232), the most prevalent form of bloodstain pattern found at the crime scene is impact spatter. This pattern is found when a common type of bloodstain pattern found at the crime scene is impact spatter; this pattern emerges when an instrument impacts with the source of blood.

- **Area of convergence**

In instances when a body is faced with a force adequate to cause bleeding, the blood spread will strike different surfaces at different angles. A point of convergence is a key area where an individual bloodstain can be drawn (Dutelle & Becker, 2009:104). The location of the source of blood can be established where there are about two drops of blood spatter, even when there are various blood spatters. The location, in which the lines of convergence meet, is where the blood originates (Bertino, 2012:206). The area of convergence is the point on a two-dimension plane from which the drops originated. This can be determined by drawing a straight line through the long axis of number of individual bloodstains, preceding the line of their tail. An instrument striking a source of blood several times will never produce the

same pattern each time. One can therefore establish the amount of impact by drawing the area of convergence for groups of stains from isolated impacts (Saferstein, 2013:234).

- **Area of origin**

According to Dutelle and Becker (2019:104), the area of origin is the 3D location from which spatter originated and it is determined projecting angles of impact of well-defined bloodstains back to an axis constructed through the established area of the convergence. Saferstein (2013:234) states that it is also essential to establish the point of origin of a bloodstain pattern. This will indicate the state of the victim in space when the stain resulting from the event took place. The spread of the droplets in an impact pattern provides a common idea of the distance from the blood source to the blood-stained surface. The generic method of establishing the point of origin at the crime scene is known as the string method, which follows these steps:

1. Establish the point of convergence for the stain pattern.

2. Place a pole or stand as an axis coming from the point of convergence, and

3. Attach one end of a string next to each droplet. Place a protractor next to each droplet and hang until it is aligned with selected angle.

- **Low-velocity-impact bloodstains**

Becker (2009:108) explains that the secondary blood splashing (ricochet) can develop as result of the deflection of huge volume of blood after an impact on a target surface. Splashed bloodstain patterns generally have a huge central point and peripheral spatter, with the spatter appearing as extended oval shaped spots. These patterns are generally produced when pools of blood are spread by objects such as shod feet, or when huge volumes of blood fall from a source such as a victim's wound. The larger the quantity of splashed blood, the larger the spatter it produces. According to Sullivan (2007:249), Low-Velocity impact spatter (LVIS) is a bloodstain pattern formed from a tiny impact or force to a blood source. Saferstein (2013:232) states that an impact pattern consisting of a preponderance of huge isolated or compounded drops with diameters of four millilitres or more is called low-velocity spatter. This type of spatter is generally formed by gravity alone, by less force, or by an object dropping into the splashing blood from a blood pool. Low-velocity stains can develop from an applied force moving at up to five feet per second.

- **Medium-velocity-impact bloodstains**

Medium-velocity impact spatter (MVIS) is a bloodstain pattern which occurs as result of a medium velocity impact or force to a blood source. A beating generally results in this type of spatter (Sullivan, 2007:249). When a strong force hits an exposed source of blood, the

blood is divided into various tiny droplets. When these droplets strike a target surface, they result in bloodstain patterns that are readily distinguishable from patterns produced by dripped blood, which is linked with a low-velocity force of impact (Becker, 2009:108).

- **Projected blood**

Where a large quantity of blood is subjected to medium or high volume, the blood is forcibly projected toward a target surface or surfaces and formulates a unique pattern. Blood released under arterial pressure creates this kind of pattern and the method of release is considered to be arterial gushing or spurting.

- **Cast-off blood**

A cast-off pattern is formulated in instances a blood-covered object flings blood in an arc surface. This type of pattern generally occurs when a person pulls a bloody fist or weapon back between landing blows to the victim (Saferstein, 2013:237). Cast-off patterns are stains created as the outcome of blood being spread from an instrument in motion (Sullivan, 2007:247). Becker (2009:109) states that, in blunt trauma cases, generally the assailant swings the weapon continuously toward the victim. These continuous blows may form a pattern as blood flung from the weapon on each repeated blow. If a weapon has produced blood, the blood will generally adhere to that weapon. At the moment of back swinging from the victim, the blood on the weapon will be flung off and travel tangentially to the arc of the swing, hitting a closer surface like walls, ceiling, floors, and other items on its way. Several cast-off patterns will allow the reconstruction of the movements of the victim and the assailant as well as their virtual positions at the time the cast-off pattern was produced. They also permit an estimation of the minimum number of blows struck plus one, because the first blow does not result in a cast-off pattern.

- **Flow pattern**

Becker (2009:109) explains that flow patterns indicate the direction of movement of flowing blood. Pooled blood acts like pool water. Flow pattern can appear on the body of the victim as well as on the surface where the victim is lying. Flow patterns and blood pooling may expose any action of the victim during or after bloodshed or any alteration of the crime scene. A blood source that strikes with an instrument moving at a speed between five and 25 feet per second will result in a medium-velocity blood spatter. According to Sullivan (2007:249), flow patterns are the direction undertaken by blood as a result of gravity or movement.

- **High velocity-impact bloodstain**

A smash between a blood source and an instrument moving at a speed of over 100 feet per second will form a high-velocity impact pattern. High velocity-impact creates a mist of showering blood that, because of its low density, does not travel a long distance. Back

spatter may occur if the assailant and the weapon are in the proximity of the victim at the time of assault (Becker, 2009:109). In the absence of an expert to conduct the examination, the photographs you take are vital to the examiner. In instances where the analyses are performed at the scene, the process needs to be recorded, and a photograph of the point of convergence(s) taken. When a point of origin is established, it must also be photographed (Sullivan, 2007:67). Sullivan (2007:248) further states that high-velocity impact spatter (HVIS) is a bloodstain pattern as result of high-velocity force to the blood source, such as a gunshot or high-speed machinery.

3.3.2 Collecting and packaging of evidence when blood pattern analysis is used

According to Sweeney (2017:94), evidence is any material that may be presented in a court case to collaborate the claim that is made. Physical evidence must be collected and packaged appropriately to ensure a crime technician is able to identify and compare evidence. Individual items of evidence are packaged separately based on the chemical and physical properties of the evidence. For example, blood-soaked material is first dried and then packaged in paper bag (Brown & Davenport, 2012:10). Gardner (2012:92) makes similar inferences that on the scene the investigator cannot always package evidence for the long term. Items bloodied and still wet must be dried and packaged at later date. Shaler (2012:342) outlines the seven rules that generally apply to all classes of biological evidence, and these are:

- Always wear protective gear, face marks, gloves, proper outer wear, and shoe/ boot covers.
- Dry all blood evidence. If it cannot be done, move it to the forensic laboratory immediately, and protect it from encountering other evidence.
- Never package blood evidence in plastic. Always use paper.
- Package each item of evidence separately. Never mix items.
- Never permit adjacent bloodstain (even if dry) to meet other stains on the same or other items of evidence.
- Keep every piece of biological evidence in a cool dark place, if possible. In other words, store the evidence away from the sunlight and heat, for example, police car or crime scene unit car on a hot day during the analysis of the scene.
- Gather the whole sample, if possible. At the time, it may not be feasible as result of the size or fixed location of an object. If the method is impossible, cut the whole stain from the bigger item and record the location photographically. It is essential to gather evidence on slightly moistened swabs.

Saferstein (2013:88) states that blood examination has huge evidential value when it permits the investigator to illustrate a transfer between a victim and a perpetrator. On that basis, all clothing from both the victim and the suspect should be packaged and sent to the laboratory for analysis; this even if the presence of blood on garment is not clearly visible to the investigator. Saferstein (2013:110) states that one does that because it is not possible to determine at the crime scene what value, if any, the scientist will discover in the evidence gathered or what importance such an outcome will eventually have on the jury. Individual items of evidence are packaged separately based on the chemical and physical properties of the evidence. For example, blood-soaked material is first dried and then packed in a paper bag (Brown & Davenport, 2012:10).

Bertino (2012:27) states that when packaging, the size of the bundle depends on size of evidence. If the evidence is small, the bundle can be created from a piece of paper. If the evidence is large, the bundle might be constructed from a large piece of covering paper (Bertino, 2012:27). Ogle (2007:142-143) explains that a specific method utilized for the gathering of bloodstain evidence will rely on the form of bloodstain, whether it is wet or dry, and the nature of the surface carrying the bloodstain. As a common rule, it is advisable to gather the items carrying the bloodstains and hand the item over to the laboratory for analysis. Generally, the item bearing bloodstains cannot be picked up. To enable the crime scene specialist to gather bloodstains one must apply the method best suited for that surface which bears a bloodstain. The following guidelines highlight the techniques most suitable to the specific surfaces bearing the bloodstains:

- **Small items containing potential bloodstains**

As a rule, pick up the whole item attached to the stain (including cutting out the stained section). Make provision for the stain to air dry fully, and thereafter, package individual items in an isolated paper bag or envelope.

- **Large, immobile objects with hard, smooth surfaces (metal, glass, etc.)**

In instances where bloodstain is on large, immovable items, the stains should be drawn by immersing swabs into the stain, if moist, or alternatively, by minimum moistening swabs with distilled water and thereafter swabbing the stains, and in the process, drawing as much material into the swabs as possible. As soon as the swabs have been collated, they are supposed to be labelled.

- **Large liquid pools of blood**

Liquid pools should be sampled by absorbing a sample of the pool onto sterile cotton swabs. Enable the swabs to fully air dry fully and, thereafter, package them in paper bindles and seal them in paper envelopes or swab boxes.

- **Large objects with hard, porous surfaces (brick, wall, concrete, pavement, etc.)**

Draw the stain by utilizing dampened (with distilled water) sterile surface swabs for hard, nonporous surfaces. Enable them to air dry and package them in a paper package, with individual swab in an isolated envelope. In instances where it is feasible, the whole garment bearing the bloodstains should be picked up. It is essential that special care be taken to prevent the folding and crumpling of the garment.

