

**AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM
IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE
WEST RAND DISTRICT MUNICIPALITY**

by

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ABSTRACT

Cash-in-transit (CIT) armed robberies are among the most violent forms of organised crime in South Africa and are frequently characterised by the use of high-powered firearms and explosives. The prevalence of these robberies, particularly in Gauteng Province, raises concerns about the effectiveness of the investigative and prosecutorial strategies employed to combat this crime. Forensic firearm identification evidence can link firearms to crime scenes and connect multiple incidents involving the same weapon, thereby enhancing criminal investigations and prosecutions. However, the extent of the investigative value of such evidence in CIT armed robbery cases required further exploration.

The aim of this study was to examine the role of forensic firearm identification evidence in the investigation and prosecution of CIT armed robberies within the West Rand District Municipality. The study sought to establish the evidential value of forensic firearm identification evidence, identify the challenges associated with its use, and propose ways to enhance its contribution to criminal justice processes.

A case study design was used within a qualitative research approach, guided by a constructivist worldview. Semi-structured interviews were conducted with Directorate for Priority Crime Investigation (DPCI) investigating officers, former forensic ballistics experts from the South African Police Service Forensic Science Laboratory, and prosecutors from the National Prosecuting Authority. The data were analysed inductively using thematic analysis.

The findings revealed that forensic firearm identification evidence plays a significant role in connecting firearms to crime scenes, linking multiple crime scenes through a common firearm, reconstructing criminal events, and strengthening prosecutions in CIT armed robbery cases. The analysis of forensic firearm identification in ballistics is done within the framework of the AFTE Theory of Identification as developed by the Association of Firearm and Toolmark Examiners (AFTE). Participants emphasised that forensic firearm identification evidence does not directly link a suspect to a firearm but rather associates the firearm with a crime scene. Therefore, such evidence must be corroborated by other forms of evidence, including DNA, fingerprints, witness

testimony, and intelligence information. The study highlighted several challenges, including delays in forensic processing, resource shortages, inadequate case management, breakdowns in the chain of custody, insufficient consultation among investigators, prosecutors and ballistics experts, and limited awareness of the evidential value of forensic firearm identification.

The study concludes that forensic firearm identification evidence is an indispensable tool for investigation and prosecution in CIT armed robbery cases. Yet, its effectiveness is constrained by organisational, operational and resource-related challenges. The researcher developed a conceptual framework that outlines the recommendations, namely: enhanced awareness of forensic firearm identification, increased capacity within forensic laboratories, improved inter-agency collaboration, prioritisation of ballistics cases, comprehensive evidence-collection procedures, and exploration of advanced ballistic technologies to improve criminal justice outcomes in firearm-related crime investigations.

Key concepts: AFTE Theory; Ballistics Evidence; Cash-in-Transit Armed Robbery; Criminal Investigation; Criminal Prosecution; Forensic Firearm Identification; Investigative Value.

OKUCASHUNIWE

Ukudunwa kwezimoto zemali i-Cash-in-transit (CIT) zibanjwa izinswelaboya ziphangile, ingezinye yezinhlobo zokubamba inkunzi kuhlonyiwe enodlame nobugebengu obuhleliwe eNingizimu Afrika futhi kusetshenziswa izibhamu ezinamandla kanye neziqhumane. Ukudlanga kwalobu bugebengu, ikakhulukazi kwisifundazwe sase-Gauteng, kukhuphula ukungenami ngamaqhinga okuphenywa kanye nokushushiswa okubekiwe ukulwisana nalobu bugebengu. Ubufakazi bokuhlonzwa kwezibhamu kungayamanisa izibhamu ezindaweni zesigameko futhi buxhumanise nezinye izigameko eziningi ezibandakanya isikhali esifanayo, ngalokho kuthuthukisa ukuphenywa kobugebengu kanye nokushushiswa. Kepha, ukujula kophenyo okufana nobufakazi bamacala okudunwa kwezimoto zemali kuhlonyiwe i-CIT kudinga ucwaningo olwengeziwe.

Inhloso yalolucwaningo ukuhlola indima ubufakazi bokuhlonzwa kwezibhamu ekuphenyweni kanye nokushushiswa kwamacala e-CIT ngaphansi kukaMasipala wesifunda sase-West Rand. Ucwaningo lwaluhlose ukusungula ukubaluleka kwezehlakalo zobufakazi bokuhlonza izibhamu ngokomthetho, ukuhlonza izingqinamba ezihambisana nokusetshenziswa kwazo, nokuphakamisa izindlela zokwandisa umnikelo wazo ezinhlelweni zobulungiswa kubugebengu.

Kusetshenziswe uhlelo locwaningo lwamacala ngaphakathi kwendlela yocwaningo lwekhwalithi, luqondiswa ngumbono kazwelonke. Kwahlelwa izingxoxo ezingahleliwe kodwa ezicacile nabaphenyi be-Directorate for Priority Crime Investigation (DPCI), zochwepheshe bezindawo zamaphoyisa zokuhlola izibhamu i-South African Police Service Forensic Science Laboratory, kanye nabashushisi abavela ophikweni lwabashushisi i-National Prosecuting Authority. Idatha yahlaziywa ngendlela yokufunda ngemibono (thematic analysis).

Okutholakele kukhombisile ukuthi ubufakazi bokuhlonza izibhamu bokweseka ubugebengu budlala indima ebalulekile ekuxhumaniseni izibhamu nezindawo zobugebengu, ukuhlanganisa izindawo eziningi zobugebengu ngokusebenzisa isibhamu esisodwa, ukwakha kabusha izigameko zobugebengu, nokwandisa amandla okufaka icala ezinkantolo ezimayelana nokwebiwa kwemali ngezibhamu. Ukuhlaziywa kokuhlonza izibhamu ngokwesayensi yezibhamu kwenziwa ngaphakathi komongo

we-AFTE Theory of Identification njengoba yathuthukiswa yi-Association of Firearm and Toolmark Examiners (AFTE). Abahlanganyeli bagcizelele ukuthi ubufakazi bokuhlonza izibhamu bokweseka ubugebengu abuhlangani ngqo nomsolwa nesibhamu, kodwa buhlanganisa isibhamu nendawo yobugebengu. Ngakho-ke, ubufakazi obunjalo kumele buqinisekiswa ezinye izinhlobo zobufakazi, kuhlanganise i-DNA, izithupha, ubufakazi bofakazi, nolwazi lwezobuhlakani. Ucwangingo lukhombise izinselelo eziningana, okubalwa ukubambezuleka ekucutshungulweni kwe-forensic, ukushoda kwezinsiza, ukuphathwa kwamacala okunganele, ukuphuka kwe-chain of custody, ukungaxhumani okwanele phakathi kwabaseshi, abashushisi, kanye nochwepheshe be-ballistics, nokungabi nolwazi olwanele ngenani lobufakazi lokuhlonzwa kwezikhali ze-forensic.

Ucwangingo luphetha ngokuthi ubufakazi bokuhlonza izibhamu buyithuluzi lokusesha elibalulekile kwezophenyo nokushushiswa kwamacala e-CIT. Nokho, ukusebenza kwakho kukhawulelwe izinselelo zenhlangano, zokusebenza nezingqinamba eziphathelene nezingqinamba zokutholakala kwezinsiza. Umcwangingi wakha uhlaka lwemibono oluveza izincomo, ezihlanganisa: ukuqwashisa okwengeziwe ngokuhlonza izibhamu, ukuthuthukisa ukubambisana phakathi kwezinhlobo, ukunikeza ukubaluleka kwamacala e-ballistics, izinqubo eziphelele zokuqoqa ubufakazi, nokuhlola ubuchwepheshe obuphambili be-ballistic ukuze kuthuthukiswe imiphumela yomthetho ezicwangingweni zamacala okugebenga ngezibhamu.

Amagama Asemqoka: Ithiyori ye-AFTE; Ubufakazi bokuhlonzwa kwezibhamu; Ukudunwa kwemoto yemali kuhlonyiwe; Ukuphenywa kobugebengu; Ukushushiswa kobugebengu; Ukucutshungulwa kwezibhamu; Uphenyo.

KAKARETŠO YA ATHEKHELE

Go Thubja ga Difatanaga tša Tšhelete (CIT) go gare ga mekgwa ye me šoro kudu ya bosenyi bjo bo rulagantšwego ka Afrika Borwa, gape gantši go hlaolwa ka tšhomišo ya dithunya tša maatla a magolo le dithuthupi. Go ata ga ditiro tše, kudukudu ka Profenseng ya Gauteng, go rotoša matshwenyego ka ga go šoma gabotse ga maano a go nyakišiša le botšhotšhisi ao a šomišitšwego go lwantšha bosenyi bjo. Bohlatse bja go hlaola dithunya bja forensiki bo ka kgokaganya dithunya le mafelo a bosenyi le go kgokaganya ditiragalo tše ntši tšeo di akaretšago sebetša se tee, ka go realo bo godiša dinyakišišo tša bosenyi le ditshekišo. Le ge go le bjalo, bogolo bja boleng bja nyakišišo bja bohlatse bjo bjalo melatong ya go bosenyi ka dibetša bja CIT bo be bo nyaka go nyakišišwa gape.

Maikemišetšo a nyakišišo ye e be e le go hlahloba tema yeo e kgathwago ke bohlatse bja go hlaola dithunya bja forensiki ka dinyakišišo le go sekišwa ga go bosenyi bja CIT ka gare ga Mmasepala wa Selete sa West Rand. Nyakišišo e be e nyaka go hloma boleng bja bohlatse bja go hlaola dithunya bja forensiki, go šupa ditlhohlo tšeo di amanago le tšhomišo ya bjona, le go šišinya ditsela tša go godiša seabe sa bjona go ditshepedišo tša toka ya bosenyi.

Kakanyetšo ya nyakišišo ya mohlala o šomišitšwe ka gare ga mokgwa wa nyakišišo ya khwalithethifi, yeo e hlhlwago ke pono ya lefase ya mohlami wa tsebo. Dipoledišano tše di sego tša rulaganywa ka botlalo di dirilwe le Bahlankedi bao ba nyakišišago Bolaodi bja Dinyakišišo tša Bosenyi bja Pele (DPCI), ditsebi tša peleng tša dithuthupi tša forensiki go tšwa go Laporatori ya Saense ya Forensiki ya Tirelo ya Maphodisa ya Afrika Borwa, le batšhotšhisi go tšwa go Bolaodi bja Bosetšhaba bja Botšhotšhisi. Datha e sekasekilwe ka dintlha go šomišwa tshekaseko ya mokgwa wa nyakišišo wa khwalithethifi.