3.3.3 The significance of bloodstain pattern analysis in reconstructing a crime scene of murder

According to Inman (2001:61), physical evidence collected at the crime scene plays a key role in the reconstructing of the activities that occurred in the proximity of the crime scene. Even though the evidence individually does not explain everything that occurred, it can support or contradict an account submitted by witnesses and or suspect. Blood from the injury may be traced in various locations, including the area to which the body may have been shifted. Furthermore, this information may make it possible to establish the first place to which the body was shifted during the commission of crime (Saferstein, 2013:124).

Shaler (2012:373) indicates that sketching is generally not the most reliable method of attaining a blood stain pattern, despite indicating its location and documenting their breadth and width and as such blood evidence can assist the investigator with a variety piece of investigative information. Brown and Davenport (2012:10) explain that physical evidence may be any material gathered and analysed at a crime scene that can connect a potential suspect to a crime. The evidence can differ in size, from a drop of blood to bigger objects, like furniture, or a door.

3.4 CONCLUSION

From this chapter it is evident that blood plays a key role in the investigation of scenes of violent crime and, therefore, care must be exercised when collecting evidence at the crime scene. This is emphasized by the Public Agency Training Council (2017:2) which states that blood at crime scene, that is found from the victim, suspect, or witnesses (clothing or persons) can be regarded as being important and should be treated as such when recording,

collecting, and maintaining evidence. The chapter further highlighted the significance of blood pattern analysis as indicated by Brown and Davenport (2012:170) showing that blood spatter evidence is essential in assisting investigators to establish the position of the victim at the time of the crime, the weapon or instrument used, the number of times the victim was struck, shot or stabbed, and the possibility of the victim having been shifted.

The role of a crime reconstruction investigator was explicitly outlined. Saferstein (2013:151) indicates that a crime scene reconstruction investigator needs to apply deductive reasoning, inductive reasoning and testable to formulate a systematic reconstruction of crime scene activities. The process of the reconstruction of a crime scene involves a scientific method, reasoning, sources of information on people, criminology, victimology and experience or skill to explain the events that relate to the commission of the crime. The collection and packaging of evidence at a crime scene is critical and was discussed and defined. According to Sonne (2006:15), it is best that the forensic technicians document the scene with photographs and sketches and collect evidence, but it is not always practical as there may also be occasions when forensic investigators are not available. Furthermore, the chapter highlighted the role of the investigation team leader to ensure that physical evidence is located, documented and collected from the crime scene and from sources outside of the primary crime scene as well.

CHAPTER FOUR: PRESENTATION AND INTERPRETATION

4.1 INTRODUCTION

In this chapter, the researcher presents and analyses data which came as a result of intensive in-depth interviews with participants in selected areas in the Tembisa Cluster, Gauteng Province. De Vos, Strydom, Fouche and Delport, (2011:397) states that data analysis is the process of bringing order, structure and meaning to the mass of collected data. In line with the above-mentioned authors, the researcher, with the assistance of the supervisor, developed themes which were aimed at answering the research aim as well as the research questions posed in chapter one. The aim of this research study is to explore the significance of bloodstain pattern analysis in reconstructing a murder scene within the Tembisa Cluster. The research question is: What is the significance of bloodstain pattern analysis in the reconstruction of a murder scene?

In order to avoid any distortion of facts, the researcher presents the participants' viewpoints *verbatim*. As one reads the opinions of some of the participants which were quoted *verbatim*, a thread is drawn which links these responses to their experiences with the phenomenon of crime investigation and within their lived experiences regarding the concept of this study. This chapter focuses on the findings from the collected data and discusses results with reference to the objectives and research questions. Moreover, findings in this research afford readers an opportunity to make sense of the research findings as obtained from participants. As indicated earlier, this chapter largely reflects the participants' viewpoints and responses as quoted *verbatim*. To this end, the participants' comments and experiences are corroborated with the relevant literature where this is appropriate.

In this study, the researcher adopted a qualitative approach to achieve the stated objectives and to answer research questions according to interview schedule (Annexure A). Owing to the Covid-19 pandemic, the researcher used alternative data collection methods in line with Unisa position on research ethics where it was not possible to meet with participants face-to-face (See Annexure D).

However, there were instances where face-to-face interviews with participants were possible. In this instance, all Covid-19 regulations, such as social distancing and sanitizing, were observed. Participants' responses were coded in terms of similarities and/or association. According to Grinnell and Unrau (2005), the primary task for coding is to identify and label relevant categories or topics of data. Flick (2006) mentions that, although interpretation is at the core of qualitative data analysis, its importance is seen differently in the various approaches or strategies. The following section presents themes which emerged

from participants' responses. For this reason, the researcher interprets data by giving them meaning or making them understandable from the point of view of the people being studied (De Vos, et al., 2011:417). The following section presents themes which emerged from participants' responses.

4.2 EMERGING THEMES

The purpose of developing themes involves the process of transforming data into findings which can be interpreted. In addition, this involves reducing the volume of raw information, sifting significance from trivia, identifying significant patterns and constructing a framework for communicating the essence of what the data reveals (Patton, 2002). Broadly conceived, this is the activity of making sense of interpreting the data (Schwandt, 2007:6). This is in line with the suggestions of Angrosino (2007) who supports an approach where "the subjects speak for themselves". Consequently, it was important to use the words and phrases by participants themselves in order to enrich this research. In order to analyse data, the researcher used a data analysis spiral as guided by Creswell, (2009:185) and Leedy and Ormrod (2010:153). Before analysis, the researcher coded raw data by hand with the assistance of the supervisor. According to Grinnell and Unrau (2005), the primary task of coding is to identify and label relevant categories or topics of data. The idea behind coding is to reduce the data into small, manageable set of themes and to write it into the final narrative (De Vos, et al., 2011:410).

This study aimed to derive new insights into an understanding of the experiences and meaning of crime investigation in general and bloodstain pattern analysis in the South African context. The researcher embarked on this study in order to conceptualise the phenomenon in order to provide solutions to crime which affects different people and organisations in various ways. Furthermore, the researcher's interpretations and findings had to be grounded in the participants' social reality in order to be able to present a valid reflection of the crime phenomenon (De Vos, et al., 2011:414). Throughout her research study, the researcher used the participants' responses to generate and analyse data as well as developing themes as presented below. The researcher captured ideas and thoughts that helped her to make sense of the data and the categories she had drafted right after analysing the first interview (De Vos, et al., 2011:414). A decision to discard or ignore immaterial data was taken when saturation was reached. Saturation was reached when no new themes/categories emerged. The following section presents the conceptual themes which the researcher believes provide a comprehensive perspective of the participants in this research.

4.2.1 Theme 1: The significance of bloodstain pattern analysis in the reconstruction of a murder scene

The literature presented throughout this research supports aspects related to the previous chapter and highlights the challenges caused in terms of bloodstain pattern analysis in the investigation of crime as a phenomenon being studied in a South African context. The researcher sought to explore challenges related to crime investigation in South Africa. From the participants' responses, it is evident that there are serious considerations to be made with regard to the empowerment of investigators in general and for the Tembisa Cluster specialists or experts. Research shows that crime poses a great risk to both private individuals, small or large corporations and organisations, not only in this country, but the whole world (Sweeney, 2017:107-108). From the participants' responses, it is evident that the impact of crime in South Africa requires capable and well-resourced investigators. However, the extent of the challenges faced by investigators can only be quantified when a skills audit is conducted. These challenges are often the result of a lack of political will by management to address the skills deficit in the SAPS.

When asked about the significance of bloodstain pattern analysis in the reconstruction of a murder case, one participant had this to say:

> "…*Assist in the reconstruction of those events that could have created the stains and stains pattern at the crime scene* (**Participant 1)**. Other participants responded later in theme numbers 6, 16, 17 and 18.

4.2.2 Theme 2: Specialized training with regards to the use of bloodstain pattern analysis

In this section, the aim was to solicit the level of training or lack thereof that participants possess. When asked about the specialised training with regards to bloodstain pattern analysis, some of the participants responded as follows:

> *"…Yes, Advance Crime Scene Course".* "Yes, how analyse bloodstain pattern". (**Participant 1)**.
>
> *"Yes, I did Advance Crime Scene Investigation course". "Yes, when I was doing Crime Scene Reconstruction course"* (**Participant 2)**.
>
> *"…Yes, I attended advanced crime scene course at Philippi Police College".* (**Participant 3)**.
>
> *"…Yes, I attended DNA Recovery course at Pretoria presented by National CR and CSM".* (**Participant 4)**.

"…Yes, Crime Scene investigation for Local Criminal Record Centre". Yes, 2017. Yes, advanced Crime scene Investigation" (**Participant 5 and 6)**.

"…Yes, I have attended seven different types crime scenes and I was a trainer in Crime Scene.
Investigation for First Responders, Detectives, Organised Crime, Serious and Violent crimes, Sexual offences, Endangered species as well as computerised crimes". (**Participant 7)**.

On the other hand, most participants interviewed indicated that they were not given opportunities to attend any specialised training while they were expected to attend crime scenes which required such training and skills. The responses by these participants are of major concern considering the number of cases which are thrown out of courts owing to a lack of, or insufficient, evidence. Bear in mind that these participants are fieldworkers who are expected to perform their duties in a professional manner. From the above responses, it is evident that training should be prioritised in order to ensure that all crime scenes are handled in a manner that will result in the resolving of crimes and to ensure the conviction of perpetrators of crime.

4.2.3 Theme 3: Crime investigation

Crime investigation is described by Van der Westhuizen (1996:1) as a systematic search for the truth with the primary purpose of finding a positive solution to the crime with the help of objective and subjective clues. In this study, the researcher sought to establish the participants' understanding of the concept of crime investigation. To this end, a question was posed to participants in order to elicit their individual perspectives. Asked about this concept, participants responded as follows:

"…Any form of attend, visual examination, interrogate and investigate whereby the crime is committed" (**Participant 1)**.

"…*Criminal investigation is when the investigating officer try to find out what happened during crime that was committed in his / her area. It is also a way of finding who committed a crime and why*" (**Participant 2)**.

"…Manage the process of collecting, attending, and processing and investigate of evidence at crime scene" (**Participant 3)**.

"…Crime investigation is the search for the truth regarding crime committed" (**Participant 4)**.

This participant appears to echo what is described in Van der Westhuizen (1996:1).

"…When crime is committed, and investigators try to get a lead to arrest the perpetrator" (**Participant 5)**.

"…Crime investigation of to gather facts about the crime in other to assists the court in taking an objective decision" (**Participant 6)**.

"…Is the search for the truth from the crime scene until presented to court" (**Participant 7)**. This participant also mentioned similar sentiments as described in Van der Westhuizen (1996:1).

"…From the time crime was committed until the suspects found guilty or not at court, crime prevention is the process of identifying people and physical objects" (**Participant 8)**.

"…Crime investigation is the search for truth after a particular criminal incident has happened" (**Participant 9)**

"…Crime investigation is the use of objective clues like physical evidence and or subjective clues like witness, suspect or victim statement to search for the truth" (**Participant 10)**.

"…When you investigate crime and submit proof at court" (**Participant 11)**.

"…Is the search for the truth from the crime scene until presented to court" (**Participant 12)**.

"…Crime investigation can be described as seeking for information after crime has been committed" (**Participant 13)**.

"…The concept of crime investigation is the process of collecting evidence to prove or disprove a criminal and/or civil matter" (**Participant 14)**.

"…An attendance and investigation of crime scene using all crime scene equipment" (**Participant 15)**.

"…Crime investigation is to analyse clues and exhibits on a crime scene or alleged crime scene to ascertain is a crime was committed and find the responsible person or persons" (**Participant 16)**.

In the light of the above, the researcher agrees with the assertion by Lochner and Zinn (2015:29) who indicate that it is a basic principle in any investigation that an investigator must know how to approach and search the scene of incident.

4.2.4 Theme 4: The objectives of crime investigation

Lochner and Zinn (2015:33) highlight the fact that the objective of scene investigation is to identify, recover and document physical, and the systematic and careful collection of facts,

clues and physical evidence. In this section, the question was: What do you regard as the objectives of criminal investigation? Participants responded as follows:

> *"…To determine who committed crime; to apprehend the criminal; to brought criminal to court"* (**Participant 1)**.
>
> *"…Is to find out who committed crime, if truly crime took place and also the investigator need to present the evidence at court, convincing the prosecutor that the suspect is the right person who committed an offence"* (**Participant 2)**. *"…To determine who and how crime committed"* (**Participant 3)**
>
> *"…Identification of crime, gathering of evidence, arrest the suspects and recover stolen property and prosecution process and bringing perpetrator to court"* (**Participant 4)**.
>
> "…*Determine if crime is committed indeed and arrest the person responsible to appear in court"* (**Participant 5)**.
>
> *"…To gather facts about crime; to ascertain if crime was committed; to get evidence"* (**Participant 6)**.
>
> *"…To determine if crime is committed; Arrest the perpetrators; Recover stolen property* (**Participant 7)**.
>
> *"…Gather facts and that this has to be accurate; Determine whether crime has been committed; Arrest the suspects; Recover stolen property; Present best case in court"* (**Participant 8)**.
>
> *"…To determine what actually happened and be able to link the perpetrator to the crime"* (**Participant 9)**.
>
> *"…Objectives of investigation include recovery of stolen goods, tracing and arresting suspects and presentation of complete investigation docket in court"* (**Participant 10)**.
>
> *"…To determine if crime is really committed; to arrest the perpetrators; to submit evidence in the court of law"* (**Participant 11)**.
>
> *"…To determine if crime is committed; Arrest the perpetrators; Recover stolen property"* (**Participant 12)**.
>
> "…*Investigate if crime is committed, Arrest the suspects, and recover stolen property and present evidence at court"* (**Participant 13)**.
>
> *"…The objective of criminal investigation is to gather evidence, identify offenders of crime, and apprehend offenders and to assist in the successful prosecution of offenders"* (**Participant 14)**.

"…Finding out how crime was committed; Solving of crime scene; Aiding the investigation process" (**Participant 15)**.

"…Is to investigate if a crime was committed and if so to find the person / persons or institution that was responsible for the crime and bring these perpetrators before a court of law" (**Participant 16)**.

From the above, it emerged that many participants had a good understanding of the concept. The next section presents some aspects of crime investigation.

4.2.5 Theme 5: Investigative aspects during the investigation of crime

According to Lochner and Zinn (2015:32), the scene of an incident is the most vital and crucial part of any investigation. To this end, there are no hard and fast rules of approaching all crime scenes. However, there are basic principles and aspects which all investigators should always bear in mind. When asked the question: What investigative aspect do you regard as important during the investigation of crime, participants responded as follows:

"…Visual examination; Taking care of not contaminating exhibits; Point of entry; Photograph scene as it is" (**Participant 1)**.

"…When investigating crime, it is important to make sure that all the evidence are collected at the crime scene, witnesses are interviewed and protected" (**Participant 2)**.

"…*Walk through crime scene. Investigate thoroughly"* (**Participant 3)**.

"…Physical evidence and exhibits regarded as important when investigating crime" (**Participant 4)**.

"…*Locate witnesses, secure the scene and collect evidence"* (**Participant 5)**.

"…The collection of evidence and its proper handling; Identification of witnesses" (**Participant 6)**.

"…Locating of witnesses and arresting of the suspects" (**Participant 7)**.

"…Securing crime scene; Taking fingerprints; Photographs the crime scene; Collecting of evidence" (**Participant 8)**.

"…To find evidence that will link the perpetrator to the crime" (**Participant 9)**.

"…Important aspect is locating witnesses including suspects and victims of crime" (**Participant 10)**.

"…Locating witnesses; Taking photographs; Taking fingerprints" (**Participant11)**.

"…Locating of witnesses and arresting of the suspects". (**Participant 12)**.

"…Securing the crime scene, collect physical evidence, and secure information from the witnesses" (**Participant 13)**.

"…Communication is the most important aspect of crime investigation from the first responder at a crime scene up to the analyst at the forensic science laboratory until it reaches court" (**Participant 14)**

"…with all the activities and actions to be taken communicated either verbal or by means of documents or statements, this would ultimately lead to positive prosecution and conviction" (**Participant 15)**.

"…I find that Physical Clues and Exhibits are very important. People do not remember everything and can perjure themselves so I would say direct evidence" (**Participant 16)**.

To this end, it is evident that participants have a variety of perceptions regarding the above aspect.

4.2.6 Theme 6: Investigative aspects when collecting bloodstain patterns at the murder scene

Van Rooyen (2008:87) is of the opinion that forensic investigations must be properly and lawfully executed in a fair, impartial manner and accurately documented. To this end, investigators are required to follows correct procedures, use the right equipment and ensure the integrity of collected evidence until it is presented in court. The following question was posed to participants: What investigative aspects do you regard as important when collecting bloodstain pattern at a murder scene? These participants responded as follows:

"…*In order to determine the donors of different kind of blood spatter throughout the crime scene, method of DNA analysis should be applied"* (**Participant 1)**.

"…*Protective equipment regarded as the most important when collecting bloodstains at the crime scene as it helps not to temper with evidence and contaminate crime scene"* (**Participant 2)**.

"…To determine the donor of different kind of blood spatter throughout the crime scene, method of DNA analysis should be applied" (**Participant 3)**.

"…Blood is unique, so it is important to use relevant containers to store blood" (**Participant 4)**.

"…Forensic investigators called to collect blood at the crime scene" (**Participant 5)**.

"…Use clean equipment. Always use gloves when handling blood stains. Use appropriate equipment and store them in appropriate location" (**Participant 6)**

"…Use the correct equipment to collect and package blood" (**Participant 7)**.

"…Using of clean equipment; Wear protective gloves; Store the evidence in cool and secure place" (**Participant 8)**.

"…Use collection kits specific to collecting blood samples; Not to contaminate the evidence" (**Participant 9)**.

"…Important aspect regarding the collection of blood in the recording of the condition of blood and its appearance" (**Participant 10)**.

"…Photograph the crime scene, securing the crime scene" (**Participant 11)**.

"…Use the correct equipment to collect and package blood" (**Participant 12)**.

"…Arrange with the expert to collect evidence at the crime scene" (**Participant 13)**.

"…The most important aspects to regard when collecting blood stain is to properly and precisely document the pattern (using appropriate documentation and/or camera), collect and optimally preserve this type of evidence due to its sensitive Nature" (**Participant 14)**.

"…Analysis of DNA; Finding out the Donor of different kind of blood spatter; Collecting bloodstains, the shape of bloodstain pattern will depend greatly on the force used to" (**Participant 15)**.

"…Firstly, the scene of crime must not be disturbed. The Forensic Science Laboratory or the Local Criminal Record Centre must ensure that photos and a video is taken before any clue or exhibit is packed and forward for analysis. The scene can tell you through the different types of blood and the trajectory of the blood how the crime was committed and what weapon likely was used as well as the height of the offender" (**Participant 16)**.

In the light of the above responses, it is evident that there were different views with regard to the aspect raised. To this end, the researcher is of the opinion that an investigator requires extensive skills training in order to approach crime scenes with confidence and to ensure that integrity of evidence is maintained throughout. This led to the next question relating to the aspect about the responsibilities of crime investigators.