Dikhwetšo di utollotše gore bohlatse bja go hlaola dithunya ka forensiki bo kgatha tema ye bohlokwa go kgokaganya dithunya le mafelo a bosenyi, go kgokaganya mafelo a mantši a bosenyi ka sethunya se se tlwaelegilego, go aga lefsa ditiragalo tša bosenyi, le go maatlafatša ditshekišo melatong ya bosenyi ka dibetša bja CIT. Tshekaseko ya go hlaola dithunya ka forensiki go dithuthupi e dirwa ka gare ga tlhako ya Teori ya Boitsebišo ya AFTE bjalo ka ge e hlamilwe ke Mokgatlo wa Bahlahlobi ba

Dithunya le Maswao a Didirišwa (AFTE). Batšeakarolo ba gateletše gore bohlatse bja go hlaola sethunya ka forensiki ga bo kgokaganye mogononelwa ka go lebanya le sethunya eupša bo tswalanya sethunya le lefelo la bosenyi. Ka gona, bohlatse bjo bjalo bo swanetše go tiišetšwa ke mehuta ye mengwe ya bohlatse, go akaretša DNA, dikgatišo tša menwana, bohlatse bja dihlatse le tshedimošo ye bohlale. Nyakišišo e tšweleditše ditlhohlo tše mmalwa, go akaretšwa go diega ga tshepedišo ya forensiki, tlhaelelo ya didirišwa, taolo ye e sa lekane go ya melato, go senyega ga tatelano ya go golega, ditherišano tše di sa lekanelago magareng ga banyakišiši, batšhotšhisi le ditsebi tša dithuthupi, le temogo ye e lekanyeditšwego ya mohola wa bohlatse bja go hlaola dithunya bja forensiki.

Nyakišišo e phetha ka gore bohlatse bja go hlaola dithunya bja forensiki ke sedirišwa se bohlokwa go dinyakišišo le go sekiša melatong ya go bosenyi ka dibetša bja CIT. Le ge go le bjalo, go šoma gabotse ga bjona go thibelwa ke ditlhohlo tša mokgatlo, tshepedišo le tšeo di amanago le didirišwa. Monyakišiši o hlamile tlhako yeo e hlalošago ditšhišinyo, e lego: temošo ye e oketšegilego ya go hlaola dithunya ka forensiki, bokgoni bjo bo oketšegilego ka gare ga dilaporatori tša forensiki, tirišano ye e kaonafetšego magareng ga ditheo, go etiša pele melato ya dithuthupi, ditshepedišo tše di tseneletšego tša go kgoboketša bohlatse, le go nyaka theknolotši ya maemo a godimo ya dithuthupi go kaonafatša dipelo tša toka ka dinyakišišo tša bosenyi tšeo di amanago le dithunya.

Mantšu a bohlokwa: Teori ya AFTE; Bohlatse bja Dithuthupi; Bohlakodi bja Difatanaga tša go Sepetša Tšhelete; Dinyakišišo tša Bosenyi; Botšhotšhisi bja Bosenyi; Tlhaolo ya Sethunya ka Forensiki; Boleng bja Dinyakišišo.

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DEDICATION

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LIST OF ABBREVIATIONS

ABSA	Amalgamated Banks of South Africa
AFTE	Association of Firearm and Toolmark Examiners
ATM	Automated Teller Machine
AV	Armoured Vehicle
BBC	British Broadcasting Corporation
BPS	Botswana Police Service
CCTV	Closed-Circuit Television
CIT	Cash-in-Transit
CITASA	Cash-in-Transit Association of South Africa
COSATU	Congress of South African Trade Unions
CSIR	Council for Scientific and Industrial Research
DNA	Deoxyribonucleic acid
DPCI	Directorate for Priority Crime Investigation
EPS	Eswatini Police Service
FEDUSA	Federation of Unions of South Africa
FNB	First National Bank
FRO	First-Responding Officer
FSL	Forensic Science Laboratory
GBH	Grievous Bodily Harm
IBIS	Integrated Ballistics Identification System
ICDMS	Integrated Case Docket Management System
IO	Investigating Officers
JOIC	Joint Operations Intelligence Centre
NPA	National Prosecuting Authority
NPVC	National Priority Violence Crimes

PCEM	Property Control and Exhibit Management
PMG	Parliamentary Monitoring Group
PSIRA	Private Security Industry Regulatory Authority
PUDU	Polyurethane Dispensing Unit
SA	South Africa
SABRIC	South African Banking Risk Information Centre
SANDF	South African National Defence Force
SAPS	South African Police Service
SBV	Standard Bank, Barclays, and Volkskas
SOCIU	Serious Organised Crime Investigation Unit
SPLM	Swaziland People's Liberation Movement

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CHAPTER 1: GENERAL ORIENTATION

1.1 INTRODUCTION AND BACKGROUND TO THE PROBLEM

There is a rapid growth of cash-in-transit (CIT) armed robbery in South Africa (Burger, 2018). The British Broadcasting Corporation (BBC) News (2018) highlighted that this outbreak resulted in millions of rand left in the hands of criminals. Since the beginning of 2020, one CIT armed robbery has been reported every day nationally (Mahamba, 2020). The author further indicated that most of these robberies were reported in the Gauteng Province. CIT armed robberies pose a risk to the economy of the country and the safety of the people (Burger, 2018). According to former South African Police Service (SAPS) spokesman Brigadier Hangwani Mulaudzi, these criminals do not value the lives of other people and are characterised by violent acts, exploding CIT armoured vehicles (AVs), and firing shots to accomplish their mission (BBC News, 2018).

As a result of firearms being used to commit CIT armed robberies, forensic firearm identification plays a significant role in determining whether a particular firearm (either seized from a suspect or found at a crime scene) has discharged the recovered fired cartridge cases and bullets. Forensic firearm identification is based on examining marks imparted on the fired cartridge cases and bullets during the firing process (Dack, 2014:2). Forensic evidence plays a major role in investigating and prosecuting crime (Incognito Forensic Foundation, 2021). Courts will accept forensic identification evidence based on their satisfaction with the chain of custody and the forensic analyst's qualifications and experience in the forensic field (Dack, 2014:6).

Often, firearms and other firearms-related evidence, such as fired cartridge cases and bullets recovered from the CIT armed robbery scenes, are submitted by investigating officers at the Forensic Science Laboratory (FSL) in Silverton, Pretoria, for ballistic analysis. Among other requests, analysis of forensic firearm identification evidence is common. Mutsavi and Meintjies van der Walt (2020) emphasised that the ballistics experts must follow standard operating procedures when examining forensic evidence, such as forensic firearm identification evidence, to ensure that the requirements imposed by the courts are met in terms of admissibility standards and issuing the correct findings. These authors further pointed out that this ensures the

credibility of the ballistics expert and the evidential value of forensic firearm identification.

The theory behind forensic firearm identification is that when a firearm is discharged, it leaves unique marks on the ammunition components, such as bullets and cartridge cases. Forensic firearm identification is based on confirming or eliminating firearms recovered at a specific crime scene through microscopic comparison of test-fired and recovered fired bullets and cartridge cases. Dack (2014:5) pointed out that the ballistics experts use a microscope to compare firearm marks imparted on the test-fired and recovered exhibits, such as fired bullets or cartridge cases.

1.2 PROBLEM STATEMENT

Bwisa (2018) pointed out that the identification of a research problem forms the basis of the study. The author described a research problem as an area of concern that requires investigation. Pardede (2018:7) described the research problem as a concern being addressed in research. A research problem can also be described as an issue that the researcher intends to address (McCombes, 2019a). Forensic firearm identification has been part of the researcher's expertise for more than a decade, and she found it imperative to explore the role of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies in the West Rand District Municipality. The researcher realised that often the investigating officers request ballistics reports, indicating that they are urgently needed in court. It was unclear to what extent forensic firearm identification evidence contributes to the investigation and prosecution of the CIT armed robberies.

The researcher maintains that forensic firearm identification reports must be used in the investigation and prosecution of crime involving firearms. It also raises a concern as to the extent to which the ballistics reports contribute to their investigations in tracing and arresting suspects in CIT armed robbery cases. The role of forensic firearm identification evidence in the investigation and prosecution of CIT armed robbery cases must be determined to ensure that it does not just form part of case docket compilation for court purposes. The forensic firearm identification evidence should also assist in the investigation process to strengthen the case.

1.3 DELIMITATION OF THE STUDY

Delimitation refers to establishing research boundaries of the researcher, showing what the research will include or exclude, and its justification (Root, 2021). Naar-Last (2021) explained delimitation as creating research boundaries by indicating what the research will cover. According to the author, setting these boundaries allows the researcher to narrow the focus and deal with the relevant factors of the research. When the delimitation of the research is well defined, the research topic, methods, target population, and the importance of the study become clear (Root, 2021). The same author emphasised the significance of identifying research boundaries at the initial phase, as they become the overall scope and delimitation of the research. The researcher sets geographical and crime category as the limitations for the study.

1.3.1 Geographical delimitation

This study was conducted in Krugersdorp, in the West Rand District Municipality. This area is in the Gauteng Province. Figure 1.1 depicts the map of Krugersdorp.

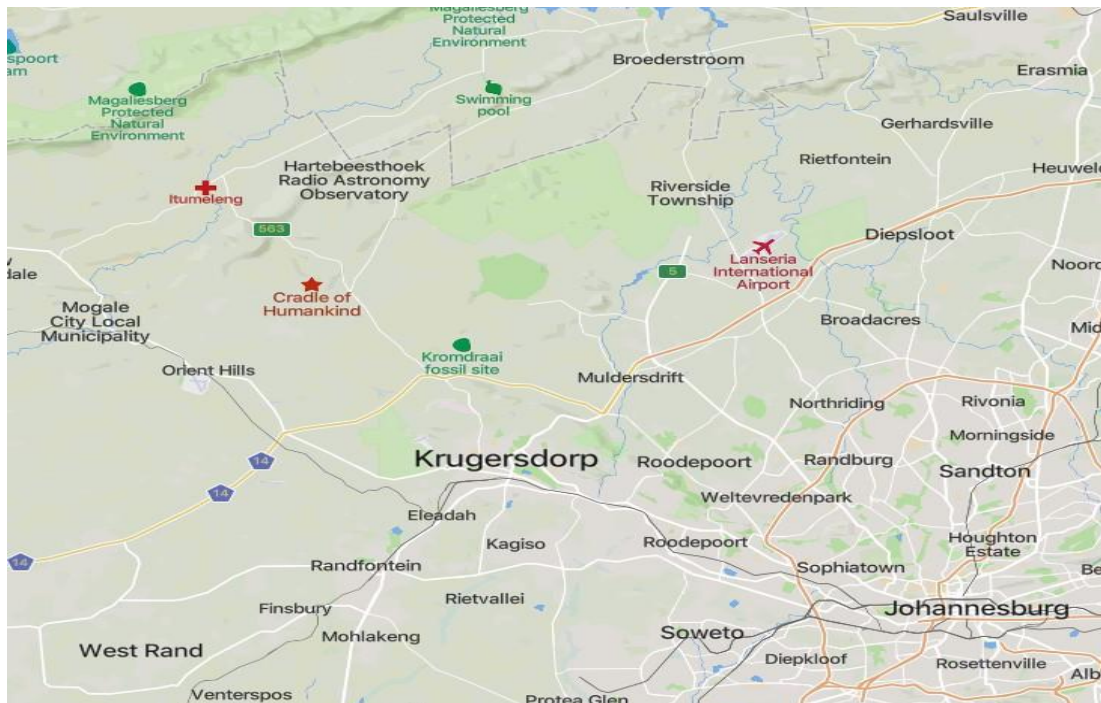


Figure 1. 1: A map of Krugersdorp (Mapcarta, 2024)

1.3.2 Crime category

The primary category of crime which this study will focus on is armed robbery. In this study, this crime type is colloquially referred to as 'cash-in-transit' (CIT) robberies. The definition is provided in para 1.7.2 below.

1.4 RESEARCH AIM

Lempriere (2019) described the research aim as a statement of intent. The research aim refers to the overarching purpose of the research (Pate, 2018). Nieuwenhuis (2016b:73) emphasised that the research aim must align with the significance of the study.

The research aim is:

- To establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality.

1.5 RESEARCH OBJECTIVES

Research objectives refer to the researcher's steps to achieve the research aim (Lempriere, 2019), and they must align with it (Barnabas, 2020). According to Pate (2018), research objectives outline how the researcher plans to accomplish their research aim.

The objectives of this study are:

- To explore what may be considered ballistics evidence found at CIT armed robbery crime scenes.
- To explain what CIT armed robbery is and how it manifests in SA as opposed to other countries in the Global South and North.
- To explain what forensic firearm identification entails.
- To explore and explain the evidential parameters that frame the use of forensic firearm identification.
- To explore the role of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies.
- To determine any challenges associated with forensic firearm identification evidence in investigating and prosecuting CIT armed robberies.

1.6 RESEARCH QUESTION

Research questions address the problem by analysing and interpreting the collected data, and can be answered by the research findings (Bouchrika, 2021). According to Pardede (2018), research questions are derived from the research problem as an attempt to provide answers through research. Nieuwenhuys (2016b:73) indicated that the research questions determine a suitable research design for the study.

The research question is:

- What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

While it is common practice for each mentioned research objective to be reflected as a research question, the researcher chose not to follow this approach. Working from an over-arching research question, which was unpacked in the interview schedules to address the objectives, served the same purpose.

1.7 CONCEPTUAL CLARIFICATION

Conceptual clarification serves as a point of reference for readers because it explains the meaning of concepts used in research (Antony, 2021). According to Ngo-Ndjana (2020), conceptual clarification provides an overview of the subject and allows readers to synthesise knowledge about a research topic. Bringmann, Elmer, and Eronen (2022) pointed out that although conceptual clarity might not be important in conversations, it is important for the systematic application of these concepts. For this study, it is important to understand these concepts, and the concepts that follow were used in this study.

1.7.1 Ballistics

Refers to the forensic analysis of firearms-related evidence to establish facts in criminal incidents that involve shootings (Kelly, 2018).

1.7.2 CIT armed robbery

Burgess (2018) described it as the premeditated robbery of cash from CIT vehicles by firing shots and sometimes using explosives.

1.7.3 Firearm

A firearm can be defined as any device that can discharge ammunition (SA Government Gazette, 2001).

1.7.4 Forensic evidence

Forensic evidence refers to any evidence that requires forensic analysis and interpretation of the findings based on facts (Olaborode & Meintjies Van der Walt, 2020).

1.7.5 Forensic firearm identification

Mutsavi and Van der Walt (2020) define forensic firearm identification as a scientific process of determining whether the firearms recovered from the crime scenes were or were not used in the commission of a crime.

1.8 CHAPTER LAYOUT

The study consists of seven chapters:

Chapter 1: General orientation

The chapter introduces the study. The problem statement, objectives, aim, and questions of the study are outlined. The conceptual clarification and the chapter layout are included.

Chapter 2: An overview of cash-in-transit armed robbery in South Africa

This chapter presents an overview of CIT armed robberies in South Africa. The discussion includes an overview of CIT businesses and companies in the country. The types of physical evidence related to firearms found at the CIT armed robberies crime scenes form part of this chapter. This includes the collection, marking, and packaging of the exhibits. The chain of custody of the firearms and firearms-related evidence is discussed. The researcher explored how other countries investigate CIT armed robberies and their strategies for dealing with and preventing them, considering the modus operandi of the robbers. The role of forensic firearm identification in investigating and prosecuting CIT armed robberies is also discussed.

Chapter 3: The science of forensic firearm identification

This chapter focuses on what forensic firearm identification entails. The Theory of Identification and the process of forensic firearm identification through microscopic comparison, and the Integrated Ballistic Identification System (IBIS) are discussed. The process starts when the forensic firearm examiners receive the exhibits from the case reception of the ballistics administration of FSL and lasts until the ballistics report is issued. The researcher inserted microscopic images that indicate possible microscopic comparison of firearm marks on fired cartridge cases and bullets.

Chapter 4: Research methodology

This chapter provides the research approach, ethical considerations, and methods to ensure trustworthiness.

Chapter 5: Presentation and discussion of the findings

The findings are presented thematically in this chapter.

Chapter 6: Interpretation of the findings

The findings are interpreted considering the literature review.

Chapter 7: Summary, recommendations, and conclusion

The summary, recommendations, and conclusion of the study are presented in this chapter.

1.9 SUMMARY

This chapter presented the general orientation of the study. It covered the problem statement, delimitation of the study, research aim, objectives, and questions. Conceptual clarification, philosophical worldview, and chapter layout were also included. The next chapter focuses on the overview of cash-in-transit armed robberies in the Global North and South.

CHAPTER 2: AN OVERVIEW OF CASH-IN-TRANSIT ARMED ROBBERIES IN THE GLOBAL NORTH AND SOUTH

2.1 INTRODUCTION

Robbery remains a widespread crime associated with criminals who are ready to destroy anything that disturbs their mission. Snyman (2020:448) defined robbery as an illegal and deliberate violent appropriation of someone's property. It is commonly known as theft of violence. It has evolved over the years and resulted in various kinds, including CIT robbery. The concept of CIT robbery is utilised by the SAPS for statistical purposes. It is a robbery with aggravating circumstances. Section 1(1)(b) of the Criminal Procedure Act 51 of 1977 describes aggravating circumstances in the context of robbery, as the use of a dangerous weapon, such as a firearm, by the perpetrator, before, during, or after the crime to cause grievous bodily harm (GBH). It is a CIT robbery when the cash is still within the CIT security company, for example, in the hands of CIT security guards (SAPS, 2023:30). However, once the cash has been signed off to the client and they are robbed, it becomes a business robbery. Similarly, when a person is robbed while transporting money to or from the bank in their personal capacity, this is not a CIT robbery.

This chapter examines the status of CIT robberies in South Africa, the modus operandi of CIT robbers, and the possible profile of such robbers. The prevalent use of firearms during the commission of CIT robberies, the investigation of CIT robberies, and new trends emerging in the commission of these robberies also form part of this chapter. The Cash-In-Transit Association of South Africa (CITASA), as a standard-setting body of the CIT industry, is briefly explained. The chapter then explores the prominent CIT companies responsible for transporting cash within the country. Since this crime does not occur in isolation, the chapter examines the potential factors that may contribute to CIT robberies and discusses the training and working conditions of security officers in the CIT context.

An overview of CIT armed robberies in the Global North and South also form part of this chapter. It focuses on the prevalence of CIT robberies in the Global South, with a focus on Botswana, Eswatini, and Zimbabwe. In the Global North, the prevalence of CIT robberies in Italy and Switzerland is part of the study. The researcher then compares the similarities within the Global South and the Global North, including the

similarities between incidents in the two regions. In the last section of the chapter, the researcher examines the impact of CIT incidents on security officers, the CIT industry, and society.

2.2 CIT ARMED ROBBERIES IN SOUTH AFRICA

The South African Banking Risk Information Centre (SABRIC) reported that CIT armed robberies in South Africa have increased, with a seizure of over R15 million nationwide, between January and April 2017 (Zwane, 2017). The CIT industry reported 268 CIT armed robberies in 2016 and 37 cases in 2017 (PMG, 2018). According to Kalyani Pillay, the SABRIC Chief Executive, the organisation recorded 229 CIT armed robberies in 2017 (Zwane, 2017). The CITASA Head of Operations Grant Clark pointed out that, from January 2021 until April 2021, a total of 87 CIT armed robberies were recorded. Clark indicated that between March 2020 and April 2021, about 306 CIT armed robberies were recorded (Pitt, 2021). An increase in CIT armed robberies in Gauteng is a significant concern (Nkosi, 2023). Clark also indicated that from January 2023 to March 2023, compared to the same period in 2022, there was a 24% increase in CIT armed robberies. A monthly comparison of March 2023 and March 2022 resulted in a 37% increase being recorded (Nkosi, 2023). These figures illustrate that CIT armed robberies in the country are prevalent. The following section focuses on how CIT armed robbers carry out these robberies.

2.3 MODUS OPERANDI OF CIT ARMED ROBBERS

The prime objective of a crime investigation is to identify the offender. According to Lochner, Horne, and van Wyk (2018), modus operandi is one of the methods that can be utilised to identify the offender. The same authors indicated that it comprises three stages. These phases encompass the planning and execution of CIT robberies and the robbers' actions after the robbery. The planning phase of the CIT armed robbery includes surveying the targeted area, where the CIT armed robbery will be carried out. During this phase, surveillance involves checking the placement of cameras, identifying potential panic button locations, determining the most suitable routes, assessing whether traffic lights need to be manipulated, calculating the distance from the crime scene to the safe area, and determining how information will be obtained

Marlene Welman, the Joint Operations Intelligence Centre (JOIC) manager, divided the modus operandi of a CIT armed robbery into two categories, vehicle-on-road and

cross-pavement (Security Focus Africa, 2021). In the first category, the CIT armed robbers shoot at the CIT AV and its tyres to make it stop, and sometimes they ram it with another car, and bomb it open. According to Tau (2018 CIT armed robbers bring the CIT AV to a halt through a head-on collision or by shooting the tyres. Hlangu (2025) indicated that the CIT robbers use luxurious vehicles to ram the CIT AVs, which are later set alight to eliminate evidence. They deliberately ram the CIT AVs to bring them to a halt. Cross-pavement occurs between exiting the mall and loading cash into the CIT AV, with the number of perpetrators ranging from two to seven people (Security Focus Africa, 2021).