4.2.7 Theme 7: Responsibilities of a crime investigator

According to Petherick (2009:293), the investigator is the official responsible for the overall case. The author further explain that the investigator talks to witnesses, victims and suspects, process the scene and to gather evidence. The following question was posed to participants: What are the responsibilities of a crime investigation? Participants responded as follows:

> *"…Assess the crime; Took photographs; Take measurement"* (**Participant 1).**
>
> *"…The responsibility of crime investigator is to make sure that perpetrators brought to court to be accountable of their actions as crime does not pay"* (**Participant 2).**
>
> *"…Checking scene; Prepare diagrams and sketches; Take measurements"* (**Participant 3).**
>
> *"…Arrest suspects, investigate crime, interview witnesses, recover stolen property, proof is suspect is quilt on not and to present best case in court"* (**Participant 4)**
>
> *"…Arrest the suspects, interview complainant, interrogate suspects, and testify at court"* (**Participant 5).**
>
> *"…To collect evidence, identify and interview witnesses, to assist the court to come to an objective decision"* (**Participant 6).**
>
> *"…Collect evidence; Present case at court; Collect evidence at the crime scene"* (**Participant 7).**
>
> *"…Secure the crime scene; Locates witnesses; Arresting suspects; Taking fingerprints; Collecting bloodstains; Present the case in court; Recover stolen property"* (**Participant 8).**
>
> *"…To determine if the crime happened and what crime; To identify the victim/s; To secure the crime scene and evidence until is collected by trained official; To call experts in the field where he/she is not capable; To identify potential witnesses and suspects"* (**Participant 9).**
>
> *"…Responsibilities of crime investigation includes protection of witnesses and physical evidence"* (**Participant 10).**
>
> *"…Arrest the suspects; Protect crime scene; Determine if crime is committed; Take photographs; Protect physical evidence"* (**Participant 11).**
>
> *"…Collect evidence; Present case at court; Collect evidence at the crime scene"* (**Participant 12).**

"…Protect evidence at the crime scene, arrest perpetrators, present evidence in court, proof quilt or innocents of perpetrators, and protects witnesses" (**Participant 13).**

"…The responsibility of the investigator is to investigate criminal or civil acts, solve crime problems, prevent possible criminal or civil acts, arrest offenders and assist in the prosecution of Offenders" (**Participant 14).**

"…Take charge of crime scene; Plan and sketch the crime scene; walking caution to check crime scene" (**Participant 15).**

"To investigate if a crime was committed and if so to bring the perpetrator before a court of law" (**Participant 16).**

In the light of the above, the researcher argues that investigators should be capacitated and trained in order to sharpen their skills. Aspects about evidence contamination is presented in the next section.

4.2.8 Theme 8: Understanding of contamination of evidence

Contamination is when there is the transfer of any other material to the original physical evidence (Lochner and Zinn, 2015:20). These authors further argue that contamination can also happen between two or more items of physical evidence. This is known as cross-contamination. Contamination can occur from the time evidence is found or seized until the actual analysis or presentation of the physical evidence in court. According to Lochner and Zinn (2015:20), there are many causes of evidence contamination and not even one can be singled out as the principal one. "*No to temper with evidence, not transferring any foreign new evidence, to exact evidence found on crime scene"* (**Participant 1).**

Lochner and Zinn (2015:20) list the following as some of causes that contribute greatly to contamination: weather conditions; uncontrolled activities at the scene of incident; and improper handling of physical evidence. Asked about what their understanding of contamination of evidence participants is responded as follows:

"…*Contamination of evidence is when someone tempered with evidence by bringing or taking evidence from the crime scene. The scene is no longer in the origin"* (**Participant 2).**

"…Altering the origin of the evidence" (**Participant 3).**

"…Bringing physical evidence to crime scene and destroying some evidence e.g., touching the scene leaving your own fingerprint" (**Participant 4).**

"…Evidence tempered with at the crime scene to destroy the origin of it" (**Participant 5).**

"…Not handling evidence in a proper way" (**Participant 6).**

"…Collecting evidence without protective clothing can contaminate crime scene" (**Participant 7).**

"…Altering the origin of the evidence" (**Participant 8).**

"…This is where foreign facts/items are brought into to the evidence thereby mixing the evidence with probably what was not the evidence for the specific crime scene" (**Participant 9).**

"…Contamination involves tampering with evidence to reduce the integrity of it" (**Participant 10)**

"…Tempering of physical evidence to reduce the origin of it" (**Participant 11).**

"…Collecting evidence without protective clothing can contaminate crime scene" (**Participant 12).**

"…Contamination of evidence means the corrupt of physical evidence at the crime scene during packaging, collection and transportation of evidence to a secure facility or laboratory" (**Participant 13).**

"…Contamination of evidence is making impure of any physical evidence (that is to change form or shape of any evidential matter from its original form) "(**Participant 14).**

"…Changing the way Evidence found before it can be investigated" (**Participant 15).**

"…The moment any evidence is handled without using the correct methods evidence is contaminated" (**Participant 16).**

From the above, it is evident that physical evidence handled too much holds a great risk of contamination. To this end, the integrity of such evidence may eventually be questioned in a court of law. Lochner and Zinn (2015:20) posit that, if the equipment used to collect and to preserve physical evidence is not clean and free from any material, it will certainly transfer unwanted material.

The researcher is of the view that the aspect of continuity of possession
and the use of appropriate equipment will ensure that no contamination of evidence takes place. This will certainly result from proper training provided to all those who have the responsibility to collect and preserve such evidence. It is a great concern that some of the participants indicated that they are not given training opportunities. The next section presents the aspect of chain of evidence/possession.

4.2.9 Theme 9: Chain of evidence

It is important that a proper record is kept of all types of evidence from the scene until presentation of evidence in a court of law. According to Van Rooyen (2008:22), the continuous safe keeping of physical evidence is of cardinal importance in crime investigation. This is commonly known as the continuity of possession or "chain of possession". When asked what chain of evidence is, and what you do to maintain the chain of evidence, participants responded as follows:

> "…*The integrity of a piece of evidence, (tracing that the value not compromised along the process)"* (**Participant 1).**
>
> "*Each evidence needs to be marked and the receiver should sign for continuity of evidence"* (**Participant 2).**
>
> *"…It explains that any person who handle evidence from the crime scene until the evidence submitted to court to prove innocence or guilt of the suspects. All investigators who handle evidence need to be responsible"* (**Participant 3).**
>
> *"…All people handling the evidence from crime scene must be accountable as evidence need to be handled with care"* (**Participant 4).**
>
> *"…Tracing that value not compromised along the process". Making sure that all the collected evidence is placed on tampered evidence bag and is marked accordingly"* (**Participant 5).**
>
> *"…Start from the crime scene when evidence is collected, packaged, analysed until presented to court". Experts handling the evidence must follow correct procedures when presenting evidence"* (**Participant 6).**
>
> *"…All the people dealing with evidence found at the crime scene"* (**Participant 7).**
>
> *"…It is the collection, handling, the storage and presenting evidence in the court of law".*
>
> *"Evidence should be labelled with details of the person who collected and the one who examined them"* (**Participant 8).**
>
> *"…Evidence collected from the scene until is presented at the court of law". "Everyone handling evidence must the responsible and use relevant equipment"* (**Participant 9).**
>
> *"…Start from the collection, handling, and storage and presenting of evidence in court"* (**Participant 10).**
>
> *"…Correct labelling of evidence"* (**Participant 11).**

"…The method used by all persons who handled the evidence, so as to account as to what happened to the evidence from the moment it was discovered, who handled it, what they did with it, until the evidence is brought before the court" (**Participant 12)**

"…I ensured that only those who actually need to handle the evidence are allowed, and they must give account as to where they received the evidence, what they did with it and why. This account must be given in the form of affidavit or statement according to Section 212 of the CPA" (**Participant 13).**

In agreement with most of the participants' responses, Lochner and Zinn (2015:14) indicate that the continuity of possession is referred to as the 'chain of evidence' or 'chain of possession' or 'chain of custody'.

"…Chain of evidence is the custody of evidence from crime scene until is disposed of after the court case was finalised". I maintain chain of custody by limiting the number of people handling exhibits" (**Participant 14).**

"…Custody of evidence handled by all responsible persons from the crime scene until presenting evidence in court." "Make sure that all relevant people are responsible and accountable for their actions" (**Participant 15).**

"It is the path evidence take from the scene of crime to the collection, analysis and presenting the findings in the court of law" (**Participant 16).**

In the light of the above, it emerged that most participants understand aspects around the handling of physical evidence. The crime scene is presented in the following section.

4.2.10 Theme 10: The Crime Scene

The researcher sought to explore participants' understanding of a crime scene. When asked what a crime scene is, participants responded as follows:

"…Area where an offence has been committed and foreign evidence may be gathered. (**Participant 1).**

"…It is a place where crime took place. It can be inside the building or outside" (**Participant 2).**

"…Place where crime has been committed" (**Participant 3).**

"…Primary crime scene is the place where crime is committed while secondary crime scene is another location where crime proceeded". (**Participant 4).**

"…Area where crime took place" (**Participant 5).**

"…Is an area in where crime was committed" (**Participant 6).**

"…The place where crime is committed, there are two types of scenes, primary and secondary crime scene" (**Participant 7)**

"…The starting point of investigation, place where crime took place" (**Participant 8).**

"…A place where the incident occurred and needs to be investigated to get the clues and evidence. This includes the body of the human being" (**Participant 9).**

"…Crime scene is the location of a criminal incident including where other items of evidence are hidden" (**Participant 10).**

"…Place where crime took place. We have primary and secondary crime scene" (**Participant 11).**

"…The place where crime is committed, there are two types of scenes, primary and secondary crime scene" (**Participant 12).**

"…The place where an offence has been committed and forensic evidence may be gathered" (**Participant 13).**

"…A crime scene is a location or a place where a criminal activity has taken place, where possible evidence and criminal clues can be found" (**Participant 14).**

"…Place where crime committed" (**Participant 15).**

"…Anything that is involved in an alleged offence" (**Participant 16).**

The results of the study found that most participants understand what crime scene entails. This appears to be owing to their involvement as police officers in the attendance of crime scenes when they are on duty. In the light of the above viewpoints, Lochner and Zinn (2015:108) also posit that a crime scene or scene of incident is the place where crime occurred.