The execution of CIT armed robbery leaves *modus operandi* information on the crime scene. As CIT armed robberies are thoroughly planned and executed quickly, it is evident that the CIT armed robbers' experience, expertise, and reliability play a role (Lochner et al., 2018). A CIT armed robbery that indicated that it was extensively planned occurred on 26 September 2021 in Silverton, east of Pretoria (Geldenhuys, 2022:11). The Fidelity AV was attacked by CIT armed robbers. How the CIT robbers carried out the CIT armed robbery was evident that it was well-planned, and the BMW ramming vehicle was intentionally set alight to destroy evidence that could later connect them to that crime scene. Even the way the gunmen were positioned made it clear that they knew what they wanted. The burning of the BMW destroyed potential evidence that could identify the robbers (Geldenhuys, 2022:11). In response to this robbery, the CEO of Fidelity Cash Solutions, Wahl Bartmann, said that the robbers had information that the CIT AV was loaded with money, including its possible routes. The robbers had backup teams following the Fidelity CIT AV and targeted it on its route to the depot (Geldenhuys, 2022:11).

Burger (2018:6) emphasised the use of inside jobs by CIT robbers, suggesting that CIT employees are bribed and intimidated into providing information to the criminals. Using inside jobs remains a primary *modus operandi* of CIT robbers (Bolhuis, 2025). CIT security guards and other law enforcement officers often provide information to criminals. Promises of luxurious houses and cars are used in exchange for inside information from the CIT personnel by the CIT armed robbers (Sambo, 2023).

Using firearms is a standard *modus operandi* in CIT armed robberies, and the threat that the CIT armed robbers are expecting determines the firearms they use to execute

CIT armed robberies (Gichanga, 2018:20). Geldenhuys (2022:12) pointed out that CIT armed robbers destroy anything that hinders their mission to get cash, and this includes killing a person. They are equipped with bulletproof vests, firearms, explosives, and a signal. This is supported by what transpired in February 2022, when Milton Sandile Gasu was arrested for his involvement in the Rosettenville shootings. After his arrest, four assault rifles, five pistols with magazines, over 1000 ammunition, signal jammers, security and police uniforms were found in his possession, at his residence in Tembisa (Geldenhuys, 2022:12). CIT armed robberies are carried out by attacking CIT AVs using firearms like AK-47s (Srilall, 2024).

The criminals' modus operandi is shaped by their personal conduct during the process of the commission of crime, in the context of this study, which is CIT armed robbery (Lochner et al., 2018). The CIT armed robbers have firearms and explosives training, and this was viewed on the crime scene photographs of this robbery. The CIT robbers' firearms expertise and how they placed explosives showed that they were trained on these devices. They knew how to aim their targets (Hosken, 2021). The CIT armed robbers fled with an unknown amount of cash. Dr Maree, in response to this CIT armed robbery, mentioned that the robbers identify their targets based on the services rendered by the CIT company as required by its customers. For example, Mondays are high-risk days because robbers believe that more cash is available due to business conducted over weekends and public holidays (Geldenhuys, 2022:11).

The modus operandi of the CIT armed robbers consists of three phases: planning, execution, and the aftermath of the robbery. During the planning phase, the CIT robbers focus on how the robbery will be carried out and what is needed to make it successful. The execution phase covers the reality of making it happen, which includes ramming the AVs to force the stop, shooting the AVs and their tyres, burning the vehicles that they used to ram the AVs to ruin evidence, and other things that can link them to the scene. Using an inside job to get necessary information about the targeted AVs was also identified as a modus operandi. The last phase covers what happens after the robbery, the escape car, and possible routes. Having explored the modus operandi of the CIT armed robbery, it is important to discuss the profile of these robbers.

2.4 THE PROFILE OF CIT ARMED ROBBERS

During the planning phase of CIT robberies, the syndicates focus on surveying the schedules for transporting cash, acquiring necessary explosives, vehicles, firearms, and recruiting skilled criminals (Srilall, 2024). Geldenhuys (2022:11) noted that CIT armed robberies are committed by experienced criminals with advanced and thorough planning. In support of this statement, Koekemoer (2015) pointed out that CIT armed robbers are associated with being organised, violent, experienced individuals, heavily armed, and ready to execute a daylight CIT robbery. Based on the detailed planning of CIT armed robberies and the precision with which CIT armed robbers execute the robberies, they are regarded as professional criminals (Geldenhuys, 2022:11).

Srilall (2024) pointed out that organised criminal syndicates execute CIT robberies. CIT robberies are generally carried out by organised groups, with each member selected for a specific role in the planning, execution, and aftermath of the crime (Lochner, 2018). They are aged between 20 and 65 years, with the majority in the category 25 to 50 years (Geldenhuys, 2022:11). CIT armed robberies are executed by violent organised criminal syndicates, which sometimes are groups of 10 to 20 people, armed with automatic rifles and using explosives, to access the cash in the vaults (Zwane, 2017). The CIT armed robbers share a common goal of getting cash.

CIT armed robbers include various nationalities, and this is usually supported by South Africa's porous borders. In support of this view, during the Rosettenville shootout on the 21st of February 2022, six foreign nationals were among the suspects arrested at the crime scene. Eight of their accomplices were killed (Rawat, 2022). One foreigner was from Botswana, and the rest were from Zimbabwe. Two days later, ten CIT armed robbers from South Africa and Botswana were killed in a shootout with the police in Gaborone.

Tau (2018) believes that CIT armed robbers require money to accomplish their mission. They need money to hire hotels, where they plan their next CIT armed robbery, and powerful cars to use in fleeing the crime scenes. The vehicle was identified as an essential tool for armed CIT armed robbers, without which it is impossible to execute CIT armed robberies (Geldenhuys, 2019). According to Dr Thobane, CIT armed robbers use various vehicles, including the vehicle that rams the CIT vehicle, which is often left at the crime scene due to extensive damage, and the

getaway vehicles. These vehicles are often purchased from hijackers or hijacked by them. Sometimes, corrupt law enforcement officials provide transport for CIT robbers (Geldenhuys, 2019).

For some of the CIT armed robbers, it is a career to attack CIT AVs, and they have been engaged in criminal activities since they were young. They step up the ladder to become CIT robbers. Some were former CIT employees, security guards, soldiers, and police officials (Geldenhuys, 2022:11). According to Srilall (2024), most CIT robbers are characterised by criminal records for violent crimes, such as CIT robberies. To limit the number of possible witnesses and interruptions, the CIT robbers carefully choose the time to execute the robbery (Koekemoer, 2015:11). According to BBC News (2018), the CIT armed robbers are also characterised by confidence that is seen when they attack the CIT AVs during the day, on the public roads. They do not respect the police and are not scared of apprehension. According to Dr Maree, the CIT robbers are not first-time offenders. Although some CIT armed robbers might be appearing before the court, that does not mean they are first offenders. In some instances, it is because they are caught (Geldenhuys, 2022:10). The literature revealed that CIT armed robbers are confident in carrying out daylight CIT armed robberies. Furthermore, they are characterised by violence and have no respect for human life. They focus on securing cash, and anything that disturbs their mission gets destroyed.

2.5 THE USE OF FIREARMS IN THE EXECUTION OF CIT ARMED ROBBERIES

There is easy access to firearms and various ways the CIT robbers obtain these firearms in South Africa. This includes disarming the police, security guards, and acquiring firearms (Geldenhuys, 2019). CITASA confirmed that some criminals serve as the source of firearms to others, such as the CIT armed robbers. Nosiviwe Mapisa-Nqakula, who is the former Minister of Defence and Military Veterans, indicated that firearms are stolen from the South African National Defence Force (SANDF) (News24, 2018). Firearms are also obtained from their legal owners through house robberies. During CIT armed robberies, despite the form of robbery, either cross-pavement or AV attacks, the CIT crew get robbed of their firearms. The CIT robbers' target is not limited to cash but also firearms (Geldenhuys, 2022:12). CITASA revealed that those firearms are hardly ever recovered.

The AK-47 rifle was identified as a firearm of choice in 2003 and 2006, as revealed by the SABRIC (Irish-Qhobosheane, 2021). According to Brown (2016), R4, R5, and AK-47s were predominantly used to threaten the CIT security guards. The R4 and R5 rifles were commonly used in 2016 and 2017 during CIT armed robberies, with AK-47s being used less often. Between 2019 and 2020, R4s and R5s were predominantly used, but the use of AK-47 rifles has risen again (Irish-Qhobosheane, 2021). As already indicated in section 2.3, the CIT armed robbers shoot the tyres of the AVs to halt them. These firearms are also used to threaten the CIT security guards to comply with their demands when executing the CIT armed robberies.

2.6 CASH-IN-TRANSIT ASSOCIATION OF SOUTH AFRICA (CITASA)

CITASA was formed in 2021 by Standard Bank, Barclays, and Volkskas (SBV), G4S, and Fidelity as an oversight for the CIT industry (CITASA, 2022). According to the same author, it regulates the CIT industry by formulating standards that enhance safety and shared best practices to combat CIT robberies. Chimoio (2025) explained that initially, CITASA provided data analytics to the Hawks via Closed-Circuit Television (CCTV) analysis. This contributed to securing convictions in CIT robbery cases (Chimoio, 2025). The same author explained that CITASA introduced predictive analytics software that identifies CIT robbery hotspots, traces the movement of CIT armed robbery syndicates, and alerts when a CIT robbery is detected. According to the chairperson of CITASA, Mr Thabo Mokoena, this system grants the CIT industry an opportunity to fight against CIT robberies.

2.7 CIT COMPANIES IN SOUTH AFRICA

The CIT companies focus on moving cash to various places under protection (Sambo, 2023). Thompson (2020) identified SBV, Fidelity, and G4S as the leading CIT companies in South Africa. These companies are responsible for the collection and delivery of cash and the risk reduction (G4S, 2010). In South Africa CIT services are carried out by private security companies such as SBV, Group 4 Security (G4S), and Fidelity (Sambo, 2023:1). Regarding the protection of the CIT security guards and cash being transported, the CIT companies rely on trained security guards, firearms, AVs, and bulletproof vests.