4.2.11 Theme 11: Considering the body of murdered victim as crime scene

"In considering whether the body of the murdered victim may be regarded as crime scene, there are also different views as can be observed in the participants' responses below". The question was: Do you consider the body of murdered victim as crime scene? Participants in this instance responded as follows:

"…Yes, crime is all places that an offence has been committed, murder is a crime" (**Participant 1).**

"…I don't know" (**Participant 2)**

"…NO, crime scene is the area of crime" (**Participant 4).**

"…No, it is part of evidence found in the crime scene" (**Participant 5).**

"…*Yes, evidence can be collected from the deceased"* (**Participant 6).**

"…Yes, physical evidence can be collected from the body of a victim, e.g., in a case of rape" (**Participant 7).**

"Yes, there are clues and evidence that can be recovered from the body of the victim" (**Participant 8).**

"…Yes, the body is part of crime scene as lot of information is located there" (**Participant 9).**

"…Yes, evidence can be taken from the body of victim" **(Participant 10).**

"…Yes, evidence can be collected from the deceased" **(Participant 11).**

"…Yes, a body of a murdered victim is a crime scene because crucial information and evidence can be found" **(Participant 13).**

"…Yes, for investigation purpose" (Participant 14).

"…No. crime scene is a place not a person" ***(participant15)***

"…Yes, evidence can be hidden on the body" **(participant 16)**

4.2.12 Theme 12: Considering the body of suspect as crime scene

In the same vein, when asked their opinion with regards to the body of the suspect, they had different viewpoints. The question was: When asked: Do you consider the body of suspect as crime scene? Participants? Participant responded to the question as follows:

"…Yes, still need to be investigated how the body been there and other aspect like how he died, e.g., strangled or shot" **(Participant 1).**

"…I don't know" **(Participant 2).**

"…Yes, Suspect does not rule out to be investigated" **(Participant 3).**

"…No, it is also part of evidence" **(Participant 4).**

"…Yes, clothes of suspect can be used as evidence during rape case" **(Participant 5).**

"…Yes, physical evidence can be collected from the crime scene. E.g., blood and semen" **(Participant 6).**

"…Yes, because immediately we learn that there is evidence that can be found from the body of the suspect, assuming he can be easily found, we get hold of him/her and follow the procedure of obtaining evidence from him/her, e.g., scars, DNA, fingerprints" **(Participant 7).**

"…Yes, the body of a suspect maybe a crime scene items of evidence should be found there" **(Participant 8).**

"…Yes, blood of victim can be found at the body of suspect" **(Participant 9).**

"…Yes, clothes of suspect can be used as evidence during rape case" **(Participant 10).**

"…Yes, the body of a suspect can also be considered as a crime scene because important evidence can be found such as blood from the victim, vaginal fluid or any other DNA matter can be found from the suspect" **(Participant 11).**

"…Yes, more clues can be found like blood from a victim" **(Participant 12).**

"…No, it can only help to trace evidence" ***(participant 13).***

"… Yes, the body of a suspect can lead investigators to the crime scene" ***(participant14).***

"…Not sure if the body of a suspect can be regarded as crime scene" ***((participant 15).***

"…Yes, Evidence can be found on the body of a suspect" ***(participant 16).***

The researcher is of the view that the two questions above requires further ventilation in order to find common ground. While both the victim and the suspect form part of the crime, it is not clear they can be regarded as the actual crime scene. More research in this area is required, looking into international best practices.

4.2.13 Theme 13: Physical evidence

Van Rooyen (2008:15) states that a person cannot commit crime without performing an act. Moreover, while perpetrating a criminal act, a person usually uses objects and leaves/takes/removes something from the scene which may eventually connect him/her to the crime scene. According to the Locard principle, a clue is usually left behind when two or more objects or people come into contact with each other. The best-known examples of physical evidence are fingerprints and blood which is the focus of this study. From the judicial point of view, evidence may be defined as all relevant information that is admissible and presented in court (Van Rooyen (2008:17). When asked what physical evidence is, participants responded as follows: When asked what physical evidence is, participants responded as follows:

"…Anything that altered, handled at the crime scene" **(Participant 1).**

"…Any object or material found at the crime scene that can be used as a proof that a crime has been committed" **(Participant 2).**

"…Anything that has been altered, handle or moved and left at the crime scene" **(Participant 3).**

"…Anything that can be seen or touched at the crime scene that can link the suspect to the crime scene" **(Participant 4).** *"…Evidence that you can touch"* **(Participant 5).**

"…Is evidence that comes from a non-living origin. It can be the tools that were used in the commission of crime such as a firearm" **(Participant 6).**

"…Evidence that can be seen, touched at the crime that can proof suspect quilt or not" **(Participant 7).**

"…A person cannot commit a crime without performing some act, the suspect will leave or take something from the scene which could contribute to connecting him with the criminal act. E.g., fingerprint and blood" **(Participant 8).**

"…Evidence that can be seen and touched, like an object used in a murder e.g., knife, firearm" **(Participant 9).**

"…Physical evidence is any item related to a crime" **(Participant 10).**

"…Evidence that can be seen or touched linked to crime, like blood or knife found at the crime scene" **(Participant 11).**

"…Evidence that can be seen, touched at the crime that can proof suspect quilt or not" **(Participant 12).**

"…Is any material object that plays some role in the matter that gave rise to the litigation, introduced as evidence is a judicial proceeding to prove a fact in issues based on the object's physical characteristics? **(Participant 13).**

"…Physical evidence is any material object that can assist in proving or disproving a criminal or civil matter at issue which can also be produced its physical form or by means of an expert statement (in terms of section 212 of CPA) at court or during a civil Litigation" **(Participant 14).**

"…Anything that was left at the crime scene like cigarettes buds" **(Participant 15).**

"…It is evidence that you can touch" **(Participant 16)**

In the light of the above, the researcher is of the opinion that the concept is largely understood, but it is not certain how participants ensure that physical evidence and its integrity must be preserved appropriately in order to ensure convictions. Training which emphasises the significance of physical evidence should be made available to all investigators.

4.2.14 Theme 14: Forensic investigation

Van Rooyen (2008:14) indicates that forensic investigation is usually associated with the investigation of computer related crimes which also include corruption, fraud, embezzlement

and or/other white-collar crimes. When asked the question: What do you consider to be forensic investigation? Participants responded as follows:

"…*Gathering and analysis of all crime related to physical evidence in order to come to conclusion about the suspect"* **(Participant 1).**

"…Advance investigation that can assist the investigator to establish information that will not be uncovered under ordinary investigation" **(Participant 2).**

"…Analysing and gathering of all crime-related physical evidence in order to come to a conclusion" **(Participant 3).**

"…When the experts investigate crime for example taking of fingerprints as not every investigator can take fingerprints at the crime scene" **(Participant 4).**

"…Investigation by the scientists" **(Participant 5).**

"…Is evidence that are obtained by scientific methods" **(Participant 6).**

"…Don't know" **(Participant 7).**

"…An in-depth, meticulous investigation methods and technique, in order to lawfully discover, collect, prepare, identify and present evidence to court" **(Participant 8).**

"…Investigation that is directed at collecting evidence and facts to assist in the court to make the decision concerning a particular crime or offence" **(Participant 9).**

"…Forensic investigation is the use of a relevant expertise to determine the truth" **(Participant 10).**

"…Not sure of the meaning" **(Participant 11).**

"…Don't know" **(Participant 12)**

"…Is the application of science to criminal and civil laws, mainly on the criminal side during criminal investigation, as governed by the legal standard of admissible evidence and criminal procedure? **(Participant 13).**

"…Forensic investigation is the use of science in criminal or civil investigations" **(Participant 14).**

"…The determination of finding out, analysis of crime related to physical evidence that can link the suspect" **(Participant 15).**

"…It is investigation that is carried out on clues or exhibits that need to be analysed through a scientific method to ascertain certain facts regarding a crime" **(Participant 16).**

From the above it emerged that this concept was understood by most participants.

However, there is still a requirement for further training in this regard.

4.2.15 Theme 15: Crime Scene Reconstruction

It is sometimes required that investigators re-visit the crime scene in order to clear certain aspects which might have been over-looked or missed during the preliminary phase of investigation. Such reconstruction may appear to be fictitious as the real objects, victims, etc. may no longer be at the crime scene. However, a re-visit is significant in the sense that such re-construction often clarifies some uncertainties. The reconstruction of crime scenes is often initiated by either the court or the parties involved in the case. The participants were asked what they understand by Crime Scene Reconstruction, and they responded as follows:

> "…*Process of determining the sequence of events about what occurred during and after crime scene"* **(Participant 1).**
>
> *"…Establishing the activities that took place during the commission of crime"* **(Participant 2).**
>
> *"…Process of determine the sequence of events about what occurred during and after a crime"* **(Participant 3).**
>
> "…*The process of determining the sequence of events. The investigators use all the evidence collected at the scene through writing"* **(Participant 4).** *"…Process of determining the sequence of events"* **(Participant 5)**
>
> *"…Is going back to the scene or using electronic equipment to simulate how crime was committed"* **(Participant 6).**
>
> *"…When investigator revisit the crime scene to rebuild the scene. If the crime scene was destroyed by weather condition, the investigator must go back to the crime scene but in writing using all evidence collected at the crime scene"* **(Participant 7).**
>
> *"…When investigators use the facts to determine sequence of events"* **(Participant 8).**
>
> *"…Investigation in reverse order, trying to show how the original crime scene looked like before we found it in this current state"* **(Participant 9).**
>
> *"…Crime scene reconstruction is when the investigator uses the facts of the crime to determine sequence of events"* **(Participant 10).**
>
> *"…Process to determine Sequence of events"* **(Participant 11).**
>
> *"…When investigator revisit the crime scene to rebuild the scene. If the crime scene was destroyed by weather condition, the investigator must go back to the crime scene but in writing using all evidence collected at the crime scene"*

(Participant 12).