SBV was formed in 1986 by Standard Bank, Barclays Bank, and Volkskas in South Africa (SBV, 2018:3). It is managed by Amalgamated Banks of South Africa (ABSA),

Nedbank, and First National Bank (FNB) (Sambo, 2023:4). They are responsible for transporting cash, management of Automated Teller Machines (ATMs), and serving as a cash management centre (SBV, 2018:2). Group 4 Security (G4S) is an international entity (Sambo, 2023:4), developed in 1957, to protect and transport cash (G4S, 2018:5). Fidelity security services were developed in 1957, in South Africa (Fidelity security services, 2018:6).

2.8 THE WORKING CONDITIONS OF THE CIT SECURITY GUARDS

Despite the CIT security guards' rigorous training and the technologically advanced CIT AVs, they know that brazen CIT armed robbers target them. Each time they go to work, they face uncertainty about both their own safe return and the secure delivery of the cash (Geldenhuys, 2022:13). In support of this statement, Hlatshaneni (2018) pointed out that CIT security guards fear CIT robbers and need high-calibre firearms to retaliate when attacked. The CIT security guards do not know when a CIT armed robbery will occur or even how it will unfold; they only know that it could happen at any moment (Hlatshaneni, 2018).

The CIT security guards are not as heavily armed as the CIT armed robbers, who are usually armed with handguns and automatic weapons. It was reported that CIT security guards carry basic firearms, such as Norinco pistols, with an 8-cartridge magazine capacity. The CIT robbers are heavily armed with automatic rifles and shotguns (Sifile, 2019). CIT armed robbers are using AK-47 rifles and explosives to execute CIT armed robberies, as discussed in section 2.5 (BBC, 2018).

The CIT security guards are not sure whether they will be shot or blown up by the CIT robbers while transporting cash (Hlatshaneni, 2018). Based on the background of CIT armed robberies in South Africa, it is evident that being a CIT security guard is risky. They are targets of sophisticated syndicates, as they protect their clients' money with their lives (Geldenhuys, 2022:13). The working conditions of CIT security guards are dire, compounded by the fact that in every CIT robbery, the security guards are often the first suspects. Sifile (2019) pointed out that once a CIT robbery has occurred, the security guards are interrogated and subjected to lie detector tests.

CIT security guards described their work as unappreciated, as they risk their lives and transport cash, which criminals are targeting (Sifile, 2019). Parliamentary Monitoring

Group (PMG) (2018) indicated that in 85% of the CIT AVs used to transport money, a two-person crew was used when air conditioners were not working in hot weather. According to Jacob (2018), there is a need for enough CIT security guards in the AVs, rather than the usual three personnel. The low salary scales affect CIT security guards' willingness to participate in CIT armed robberies; as a result, Congress of South African Trade Unions (COSATU) believes that CIT security guards deserve a salary of R20,000.00 per month and should be permanently employed, with the benefits of pension funds, medical aid, and life insurance (PMG, 2018). In support of this statement, the Federation of Unions of South Africa (FEDUSA) also believes that the CIT security guards should receive a salary of R20,000.00 per month. According to Sifile (2019), despite the risks associated with the CIT job, CIT security guards are still paid about R11,000 per month. PMG (2018) indicated that CIT security guards work long hours, such as 12 hours, with low salaries, and most illegal foreigners are deliberately employed and exploited, with a salary of R3500.00 (approximately US \$ 219) per month.

2.9 THE TRAINING OF THE CIT SECURITY GUARDS

The South African private security industry is regulated by Private Security Industry Regulatory Authority (PSIRA) (Sambo, 2023:3). Clark indicated that the training offered to security guards should be in line with PSIRA regulations and an understanding of the process of cash collection and delivery, using firearms, the application of proactive measures for life, and cash protection (Geldenhuys, 2022:13). Their training is conducted in line with PSIRA regulations and the Firearms Control Act 60 of 2000 (Geldenhuys, 2022:13). Although the CIT companies spend significant money training their employees to counteract criminals, the groups of perpetrators are becoming larger, highly organised with military precision, and more violent (Pitt, 2021). Although the CIT security guards are trained, the CIT armed robbers are advanced.

2.10 FACTORS THAT CONTRIBUTE TO CIT ARMED ROBBERIES

Several factors contribute to CIT armed robberies. Grant Clark, Head of Operations at CITASA, and Dr. Alice Maree, Incident and Analytics Manager at CITASA, discussed the issue of CIT armed robberies with Servamus following a recent increase in such incidents. Their conversation addressed factors contributing to the prevalence of CIT armed robberies (Geldenhuys, 2022:12). According to the same author, the duo

identified the country's socio-economic situation, especially poverty, unemployment, and moral decay, as the contributing factors to CIT armed robberies. Dr Maree identified greed as a contributing factor. Similarly, Koekemoer (2015:12) pointed out socio-economic factors and peer pressure as the contributing factors to CIT robberies. According to Adams (2021), the depressed economic situation and high unemployment rate are contributing to the increase in CIT armed robberies. It was further indicated that the rise in the CIT armed robbery rate is due to failures in the criminal justice system (Burger, 2018).

Apart from the socio-economic factors, easy access to unlawful firearms and explosives in South Africa is concerning (Geldenhuys, 2022:10; Irish-Qhoboshiane, 2021). Ezeji and Uwizeyimana (2025:330) identified the easy access to firearms in South Africa as one of the contributing factors to the prevalence of CIT armed robberies. Also, the South African borders are easy for foreign nationals to cross into the country, which also plays a role in CIT armed robberies. CIT robbers who are foreign nationals enhance the ability of the syndicates to recruit skilled criminals and the procurement of firearms and explosives (Srilall, 2024). Dr Maree indicated that it has come to their attention at CITASA that foreign nationals are involved in the CIT armed robberies, and that requires necessary attention (Geldenhuys, 2022:10).

Additionally, parole is also concerning, during a police shootout in February 2022, with a group of about 25 heavily armed criminals in Rosettenville, in Johannesburg, who were about to commit a CIT armed robbery, it was found that one of the suspects was on parole when he was arrested (Geldenhuys, 2022:10). Milton Sandile Gasas was granted parole in 2020, after having served only 16 years of his 31 years sentence for CIT armed robbery (Seleka, 2022). Geldenhuys (2022:10) believes that CIT armed robbers view their arrests as a break from the career as CIT armed robbers. Once they are released from prison, they continue from where they were caught.

BBC News (2018) identified corruption as a contributing factor in the successful execution of CIT armed robberies, particularly when the police are involved, and CIT personnel give criminals confidential information. It was further indicated that in some instances, former CIT employees form part of CIT armed robbery syndicates (Geldenhuys, 2022:12). Major General Nhlanhla Mkhwanazi identified inside jobs as a contributing factor to CIT robberies. According to Mkhwanazi, it is rare for the CIT

robbers to attack an empty CIT AV (Hlangu, 2025). This indicates that the CIT robbers possess detailed knowledge about which safes contain large sums of money. The leading CIT companies in South Africa, such as G4S, Fidelity Group, and SBV, along with the COSATU, have reported that security guards are vulnerable to bribery and intimidation, which is also extended to SAPS members and magistrates (PMG, 2018).

Burger (2018) highlighted that CIT robbers believe they cannot succeed in executing CIT armed robberies without the complicity of the police and employees of CIT security companies. Often, CIT personnel, including security guards and police officials, are involved in the actual CIT armed robberies. This situation was presented in the case of Henrico Fourie, Fannie Morris Mbuyani, Josias Lucas Maseko, and Lazarus Ntlatleng, who were sentenced on the 21st of July 2022 in the Pretoria High Court, to 30 years' direct incarceration for robbing an SBV CIT AV of more than R25 million. This was a typical inside job, with Henrico Fourie as the head of the department at SBV Watloo Cash Centre. He recruited two SBV employees, Lazarus Ntlatleng, a crew member, and David Tolo, a driver, who robbed the SBV CIT AV on the N4 freeway outside Bronkhorstspuit, on its way to Pretoria, on 7 July 2022.

The research findings of Dr Thobane (2014) from UNISA supported the notion that some police officers and security guards are involved in CIT robberies. The research was about the criminal careers of armed robbers. The research findings revealed the extent to which CIT robbers relied on police members and personnel in the CIT industry to execute CIT armed robberies (Burger, 2018). Thobane's findings revealed that the police and the employees of the CIT companies are directly involved in the CIT armed robberies, and they are bribed in various ways. The police may provide information in case dockets to criminals, such as the names of witnesses, destroy physical evidence, or even worse, transport cash and hide criminals (Burger, 2018). The literature review revealed that socio-economic factors such as unemployment, poverty, etc., greed, parole, corruption, and inside jobs are the contributing factors to the prevalence of CIT armed robberies.

2.11 CIT ARMED ROBBERY IN THE GLOBAL SOUTH

Angermann (2022) noted that countries are categorised as either part of the Global North or South based on their socio-economic dynamics. Countries in the Global South are developing countries in the southern hemisphere and are associated with

poor social-economic factors (Kowalski, 2020:1). Conversely, countries classified as being from the Global North, refers to the developed countries in the northern hemisphere and are associated with good socio-economic dynamics (Kowalski, 2020:1). The Global North and South are divided by a physical line into north and south (Angermann, 2022). The study focuses on CIT armed robbery and the investigative value of forensic firearm identification; therefore, the researcher finds it necessary to explore these concepts in other countries.

The researcher focuses on three countries in the Global South, in Sub-Saharan Africa. The countries are Botswana, Eswatini, and Zimbabwe. In the Global North, the focus is on European countries such as Italy and Switzerland. The researcher focuses on how these chosen countries experience CIT armed robberies, including the modus operandi of the armed robbers, methods of dealing with them, and the use of forensic firearm identification to solve CIT armed robberies. The researcher first explored CIT armed robberies in the Global South, starting with Botswana, then Eswatini, and finally, Zimbabwe.

2.11.1 Botswana

Botswana is an enclosed country in the centre of Southern Africa. Namibia borders it to the west and north, Zambia and Zimbabwe to the north-west, and South Africa to the east and south (Parsons, 2025). The population of Botswana was 2,556,113 in May 2025, and it is estimated to be 2,562,122 by the middle of the year (Worldometer, 2025a). The rate of unemployment was 27.6% in the first quarter of 2024 (Trading Economics, 2025).

In 2021, the predominant modus operandi of CIT robberies in Botswana involved overpowering security guards and making an escape with the cash (Sunday Standard, 2022). Bothoko (2021) highlighted that CIT armed robberies became common in Botswana due to the widespread availability of firearms allegedly smuggled from South Africa. Ndebele (2022) reported that in July 2022, three South Africans and two Botswana nationals were apprehended by the Botswana police for a foiled CIT armed robbery in Gaborone. After the arrest, the police seized an AK-47 rifle and three pistols with live ammunition (Ndebele, 2022). The South African nationals were aged between 26 and 34, while the Botswana nationals were between 39 and 42 years old. This

incident indicates how these robberies are carried out by multiple nationals and firearms being used.

Following the high rate of CIT armed robberies in the country, G4S Botswana (security company), with its competitors, collaborated with the Botswana Police Service (BPS) and military police (Sunday Standard, 2022). According to Mothusi Molokomme, Managing Director at G4S Botswana, the CIT industry in Botswana faced an unprecedented security threat towards the end of 2021, in the form of CIT AVs being attacked.

Molokomme further pointed out that, apart from government assistance to curb CIT armed robberies, G4S Botswana has tightened the security of its vehicles by installing advanced technology to protect the cash they transport from one point to another (Sunday Standard, 2022). A significant amount was invested in new CIT AVs and in their existing fleet. Although these were temporary measures, G4S Botswana responded to the prevailing security situation (Sunday Standard, 2022). Botswana law enforcement agencies are focusing on cracking down on CIT armed robbery syndicates linked to the recent surge in CIT armed robberies that have emerged around the country (Mpuang, 2022).

The BPS Assistant Commissioner, Dipheko Motube, revealed that 13 CIT armed robberies were recorded from January 2021 to August 2022, with most of these incidents in Gaborone (Mpuang, 2022). About 17 CIT armed robbery suspects were arrested and brought before the court. Thirteen suspects were from Botswana, and four were South Africans (Mpuang, 2022). According to the Botswana police spokesperson, the successful apprehension of CIT armed robbers and the arrest of suspects was facilitated by an integrated inter-agency plan involving collaboration between the Directorate of Intelligence and Security, and the Botswana Defence Force (Mpuang, 2022). Before a CIT company can resume its cash transporting services, it must submit a protection plan to the Bank of Botswana (Mpuang, 2022).

2.11.2 Eswatini

Eswatini, formerly known as Swaziland, is a country in the eastern part of South Africa, adjoining Mozambique (Masson, 2025). It extends about 175km from north to south and 130km from west to east at its largest dimensions (Masson, 2025). According to

Worldometer (2025b), the population of Eswatini is approximately 1,254,247, with an estimated 1,256,174 people as of mid-2025. The unemployment rate of Swaziland is projected to be around 23.80% in 2025, according to economic models. It was reported at 34,4% in 2024.

The Royal Swaziland Police Service received a CIT AV from Mr Martin Dlamini, the Governor of the Central Bank of Swaziland. This occurred in 2012, as a sign of gratitude for their continuous involvement and commitment to the CIT operations of the bank (Central Bank of Eswatini, 2012). It was a Toyota Hino, worth more than R1 200 000, with the specifications that fulfil CIT needs of the bank and the police, to ensure smooth and safe CIT services (Central Bank of Eswatini, 2012). In response to the presentation of the vehicle, the Eswatini Police Commissioner noted that it represents a continuous commitment between the Eswatini Police Service (EPS) and the Central Bank of Eswatini to address CIT armed robberies. The Commissioner emphasised that this type of crime results in a loss of cash and affects the lives of the security guards tasked with transporting cash from one point to another (Central Bank of Eswatini, 2012). In collaboration with relevant stakeholders to address CIT concerns, the Commissioner of the Eswatini Police Service has identified armed robberies as a key area for intervention (Central Bank of Eswatini, 2012).

On the 5th of May 2022, several robbers fired shots at the two CIT security guards at the Southgate shopping centre and fled the scene with about R2 865 038.93 (Times of Swaziland, 2022). Swaziland police arrested a founding member of the Swaziland People's Liberation Movement (SPLM) in connection with the CIT armed robbery. After the suspect was taken in for questioning, a firearm with an obliterated serial number was seized from him. The firearm was subjected to forensic analysis for identification to determine if it had been used in the commission of the robbery in question or other crimes (Times of Swaziland, 2022).

This CIT armed robbery was carried out by six men who had arrived at the shopping centre in the morning, moving from one shop to another, disguised as shoppers. Several other robbers positioned themselves in strategic areas within the shopping centre, including the entrance and exit gates (Times of Swaziland, 2022). When considering the modus operandi of CIT robbers, the execution of this CIT armed robbery fits it.

2.11.3 Zimbabwe

This section focuses on the overview of CIT armed robberies in Zimbabwe. This is a landlocked country of Southern Africa, sharing a 200km border on the south with the Republic of South Africa. It is connected by land with South Africa (Bradley & Ingham, 2025). The rate of unemployment in Zimbabwe is forecast to 92% in 2025, with unemployed people forecast to be 816.34 thousand in 2025. The total labour force in Zimbabwe is predicted to be 6.85 million in 2025 (Statista, 2025).

CIT armed robberies pose a significant challenge in Zimbabwe (Shambare, 2022). The worst version of these robberies is that they threaten the country's economy and the lives of innocent people (Shambare, 2022). Zimbabwean police have revealed that CIT armed robberies are often associated with an element of an inside job. The CIT robbers get tip-offs from CIT security guards and police before attacking their targets (Shambare, 2022).

Zimbabwe's leading security company, Fawcett's, had its security guards arrested in 2021 for a stage-managed CIT armed robbery, which resulted in a loss of R5,978,375.50 (Mazingaizo, 2021). According to the same author, the security guards were transporting cash from Bulawayo to Harare, and later claimed that they had been robbed at a bogus police roadblock on the freeway. Assistant police Commissioner Paul Nyathi stated that the security guards' version of being robbed has an element of inside job and dishonesty (Mazingaizo, 2021). As a result, the security guards were arrested.

Although the security guards claimed that they were approached by two police officers and four civilians who were armed and driving the unidentified vehicle, the police's comprehensive investigations revealed that there was a truck that had broken down at the point where the security guards claimed they were robbed. Eyewitnesses further explained that the security guards did not stop at this point, and their vehicle was seen speeding along the Harare-Bulawayo Road towards Kwekwe (Mazingaizo, 2021).

In a separate incident, a CIT robbery occurred on January 6, 2021, at approximately 2 pm, along the Harare-Chinhoyi Road near the Gwebi bridge (ZWnews, 2021). The complainants travelled in a Toyota Hilux single-cab vehicle to Chinhoyi to conduct a

CIT task. They had seven cash boxes on board, containing about R46,483,767 (ZWnews, 2021). Along the way, they allegedly gave a lift to six male passengers at Westgate and Inkomo turn-off. As they approached the Gwebi bridge, the driver stopped the vehicle as one of the complainants wanted to relieve himself. As the vehicle stopped, one of the passengers produced an unidentified pistol and fired one shot in the air, while his accomplices disarmed one of the complainants of his 303 rifle. The complainants were tied up by the suspects and driven into the bush, where they loaded the cash boxes into a red Toyota vehicle with an unknown make and registration number. Then they drove off with about R46,483,767 (ZWnews, 2021). The conduct of the security guards in this incident is questionable, as they provided a lift to unknown people, which may contravene their duties.

2.11.4 Similarities between CIT robberies in the Global South

The researcher focused on the CIT robberies in South Africa, Botswana, Eswatini, and Zimbabwe. The literature revealed that CIT robbery in these countries is characterised by violence. Firearms and explosives are used every day in the execution of CIT robberies. Although the focus of the criminals is to get easy cash, the lives of the CIT security guards are also at stake. During CIT robberies, robbers destroy anything that disturbs their mission on their way to get quick cash. This includes shooting at the CIT AVs, which leaves the security guards dead or injured. Even the explosions that occur at these robberies put the lives of other people, including the bystanders, at risk.

Using inside jobs, socio-economic factors, availability of firearms, and corruption were found to be the contributing factors to CIT robberies. Firearms such as rifles and shotguns are standard tools of crime in the Global South. During these CIT robberies, the security guards are disarmed by the robbers, which increases the chances that the robbers are heavily armed compared to the guards. The modus operandi of the CIT robbers includes ramming the CIT AVs and shooting their tyres to force them to stop. The ramming vehicles are set alight after the CIT robberies are carried out to destroy evidence.

2.12 CIT ROBBERIES IN THE GLOBAL NORTH

But countries classified as being from the Global North refer to the advanced countries in the northern hemisphere. They are associated with high salaries, advanced

technology, good infrastructure, and macro-economic and political equilibrium (Kowalski, 2020:1). The researcher focuses on two countries in the Global North: Italy and Switzerland.

2.12.1 Italy

In 2024, 62% of its population aged 15 years and above were employed, compared to the European Union's average of 71%. Italy suffers from a demographic crisis, being one of the oldest countries worldwide, and the oldest in Europe (Statista, 2024). Its population was 59,173,991 in May 2025, with an estimated 59,146,260 people in the middle of the year.

Criminals exploit every opportunity to attack CIT vehicles and security guards to steal cash (Schwegler Associated Limited, 2021). There is a demand for cash supply in the market, and banks and post offices are no longer reserving cash. As a result, the CIT companies are responsible for transporting the cash from one point to another. This leaves the risk of losing this cash through robberies to the CIT companies. Although CIT armed robbery has been identified as a major concern in Italy, Schwegler Associated Limited (2021) found that another challenge is that criminals view this as a potential source of illicit money collection.

The company Schwegler Associated Limited has more than 30 years of CIT industry experience, and it reported on the evolution of CIT armed robberies in Italy (Schwegler Associated Limited, 2021). According to the same author, despite the increase in criminal acts related to the danger associated with CIT armed robberies and the modus operandi of the robbers (burning trucks as a way of barricading the roads, firing shots at the tyres of the CIT AVs), among other methods, CIT crews in the AVs were rarely wounded. Schwegler Associated Limited (2021) described the execution of CIT armed robberies as complicated and chaotic, whereby criminals create access and escape routes from highways by cutting guardrails to create possible access ramps.

Although Schwegler Associated Limited (2021) did not reveal the security installations in detail, for security reasons, it was indicated that the CIT company has invested a lot of cash to improve security measures. The advanced technology devices installed in CIT AVs make CIT armed robberies hard to execute. Nevertheless, cross-pavement

risk remains due to the cash movement exposure. Despite the safety measures in place, vulnerabilities persist. Among other defensive mechanisms, bullet-resistant equipment was installed in CIT AVs (Schwegler Associated Limited, 2021).