"…It is an analysis of the circumstances and physical evidence of a crime, the development of a theory of how it occurred, and the testing of that theory using forensic science method" **(Participant 13).**

"…Crime scene reconstruction is the process of determining the sequence of events about a criminal activity to determine what could have happened during or after the incident" **(Participant 14).**

"…Reconstruct the event of an alleged incidence that could have created the stains and stain pattern at the crime scene" **(Participant 15).**

"…It is when a scene of crime does not physically exist anymore, and you use evidence such as videos and photos to physically reproduce the scene of crime to ascertain certain facts that is in dispute or is unclear" **(Participant 16).**

4.2.16 Theme 16: The importance of blood

Van der Westhuizen (1996:201) indicates that the scientific study and analysis of serums, and, more specifically of body fluids such as blood, plays a significant role in the investigation of crime. For this reason, the researcher embarked on this research to make a scientific contribution, adding a perspective in an identified area of this study. Research (Van der Westhuizen, 1996:201) shows that the scientific-serological identification and grouping of biological substances such as blood makes a very important contribution towards the identification of criminals and their presence at the scene of crime. Moreover, in virtually all violent crimes, blood is more likely to be found at the crime scene, on the victim, the suspect or the weapon/instruments.

Sign (2004:329) explain that blood refers to a complex mixture of cell, enzymes, proteins, and inorganic substances. Participants were asked this question: What is the importance of blood? They responded as follows:

"…It circulates through the body and delivers essential substances like oxygen and nutrients to body cells" **(Participant 1).**

"…To hydrate the body" **(Participant 2).**

"…Is essential to life" **(Participant 3).**

"…It circulates on the body and delivers oxygen" **(Participant 4).**

"…Blood helps to identify the suspects without doubt" **(Participant 5).**

"…Blood can help us in connecting the perpetrator to the scene, therefore getting an objective conclusion" **(Participant 6).**

"…Blood can help in the reconstruction of past events" **(Participant 6).**

"…Spraying chemical on the surface and using check the reaction" **(Participant 7).**

"…Blood contains DNA which can be compared to a control sample to determine if there is relationship between blood found at another place to a control sample" **(Participant 8).**

"…Blood can give can connect a suspect or a victim with a crime scene" **(Participant 9).**

"…Blood can relate the victim and the suspect" **(Participant 10).**

"…Blood can help in the reconstruction of past events" **(Participant 11)**

"…Blood brings oxygen and nutrient to all the parts of the body so they can keep working. Blood is one of the most important biological traces that are often found on the crime scene. Blood can be important in identifying the weapon used to inflict the injury and help determine if the victim was moving or motionless when injured" **(Participant 12).**

"…The importance of blood is that it can be able to identify an individual due to its biological traces and it can be tested to determine if it is from the victim or from the perpetrator" **(Participant 13).**

"…Is essential of life" **(Participant 14).**

"…Blood is the most usual type of evidence that can be found on the victim, suspect, weapon and also at the crime scene**" (participant 15),**

"…Blood can link a perpetrator directly to a crime or can proof that a victim was under the influence of substances that allowed them to react out of their normal behaviour" **(Participant 16).**

4.2.17 Theme 17: Analyzing blood stains at the murder scene

According to Van der Westhuizen (1996:202), the appearance of drops of blood, blood splashes, blood smears and pools of blood at the scene of crime can provide valuable evidence. For this reason, the researcher is of the opinion that there is a requirement by investigators to have the skills to interpret perceived blood stains at crime scenes. As indicated earlier in this study, the appearance of blood stains may be determined by various factors, such as heat and other natural substances. When asked the question: How do you analyse blood stains at murder scene? The participants answered as follows:

"…*Using presumptive tests called luminol, Tracing the blood spatter from the pool of blood around the body"* **(Participant 1).**

"…Blood is collected by using methods applicable at the crime scene"

(Participant 2).

"…By using the chemicals that determine if it is blood like Luminol" **(Participant 3).**

"…Using the tests called Luminon" **(Participant 4)**

"…You need to photograph the crime scene and analyse the amount of blood at specific place. Blood can also be taken from the victim to relate with the one taken from the suspect" **(Participant 5).**

"…By spraying a chemical on the surface and using UV lights to check the reaction" **(Participant 6).**

"…Not sure as we normally call the expert to analyse blood" **(Participant 7).**

"…Finding the shape of the blood, determine time of events, and identifying if is dry or wet" **(Participant 8).**

"…At the scene you can determine the path/rote a particular person took from the point of impact to where he/she was found. Sometimes it could be a suspect that was injured but not found at the crime scene, it could indicate the direction he took from the crime scene" **(Participant 9).**

"…Blood is analysed by checking the shape of the blood, the appearance whether is dry or wet to determine time of the event and checking the blood of the victim on the suspects" **(Participant 10).**

"…Photograph the crime scene as it will show the point of origin" **(Participant 11).**

"…Not sure as we normally call the expert to analyse blood" **(Participant 12).**

"…Analysts or investigators will typically soak up pooled blood or swap small samples of dried blood in order to determine if it is human blood and then develop a DNA profile. These become critical when there are multiple victims" **(Participant 13).**

"…Blood stain is analyzed at the crime scene by using luminol test" **(Participant 14).**

"…Using the blue star and the other presumptive test such as Luminon" **(Participant 15).**

"…Firstly, you need to photograph them then you need to analyse the trajectory of the blood and the amount of blood at a specific place. The pattern of the blood can show you what force was applied and where the blood originated from i.e., if it is a main artery the blood will pool more" **(Participant 16).**

From the discussion, it is evident that the analysis of blood patterns at crime scenes may offer great possibilities in the investigation of crime.

4.3 SUMMARY

This chapter has analysed and interpreted the research findings. Structured interviews were conducted. The population that was selected was from an identified area in Gauteng Province, South Africa. Purposive sampling was used in this study. Moreover, the chapter has interpreted the research findings from the in-depth interviews conducted with participants in Tembisa Cluster, Gauteng. A summary of the literature perused in chapter one to three was presented. The research findings were classified into the themes as categorised in chapter four. The interview results were condensed, and the research findings and literature revealed the significance of bloodstain pattern analysis in the investigation of a murder scene.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter five presents the conclusion and makes recommendations concerning the critical research findings, highlighting the challenges of crime investigation in a South African context. This chapter rounds off what was started in chapter one. The problem, which was posed in the introduction has been answered, both by the literature as well as from the views of participants. The objective of this research was to explore the significance of bloodstain pattern analysis in reconstructing a murder scene within the Tembisa cluster (See chapter 1, paragraph 1.3). The research question was: What is the significance of bloodstain pattern analysis in the reconstruction of a murder scene? Based on what was found, recommendations are made as well as suggestions for further research in this area as crime is not static.

This chapter commences with a synopsis of chapters one to four, after which the interpretations from chapter four are considered and inferences are presented. Consequently, recommendations are formulated, based on the key findings from the themes and sub-themes explored in chapter four, to contribute to the body of knowledge about bloodstain pattern analysis in the investigation of crime.

Recommendations made in this chapter could contribute to the empowerment and capacitation of investigators in South Africa. This study is significant because it explores gaps in the investigation of crime in general to limit the number of cases which are thrown out of court owing to a lack of, or insufficient, evidence. Consequently, the reduction of crime is based on the investigation capabilities of investigators as they have the responsibility of ensuring that evidence is presented in court without its being contaminated or compromised in anyway. This chapter concludes the research, focusing on the findings from collected data based on the research questions as well as the research aim given in chapter one, and making recommendations.

As highlighted earlier in this study, the researcher adopted a qualitative approach to achieve the above-mentioned objectives and, to answer the research questions. Owing to the Covid-19 pandemic, the researcher used alternative data collection methods in line with the Unisa position on research ethics where it was not possible to meet participants face-to-face (See Annexure). However, there were instances where face-to-face interviews with participants were possible. These interviews were conducted following Covid-19 protocols. In these instances, all Covid-19 regulations, such as social distancing, the wearing of masks and

sanitizing, were observed. Themes were developed from the collected data as outlined in the previous chapter.

In the previous chapter, collected data were coded and themes developed based on collected data, and then analysed and findings made.

5.2 SUMMARY OF FINDINGS

In this study, emphasis was on blood spatter analysis. The result of the study found that blood spatter analysis is done by an expert, but it is the responsibility of the investigator firstly to identify the blood spatter and then to preserve it. The expert documents the scene and then analyses the scene in his/her office by analyzing the documented information. Moreover, the responsibility of the investigating officer when it comes to blood spatter evidence on a scene is to recognise, protect and record the scene.

In chapter one, the general orientation of the study as well as the methodological direction and parameters were presented. This chapter also clarified the crucial theoretical terminology used in this study. The methodological parameters were delineated, and this included an outline of the study's explorative nature, the research approach and design, data collection and analysis methods, ethical considerations, and the procedures followed to guarantee trustworthiness. The aim of this study was achieved which was:

- To explore the significance of bloodstain pattern analysis in reconstructing a murder scene at Tembisa cluster.

The following research question was resolved in this study:

- What is the significance of bloodstain pattern analysis in the reconstruction of a murder scene?

The researcher explored the views of participants in identified areas in the Tembisa Cluster, Gauteng province. In-depth interviews were conducted with these participants.

Chapter two presented a comprehensive overview of the investigation of crime in general in South Africa. The chapter then highlighted the seriousness of crime in South Africa, supported by a literature review on the concept being explored in this study. A presentation of crime scene was also highlighted as this is the focus for investigators to retrieve evidence which ultimately leads either to the acquittal or conviction of perpetrators of crime.

Chapter three commenced with a presentation of the significance of bloodstain pattern analysis in a murder scene and presented related matters. Various aspects regarding bloodstain patterns were discussed in the context of crime in South Africa. This is the focus of this research as blood plays a significant role in linking alleged perpetrators to crime

scenes. The chapter concluded by presenting various strategies to be implemented to ensure that the continuity of possession of evidence was maintained until the evidence is presented in court.

Chapter four provided the participants' experiences and opinions and permitted the reader to gain rich insight into the collected data originating from the in-depth interviews. Tendencies and patterns were categorised through themes and sub-themes that developed from the detailed interviews. Direct *verbatim* quotations were used to give the participants' responses to the themes and sub-themes. Chapter four also dealt with the interpretation of the results. The basis of this chapter was the themes and sub-themes that originated during the in-depth interviews. Each theme was presented and reinforced with the literature from chapters one to three to explore the significance of bloodstain pattern analysis in reconstructing a murder scene at Tembisa cluster.

Chapter five presents the conclusion and makes recommendations. This chapter also make suggestions for further research. Moreover, the chapter presents recommendations concerning the critical research findings highlighting the challenges of crime investigation in a South African context. The researcher highlighted how criminal investigation has played an important role in fighting crime from as early as the 13th century. The researcher was able to indicate the objective of criminal investigation. The objective of criminal investigation is to trace the truth in relation to an alleged crime in an orderly manner and it is further applied to re-enact the past events. The researcher further highlighted how criminal investigation as discipline has changed in recent times.

The researcher further demonstrated that the information acquired from the literature points to the fact that investigators require an understanding of law, investigative techniques and investigative strategies to understand how to execute their knowledge and skills to address types of problem which they may encounter. In the end, the research has unveiled that the handling of crime scene is one of the most vital stages of investigation and it requires an experienced investigator with the logical and critical power of reasoning in order to yield positive outcomes from investigation of the scene for evidence. The researcher also established that the application of scientific methods and the gathering of evidence ensure that the cases yield better conviction rates. The researcher also established that it is prudent to ensure that, when gathering evidence, investigators must ensure that the sequence of evidence is preserved, and the containment of evidence guaranteed.

From this finding, it is evident that blood plays a key role in the investigation of crime scene and, therefore, care must be exercised when collecting evidence at the crime scene. The

role of the crime reconstruction investigator was explicitly outlined. The process of the reconstruction of a crime scene involves a scientific method, reasoning, sources of information about people, criminology, victimology and experience or skill to explain the events that relate to the commission of the crime (Saferstein (2013:151). Based on the findings above, recommendations are presented in the following section.

5.3 RECOMMENDATIONS

The rising crime levels in South Africa are a cause for great concern and any solution to this requires capable and well-resourced investigators. Bloodstain pattern analysis is one of the main skills investigators require to ensure the convictions of perpetrators of crime. As has been highlighted throughout the study, 'every contact leaves a trace' according to the Locard Principle. So, bloodstains found at crime scenes may eventually link suspects to the actual crime. The challenge is that South Africa does not have sufficient experienced and capable investigators to investigate crime adequately, leading to most cases being withdrawn in courts owing to a lack of, or insufficient, evidence. The researcher proposes a systematic pro-active plan to capacitate investigators in South Africa. This can become real only if there is the political will from the management of the police as well as the government which can ensure that there are adequate resources and a budget to address this serious threat to society (crime threat). The recommendations below were developed both from the responses of participants during the in-depth interviews and the national and international literature reviewed in the study. In addition, international best practices regarding investigation form a basis for these recommendations. Sharing best practices and crime information, and collaboration among law enforcement officers and the various affected role-players are essential to address crime challenges.

While these recommendations are developed specifically for the Tembisa Cluster, they could also be implemented in other clusters in South Africa, contributing to the reduction of crime which keeps on growing exponentially as seen when every quarter crime statistics are released. These recommendations could obviously be adapted in accordance with the needs and requirements of various clusters. Moreover, such recommendations should be evaluated before being implemented and adjusted as and when the need arises. To this end, the following recommendations are made:

5.3.1 Specialized training for all investigators

Bloodstain pattern analysis is a specialised skill and, therefore, crime scenes should be handled only by highly trained investigators and not general detectives. It is recommended that informer networks be re-established, and resources increased to assist investigators to

be pro-active in their approach to crime in general. Such an approach should be intelligence driven. Informer networks were used to yield better results in the past when it related to dealing with precious metals, and there is no doubt that such will assist in reducing violent crime in South Africa. However, such an approach must be managed properly to avoid other undesirable outcomes. Criminal networks have become more sophisticated and may be countered only when investigators are capacitated.

5.3.2 Resources

Addressing crime in South Africa requires that budget and other resources for the police should be increased annually to reduce crime exponentially. There are not enough police officers to police every corner in society, but more can be done to empower the existing police personnel in terms of capacity.

5.3.3 Political will

The researchers' view is that there is no political will to address crime in South Africa, and this results in the continuous cut of the budget which would ensure that there are enough trained officers to deal with crime. Management should reconsider allocating a special budget for the training of investigators.

5.3.4 Cold-Case unit establishment

It is recommended that a 'cold-case specialised police unit' with the sole mandate to investigate special crime challenges could produce better outcomes for combating this crime rather than a generalised approach. Such a unit could enhance responsiveness and effectiveness in dealing with serious crime in South Africa.

5.4 THE SUGGESTIONS FOR FURTHER RESEARCH

At the end of this study, recommendations would be made based on the findings that could be used as points of references for future studies, benchmarking and developing good practices by the practitioners in the field of forensic investigations when analysing bloodstain patterns in the reconstruction of a murder scene. The researcher was of the view that the questions in this study required further consideration in order to find answers to the pressing crime issues in the country. It was also a requirement to find out whether the suspect or the victim can be regarded as crime scenes. Responses by participants indicated that there were divergent views even among investigators about this aspect. Therefore, further research in the area is recommended. While both the victim and the suspect form part of the crime, it is not clear whether they could be regarded as being the actual crime scene.

5.5 CONCLUSION

The research findings indicate various shortcomings limiting the effectiveness of crime investigation in South Africa. Crime scene management is key to the investigation of crime

as evidence found at the crime scene can either link the suspect to the crime or lead to acquittal in court. It is, therefore, important that every crime scene is processed by well-trained officers to preserve evidence and ensure the successful prosecution of perpetrators of crime. Blood stain analysis plays a vital role in ensuring the successful investigation of crime; therefore, resources should be made available for specialised training to empower investigators. This research study was able to explain the problem statement, answer the research questions and achieve the research objectives.

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ANNEXURE A: INTERVIEW SCHEDULE

TOPIC:

THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN RECONSTRUCTING A MURDER SCENE

RESEARCH AIM

The aim of this research is to explore the significance of bloodstain pattern analysis in reconstructing a murder scene at Tembisa Cluster.

RESEARCH QUESTION

- What is the significance of bloodstain pattern analysis in the reconstruction of a murder scene?

PART "A"

Question 1: Gender

Gender	
Male	
Female	

Question 2: Age

Age		**Age**	

20-24 years		26-29	
30-34		35-39	
40-44		45-49	
50-55		55-59	
60+			

Question 3: Highest educational qualification

Highest educational qualification	x
Standard 8/Grade 10	
Standard 9/Grade 11	
Standard 10/Grade 12	
Certificate Level NQF 3-4	
Certificate Level NQF 5	
1-year Diploma	
BA degree	
BTech	
Masters	

Question 4

In your own words explain your understanding of the concept of crime investigation.

……

……

Question 5

What courses did you attend to improve your skills in your field/occupation?

Crime scene reconstruction	
Automated fingerprint identification system	
Evidence collection and processing	

Question 6

How many years have you been working as a field worker/crime scene investigator?

Years of work experience in crime scene investigation Less than 1 year		
1	1 year	
2	2 years	
3	3 years	
4	4 years	
5	5 years	
6	6-9 years	
7	10 Years	
8	11-15 years	
9	More than 15 years	

Question 7

What is your current work position (within the domain of crime scene investigation?

Rank structure	
Colonel	
Lt Colonel	
Warrant officer	
Sergeant	
Constable	

Question 8

What investigative procedures and processes do you follow during an investigation?

.....
.....

Question 9

How many years of experience do you have in criminal investigation?

.....
.....

PART "B"

1. Based on your experience, what do you understand about the term "criminal investigation?

……
……

2. According to your understanding, what are the objectives of criminal investigation?

……
……

3. What is the meaning of the term "evidence?

……
……

4. What is the meaning of crime scene?

……
……

5. What investigative aspects do you regard as important when collecting bloodstain pattern as a murder scene?

……
……

6. What are the responsibilities of a crime investigation?

……
……

7. What do you understand by contamination of evidence?

……
……

8. What is a chain of evidence?

……
……

9. What do you think is the significance of maintaining chain of evidence?

……
……

PART "C"

1. What is a crime scene?

……
……

2. Do you consider the body of a murdered victim as crime scene?

……
……

3. Do you consider the body of a suspect as crime scene?

……
……

4. What is physical evidence?

……
……

5. What do you consider as forensic investigation?

……
……

6. What do you understand by Crime Scene Reconstruction?

……
……

7. What is the importance of blood at the crime scene?

……
……

8. How do you analyse bloodstains at a murder scene?

……
……

9. What is the significance of bloodstain pattern analysis in reconstructing of murder scene?

……
……

10. How can bloodstains at the murder scene assist in resolving crime?

……
……

ANNEXURE B: PERMISSION TO CONDUCT RESEARCH

PERMISSION TO CONDUCT RESEARCH IN THE SAPS

APPLICATION TO CONDUCT RESEARCH IN SAPS: THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN RECONSTRUCTING A MURDER SCENE: UNIVERSITY OF SOUTH AFRICA: MASTERS DEGREE: RESEARCHER: MA MUKHOMBO

RESEARCHER: MA MUKHOMBO

Permission is hereby granted to the researcher above to conduct research in the SAPS based on the conditions of National Instruction 1 of 2006 (as handed to the researcher) and within the limitations as set out below and in the approved research proposal.

This permission must be accompanied with the signed Indemnity, Undertaking & Declaration and presented to the commander present when the researcher is conducting research.