In Italy, the risks associated with the CIT industry were analysed based on data before COVID-19 as a benchmark (Schwegler Associated Limited, 2021). In 2019, AVs experienced six attacks; in 2018, 15 attacks were recorded. In four cases, the criminals succeeded in their mission to obtain money, with approximately 3.2 million Euros in total being lost into the hands of the criminals.

One specific CIT armed robbery occurred in 2019 on a freeway around Bari in the southern region of Puglia (Squires, 2019). The CIT armed robbers gang barricaded the route for the CIT AVs by setting alight two trucks on the road. The robbery was executed by four masked men, who threatened the CIT security guards by firing automatic firearms (Squires, 2019). The CIT security guards were transporting pension money for postal office workers.

The CIT armed robbers used a one-armed digger to excavate the CIT AVs and took 2.3 million Euros (Squires, 2019). The robbers fled the scene in two powerful vehicles. Although the three CIT security guards in the CIT AV did not sustain injuries, they remained traumatised (Squires, 2019). As a result of this CIT armed robbery, the highway was closed for several hours while the police and emergency services cleared the scene. These CIT armed robberies have occurred in the past (Squires, 2019).

In the northern Italian cities of Modena and Bologna, an attempt to rob a CIT AVs occurred on June 14, 2021 (Wanted in Milan, 2021). The attempted CIT armed robbery was characterised by gunshots, explosions, and vehicles being set on fire. As a result of this attempted CIT armed robbery, A1, the main artery in the central-north of Italy, was closed in both directions (Wanted in Milan, 2021). Similarly, the modus operandi applied in this attempted CIT armed robbery was not different from other previously reported CIT armed robberies.

The robbers were a group of gunmen who put nails on the roadway to stop the traffic and the CIT AVs. To create a diversion and prevent access to the CIT armed robbery scene, two motorists were forced at gunpoint out of their cars, which were set on fire

(Wanted in Milan, 2021). Two truck drivers were ordered to place their trucks across the motorway to block the entrances. Despite the robbery's apparent meticulous planning, it went wrong, and the criminals fled the scene with no money (Wanted in Milan, 2021).

2.12.2 Switzerland

Switzerland is a small mountainous country in the centre of Western Europe. It is surrounded by Austria and Liechtenstein to the east, France to the west, Germany to the north, and Italy to the south (World map, 2025). The population of Switzerland was about 8,960,961 in May 2025 and is estimated to be 8,967,407 mid-year (Worldometer, 2025c). Its unemployment rate was 2, 8% in April 2025 (Trading Economics, 2025).

ABC News (2018) reported a CIT armed robbery on the French-Swiss border, which resulted in millions of dollars in cash being stolen. The CIT AVs was transporting money, driving on a freeway towards Lausanne, Switzerland, around 7:45 am. The driver of the CIT AVs was forced to leave the freeway and pull into a parkade near Chavornay village (ABC News, 2018). Swiss authorities described their accents as those of southern France or North America (ABC News, 2018). The driver of the CIT AVs was tied up by the robbers, who emptied the CIT AVs of the cash and fled the CIT armed robbery scene in a dark-coloured SUV. An estimated R582,393,600.00 was stolen (ABC News, 2018).

Western Switzerland has experienced a dozen CIT armed robberies since 2006, and three since the beginning of 2019 (DeVore & Bradley, 2019). On the 2nd of December 2019, a CIT armed robbery occurred in Dailens around 7:40 pm. Two vehicles blocked the path of a CIT AV. Several people got out of two vehicles, threatening the CIT AV driver and his crew with firearms. The CIT armed robbers robbed them of the entire load of cash and set fire to the three vehicles before driving off (DeVore & Bradley, 2019).

Three CIT armed robbers were found guilty in 2023 by the French court for a CIT armed robbery that occurred in 2018 in Switzerland, which netted the CIT armed robbers an estimated 25 million Swiss francs (Vanguard News, 2023). The first man was Mehdi, who was 40 years old. He was sentenced to 16 years' imprisonment for

being the ringleader of the CIT armed robbery, which occurred in Vaud canton around the French border (Vanguard News, 2023). The second robber, a 32-year-old man named Yusuf, his sentence was six years imprisonment for dishing out information to the CIT armed robbers. During the robbery, he was a passenger in the CIT AVs (Vanguard News, 2023). The third robber, Pascal, a 48-year-old man, was found guilty of admitting that he stored the briefcases in his garage that belonged to the ringleader, but he refused to admit that he was aware of their contents. The briefcases were carrying about 2.5 million Swiss francs, and valuable Deoxyribonucleic acid (DNA) evidence assisted the investigating officers in preparing their case. The cash seized by the CIT armed robbers was not recovered (Vanguard News, 2023).

2.12.3 Similarities between CIT robberies from the Global North

In the Global North, the researcher focused on Italy and Switzerland as discussed in sections 2.12.1 and 2.12.2. In Italy, the CIT robbers' modus operandi includes setting trucks on fire to block the roads, ordering the truck drivers to park them in a way that blocks the roads, shooting the tyres of the CIT AVs, and using firearms to threaten the security guards to comply. A firearm is a tool of trade for CIT armed robbers. The CIT robberies are associated with shootings, explosions, and burning of the trucks as a form of destroying the CIT AVs. Although CIT robbery is a challenge in these countries, they rely on technology and innovation as security measures.

2.12.4 Similarities between CIT robberies from the Global South and the Global North

Having explored CIT armed robberies in the Global North and South, it is evident that these robberies are a global concern, which not only compromises the security of the cash being delivered from one point to another daily, but also the lives of the CIT security guards tasked to transport the cash from one point to another. As already mentioned in sections 2.11.1 to 2.11.3, and 2.12.1 to 2.11.2, the tactics that the CIT armed robbers use to execute CIT armed robberies include, ramming CIT AVs, setting vehicles on fire, using trucks and other vehicles to block the roads, and shots at the tyres of the CIT AVs to bring them to a halt, are common in the Global North and South.

The way CIT armed robberies are carried out indicates the level of planning and preparedness of the CIT armed robbers. Even though in some instances the CIT security guards are sometimes left without casualties, they are left traumatised. The CIT armed robbery syndicates operate in groups, and they are characterised by violence, taking their time to plan how they will commit the CIT armed robberies without being overpowered. Using inside information provided by the CIT industry personnel, police, and other stakeholders in the criminal justice system was identified as a contributing factor in the CIT armed robberies in the Global North and South. In the Global North, as discussed in section 2.11.2, Botswana relies on technology to protect cash, and before transporting cash, CIT companies need to produce a protection plan for the Botswana Bank.

Although the researcher discovered that the modus operandi of CIT armed robberies globally, such as using AK-47 firearms to intimidate the CIT security guards and other motorists to comply with their instructions during the execution of this crime, is typical in these countries, the investigative value of forensic firearm identification of CIT armed robberies is not emphasised. It thus requires this study to be carried out to establish the role of this evidence in solving CIT armed robbery in the West Rand District Municipality.

2.13 THE INVESTIGATION OF CIT ARMED ROBBERIES

The Directorate for Priority Crime Investigation (DPCI), also known as the Hawks, categorised CIT robbery as one of the National Priority Violence Crimes (NPVC). The Serious Organised Crime Investigation Unit (SOCIU) is responsible for investigating this crime. Singh (2021:642) explained that crime investigation starts with the identification and recovery of physical evidence at the crime scene. Physical evidence is any tangible item found at the crime scene and is the foundation of forensic investigations (Nikoui, 2024). According to the same author, a crime scene refers to a location where a crime has occurred, allowing evidence to be recovered. Defining the crime scene, Singh (2021:642) indicated that a crime scene may involve one or more locations of occurrences. This results in having primary, secondary, and tertiary crime scenes, depending on the number of locations identified as crime scenes.

The first police official to arrive at the crime scene is called the first-responding officer (FRO). According to Singh (2021:642), the FRO is responsible for protecting the crime

scene and evidence by establishing a restrictive boundary. This can be done through cordoning off the crime scene with a crime scene tape. A safe route for other personnel who must attend the crime scene must also be established. In instances where specialists are needed at the crime scene, such as ballistics experts and others, the FRO is responsible for notifying them.

An adequate understanding of the forensic process by all role players at the crime scene is essential to ensure that the chain of evidence is maintained and to avoid contamination of evidence (Singh, 2021:642). Contamination of evidence at the crime scene is usually caused by the actions of personnel attending the crime scene. CITASA explained how CIT armed robbery scene investigation can be challenging, by showing how often the community members go to these crime scenes with an attempt of getting cash left by the robbers (Geldenhuys, 2022:13). It is essential for the bystanders who loot money from the CIT armed robberies scenes to be aware they can be charged as an accessory after the fact for CIT armed robbery. The crime scene investigation must be approached with Locard's principle in mind. According to Locard's principle, whenever two objects come into contact, they exchange traces (Baldwin & May, 2017). Regarding the focus of this study, the firearms that fired shots at the CIT armed robbery scene imparted their marks on the fired cartridge cases and bullets, which can be used to link such firearms with the crime scene, through forensic firearm identification.

Although Pitt (2021) pointed out that the investigation of CIT armed robberies is the exclusive mandate of the DPCI, CITASA mentioned that investigators attached to CIT companies are always available to assist upon the SAPS request (Geldenhuys, 2022:13). Forensic data was described by Lopez, McGrath and Taylor (2020) as evidence collected from the crime scenes, analysed and reported findings on each case to give light in the investigation and prosecution of crime.

Firearms and firearms-related evidence encompass all types of firearms, fired cartridge cases, bullets, and ammunition, including their components (Gagliardi, 2019:106). Safety is a critical factor regarding firearms and must be taken seriously. Dealing with firearm evidence requires proper handling, which includes wearing hand gloves when reasonable. It is also essential to be careful not to tamper with forensic evidence when handling the firearms evidence (Gagliardi, 2019:106).

Cooper (2025) highlighted that firearms should always be regarded as loaded to avoid accidental discharge. According to Schiro (2023), firearm safety should never be compromised. The same author indicated that when firearms need to be moved from the CIT armed robbery scene, nothing must be put inside the barrel of such firearms or around the trigger guard, and fingers must be away from the trigger. These actions not only create an unsafe situation but could also damage potential evidence. When handling firearm evidence, it is essential to ensure it is always pointed in a safe direction, so even if an accidental charge occurs, the surrounding people at the CIT armed robbery scene will remain secure.