This permission is valid for a period of Twelve (12) months after signing.

Any enquiries with regard to this permission must be directed to Col. Peters or Capt VJ Nevumbani at PetersNS@saps.gov.za/nevumbanivj@saps.gov.za

RESEARCH LIMITATIONS / BOUNDARIES:

Research Instruments: Interviews

Target audience/subjects: SAPS members in Ekurhuleni Cluster for the following stations and Unit

Geographical target:

Provincial Component	*Stations or Clusters*
Criminal Record & Crime Scene Management in Kempton Park	Rabie Ridge SAPS Ivory Park SAPS

Access to official document: No

LIEUTENANT GENERAL
PROVINCIAL COMMISSIONER: GAUTENG
E MAWELA (SOEG)

DATE: 2019/02/28

ANNEXURE C UNISA COVID-19 POSITION STATEMENT ON RESEARCH ETHICS

Prof T Meyiwa
P. O. Box 392, UNISA, 0003
TELE: +27 (0) 12 429 2851
EMAIL: *meyiwt@unisa.ac.za*

TO: **ALL RESEACHERS**

DATE: 09 April 2020

SUBJECT: **UNIVERSITY OF SOUTH AFRICA COVID-19 POSITION STATEMENT ON RESEARCH ETHICS**

Dear Colleagues

On 15 March 2020 President Cyril Ramaphosa addressed the nation to declare a state of national disaster, following an increase in confirmed cases of COVID-19. The evolving COVID-19 pandemic requires that research is adapted on an ongoing basis to the dynamic situation.

A responsible approach to human participant, community engaged, animal, environmental, molecular and cell research is required in the context of COVID-19. Unisa supports the continuation of research activities, where possible, guided by the following principles and activities supported by the Policy on Research Ethics:

Protection of the participant, the community, and the researcher(s) and research support staff from any risks of harm while conducting research through the implementation of clear pragmatic risk mitigation measures.

Researchers must assess the risk - benefit ratio of a research study, particularly research that requires face-to-face contact, and the collection of data in public spaces or in locations where social distancing cannot be practiced.

The respect for the participant's rights for self-determination should always be carefully considered, for example the right to decline participation or to withdraw or collectively exploring alternative ways of participation.

In the interest of participants and researchers, the consensus is that new face-to-face or studies with an inherent risk to participants and/or researchers should not be embarked upon for the duration of the lockdown period.

Although this sounds like a blanket statement, registered Unisa Health Research Ethics Review Committees would be willing to consider well-motivated applications as exceptions only. The researcher needs to provide an accompanying letter with a detailed rationale for why this research study needs to be enacted during this time.

Unisa Ethics Review Committees (ERCs) will continue to accept and review research ethics applications but will clearly indicate where the ERC does NOT wish this study to commence with immediate effect in accordance with the lockdown regulations.

No research involving face-to-face contact or research studies involving settings where it is difficult to institute social distancing or practice protective measures may continue without formal notification and approval by the ERC that granted the approval in consultation with one of Unisa's registered Health ERCs/RECs.

Where or when it is unavoidable to reduce, suspend or postpone research activities, the onus is on the principal researcher to notify the ERC that approved the research study and to provide a rationale why the research needs to continue.

The ERC must inform the Unisa Research Ethics Review Committee (URERC) of all ongoing studies that may pose a risk of harm relating to the Covid-19 pandemic. National instituted protective measures such as hand hygiene, cough etiquette, and social distancing should be implemented, and monitored at sites where these studies will continue.

Research for degree purposes: The College of Graduate Studies and the Heads: Graduate Studies and Research will negotiate processes to mitigate the possible negative fallout to student progress (both new research and research that is in progress). The COVID-19 outbreak and its ramifications are difficult to measure or predict, but the suggested time frame for this position statement to be enacted is not less than the lockdown period.

Staff, researchers and supervisors are requested to carefully monitor any further internal communications for directives and guidance on this matter. Researchers who are dependent on internal, and more so external, sources of funding and sponsorship should consider the potential risks that COVID-19 and social distancing strategies will have on project milestones and audit reporting deadlines. Where possible, researchers should engage with the funder/sponsor regarding these timeframes.

Approved research that may continue without ERC notification

- Research conducted by Unisa researchers that does not engage participants face-to-face and thus limits or does not pose the risk of COVID-19 infection may continue without ERC notification.

- Research studies that collect data online or consists of the review of records are considered of low risk in current circumstances and may continue.

- Data science research and other forms of research that does not require face-to-face interaction may continue.

- Laboratory-based research where appropriate safety precautions can be taken and legitimate access to the facilities negotiated may continue (except research related to COVID-19).

The researcher/s remain responsible to ensure safety and protective measures, and to continue to minimise risk.

The onus is on the researcher to contact the relevant Ethics Review Committee if uncertain or concerned about how, or if at all, to proceed with approved research studies.

Kind regards

Prof T Meyiwa

Vice Principal: Research, Postgraduate Studies, Innovation and Commercialisation

Acknowledgement:

Stellenbosch University (SU) Faculty of Medicine and Health Sciences (FMHS) Researchers' Position Statement on Research Involving Human Participants (Clinical Research), 6 April 2020

ANNEXURE D: UNISA ETHICAL CLEARANCE

UNISA 2020 ETHICS REVIEW COMMITTEE

Date: 2020:12:08

ERC Reference No. st146-2020
Name: MA Mukhombo

Dear Maropene Arbinah Mukhombo

Decision: Ethics Approval from 2020:12:08 to 2023:12:08

Researcher: Maropene Arbinah Mukhombo

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

Supervisor: Dr DQ Mabunda

The significance of bloodstain pattern analysis in reconstructing a murder case

Qualification: MA in Criminal Justice

Thank you for the application for research ethics clearance by the Unisa 2020 Ethics Review Committee for the above-mentioned research. Ethics approval is granted for 3 years.
*The **Low risk application** was **reviewed** by the CLAW Ethics Review Committee on 8 December 2020 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached. Provisional authorisation is granted.

2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

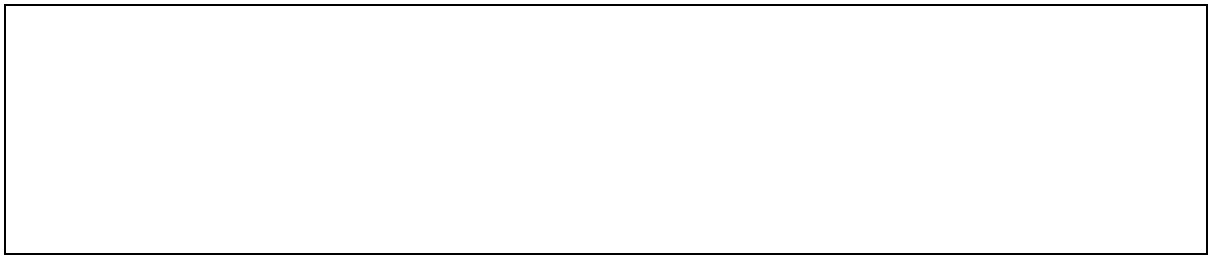
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, No 4 of 2013; Children's act No 38 of 2005 and the National Health Act, No 61 of 2003.
7. Only the identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2023:12:08**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
The reference number ST 146-2020 should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.

Yours sincerely,

Prof T Budhram
Chair of CLAW ERC
E-mail: **budhrt@unisa.ac.za**

Prof M Basdeo
Executive Dean: CLAW
Email: Basdeo@.unisa.ac.za



ANNEXURE E: EDITOR LETTER

The Reverend David Swanepoel
BA (Rhodes), Hons BA, Hons BTh, HED (SA)
Unit 2
Haven Village Retirement Centre, 269 Emmie Hartmann Street, Garsfontein, Pretoria, 0081
South Africa
Telephone +27 (0)72- 2077727
Email: davidswanepoel@wol.co.za

22 June 2021

TO WHOM IT MAY CONCERN

This is to certify that I have completed the English Editing of the text, insofar as the text has allowed, of a dissertation to be submitted in fulfilment of the requirements for the degree of

MAGISTER TECHNOLOGIAE: FORENSIC INVESTIGATIONS

in the subject CRIMINAL JUSTICE

at the UNIVERSITY OF SOUTH AFRICA

The dissertation is entitled

THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN RECONSTRUCTING A MURDER SCENE

By MAROPENE ARBINAH MUKHOMBO

I am qualified to have done such editing, being in possession of a Bachelor's degree in English from Rhodes University, Grahamstown, an Honours Degree in English and HED with English as prime teaching subject from the University of South Africa, and having taught English to Matriculation, First Year University Level, GCSE and A level in both South Africa and the United Kingdom of Great Britain for over 40 years, as well as having been Senior (English) Associate Editor of a national magazine for two years. I have edited Master's Dissertations and Doctoral Theses for several years for several universities and institutions in South Africa and abroad as well as editing documents/papers for publication for various publishing concerns and a number of international academics.

I trust that this declaration is satisfactory.

DAVID JOHN SWANEPOEL

ANNEXURE F: TURN-IT-IN REPORT

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Ma Mukhombo
Assignment title:	Revision 1
Submission title:	THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN R...
File name:	MUKHOMBO_DISSERTATION_FINAL_2021_10_30.pdf
File size:	2.5M
Page count:	112
Word count:	34,221
Character count:	191,174
Submission date:	05-Nov-2021 08:51AM (UTC+0200)
Submission ID:	1693705601

THE SIGNIFICANCE OF BLOODSTAIN PATTERN ANALYSIS IN RECONSTRUCTING A MURDER SCENE

by

MAROPENE ARSINAH MUKHOMBO

Submitted in accordance with the requirements

for the degree of

MAGISTER TECHNOLOGIAE: FORENSIC INVESTIGATIONS

in the subject

CRIMINAL JUSTICE

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: DR DD MABUNDA

NOVEMBER 2021