Gagliardi (2019:106) indicated that firearms must be rendered safe before packaging them. This can be achieved by unloading the loaded firearm, and the same author further emphasised that firearms must be pointed in a safe direction. When dealing with firearms, safety is the most important precautionary measure to prevent unintentional discharge. It is important to mark the exhibits to avoid mixing them. In case of firearms, a tag must be attached to the trigger guard. Ammunition recovered from the crime scene must be packaged separately, not with the firearms (Dhabal et al, 2022:271). If the CIT armed robbery investigating officer is not familiar with the working mechanism of the firearm, a ballistics expert must be contacted for assistance in handling the firearm.

The primary purpose of properly handling and packaging firearms and related evidence is to preserve potential evidence (Gagliardi, 2019:108). The firearms evidence must be labelled and packaged in forensic evidence bags. The location, condition found, magazine capacity, and number of ammunition must be noted. Discharged cartridge cases and bullets must be packaged separately. Detailed documentation of the recovered firearms, fired cartridge cases, and bullets can play a significant role during the prosecution phase (Gagliardi, 2019:108).

Gagliardi (2019:108) maintains that although forensic firearm identification evidence plays an important role in solving crimes, to ensure maximum prosecution results, the chain of custody should be considered. The chain of evidence documents who possessed the evidence, why they held it, and for how long. According to Badiye, Kapoor, and Menezes (2023), it assures the court about the authenticity of the evidence, as it focuses on ensuring that the evidence presented in court is the same

evidence recovered from the crime scene. Full details of everyone involved in the continuity of possession, including their reasons for possessing this evidence and the relevant period, must be provided.

2.14 NEW TRENDS AND DEVELOPMENTS IN CIT ARMED ROBBERIES

Lopez et al. (2020) indicated that the establishment of continuous advanced forensic technologies has made a substantial difference in criminal courts. Security Focus Africa (2021) identified the following new trends and developments in CIT armed robberies:

2.14.1 Innovation

Innovation was identified as key to protecting CIT security guards and cash. Criminals attempting to profit from CIT armed robberies are likely to encounter difficulties due to innovations such as state-of-the-art cash carrying boxes (Security Focus Africa, 2021). Abramjee (2018) highlighted that the CIT industry cannot curb CIT robberies on its own. They must utilise technology and innovation. It is not impossible to break open the cash boxes. However, they are equipped with smart security systems that trigger the alarm when there is a suspicious move or tampering (Security Focus Africa, 2021). The cash boxes are secured by advanced security systems.

2.14.2 Polyurethane Dispensing Unit (PUDU)

PUDU is one of the most effective tools to reduce CIT armed robberies. It is a sense and deploy device that dispenses quick-drying, solidifying polyurethane foam into the vault area of CIT AVs when attacked (Security Focus Africa, 2021). The polyurethane covers the cash in the vehicle's vault and makes it impossible for CIT robbers to retrieve the money from the CIT AV. PUDU was developed by the Council for Scientific and Industrial Research (CSIR) in 2002, for SBV services in South Africa (Security Focus Africa, 2021). The intention was to supplement the armour plating and bullet-proofing on CIT AV, to protect the cash inside, and it can be activated in various ways in line with the client's requirements (Security Focus Africa, 2021).

2.15 THE IMPACT OF CIT ROBBERIES ON THE CIT INDUSTRY, SECURITY GUARDS, AND SOCIETY

In June 2018, the Portfolio Committee reported that 49 vehicles were lost, resulting in a cost of R64 million to the CIT industry in the first five months of that year

(News24Wire, 2018). According to CITASA, to replace a single CIT AV costs about R2 million (Geldenhuys, 2022:15). As a result of the losses that CIT companies suffer due to the CIT armed robberies, CIT insurance is becoming a challenge for the industry as the premiums increase due to its high level of risk (Geldenhuys, 2021:15). The rise in CIT armed robberies affect the overall CIT industry operations due to the increase of insurance premiums, and replacement of AVs and other resources, which also concerns the South African Reserve Bank (SARB) (PMG, 2018).

Rall (2023:2) noted that CIT robberies cause unnecessary loss of life. Due to the violent nature of these robberies, the safety of security guards and society is at stake, as they are often executed in public areas during the day (Sambo, 2023:2). According to Rall (2023:2), Fidelity security services has lost 16 CIT security guards. Others sustained major injuries due to these robberies between March and October 2023. Geldenhuys (2022:13) indicated that in most cases of CIT armed robberies, CIT security guards are left injured, some dead, or surviving because of a shootout, or the vehicle's crash after being rammed. One of the Fidelity security services security guards, Titus Ramogari, expressed the trauma that comes with CIT robberies. He indicated that whenever they go to work, their return home is not guaranteed, since they might be shot by the CIT robbers (Hlatshaneni, 2018). Being exposed to such trauma, violence and murder of colleagues, surviving security guards experience severe emotional stress which may lead to depression (Geldenhuys, 2021:13). The number of injuries, the death of the CIT security guards, and the damage caused to the CIT AVs during CIT armed robberies, where CIT armed robbers use explosives and high-calibre firearms during these attacks, is a significant concern as indicated by Pillay (Zwane, 2017).

2.16 SUMMARY

An overview of CIT armed robberies in the Global North and South was the focus of this chapter. The status of CIT robberies in South Africa, the modus operandi of CIT robbers, and the possible profile of such robbers were discussed. The prevalent use of firearms when executing CIT armed robberies, the investigation of CIT robberies, and new trends emerging in the commission of these robberies also formed part of this chapter. The CITASA, as a standard-setting body of the CIT industry, was briefly explained. The chapter then explored the prominent CIT companies responsible for

transporting cash within the country. Since this crime does not occur in isolation, the chapter examined the potential factors that may contribute to CIT robberies and discusses the training and working conditions of security officers in the CIT context.

The chapter also examined the prevalence of CIT robberies in the Global South, with a focus on Botswana, Eswatini, and Zimbabwe. In the Global North, the prevalence of CIT robberies in Italy and Switzerland. The researcher then compared the similarities within the Global South and the Global North, including the similarities between incidents in the two regions. In the last section of the chapter, the researcher examined the impact of CIT incidents on security officers, the CIT industry, and society.

CHAPTER 3: THE SCIENCE OF FORENSIC FIREARM IDENTIFICATION

3.1 INTRODUCTION

Forensic firearm identification is based on determining the source of fired cartridge cases and bullets recovered from any firearm-related crime scenes or incidents. This is significant for connecting the suspected firearm with a specific crime scene. It is an important investigative tool for all those related to firearm crime or incidents. The study focuses on CIT armed robberies as a type of firearm-related crime that relies on forensic firearm identification for investigation and prosecution. Forensic firearm identification enables ballistics experts, through microscopic comparison, to determine whether a projectile (the bullet) or a cartridge case originated from a specific firearm (Mahanta & Bora, 2019:449). This chapter outlines the scope of forensic firearm identification.

The science behind forensic firearm identification is explained, encompassing several key themes. Beginning with the history of forensic firearm identification, the chapter also touches on other topics, including forensic firearm identification in ballistics, the AFTE Theory of Identification by the Association of Firearm and Toolmark Examiners (AFTE), and the various categories and types of firearms, ammunition construction, and terminology. The researcher explores the uniqueness of firearms, the firing process of a firearm, the formation of forensic firearm identification marks, and the characteristics of these marks, including those on fired cartridge cases and bullets. Central to this process is forensic firearm identification through microscopic comparison, utilising the Integrated Ballistics Identification System (IBIS). The challenges and limitations of forensic firearm identification are also addressed. The chapter also discusses the estimated error rate of forensic firearm identification and the training of ballistics experts. The role of forensic firearm identification evidence in the investigation and prosecution of CIT armed robberies, and its reliability and admissibility in court, are central features of this study and are also discussed.

3.2 THE HISTORY OF FORENSIC FIREARM IDENTIFICATION

To understand the concept of forensic firearm identification, its origin must be explored. Forensic firearm identification is based on scientific methodology. Dr Calvin Goddard, an American scientist, is a pioneer in forensic firearm identification and is also regarded as 'the father of ballistics' (McCain, 2023). The scientific basis for

forensic firearm identification was developed by Dr Goddard in the 1920s (Giverts & Kokin, 2020:110). Dr Goddard's work was instrumental for the investigation and prosecution of those responsible for the execution style murder of seven gangsters, named the Valentine's Day massacre (Northwestern, 2016).

The first time a bullet was used during an investigation was in the 18th century. A detective from Scotland Yard, Henry Goddard (Kumar et al., 2021), analysed a bullet and its related patterns to investigate a murder in 1835. Goddard analysed the bullet recovered from the deceased's body during autopsy and identified a defect that could be linked to the original mould from which the bullet was made (Vorburger, Song, & Petraco, 2016). It is not clear whether the two Goddard men were related.

Dr Calvin Goddard investigated the processes of manufacturing firearm parts and the marks imparted on fired cartridge cases and bullets (Giverts & Kokin, 2020:110). At the same time, French researcher Professor Balthazard, was conducting similar research (Jones, 2022). Both researchers' studies were based on the principle that nature never repeats. The primary objective of Professor Balthazard's research was to establish whether two firearms can produce similar marks. Based on the uniqueness of firearm marks, they are used for forensic firearm identification (Giverts & Kokin, 2020:110).

Forensic firearm identification does not rely on advanced technology (Jones, 2022). A comparison microscope is the primary tool for forensic firearm identification. Before the invention of the comparison microscope, ballistics experts relied on photomicrograph comparisons to determine the identity of fired cartridge cases and bullets. This method was time-consuming and laborious (Thompson, 2017:8), and ballistics experts had to recall the identifying marks of each specimen (Dack, 2014:18).

In 1912, the French researcher Balthazard developed a more advanced photographic technique that recorded the impressed surfaces of fired bullets in sequence (Jones, 2022). While an improvement on the previous approach, this method was also time-consuming and indirect. This was then improved by Pieterse, who used a geared camera that passed photographic film across a slit lens that faced a bullet on a mount synchronised by gears to the film drive. According to the same author, the bullets rotated at the same rate that the film moved across the slit lens, producing one strip

image of the bullet's entire bearing surface. This method was complicated and required more photography and engineering tweaks than just firearms expertise (Jones, 2022). Furthermore, with a high load of ballistics cases that required forensic firearm identification for any FSL, it also failed on deformed bullets (Jones, 2022).

The science of forensic firearm identification has propelled forensic investigations forward worldwide. Applying forensic firearm identification to criminal investigations has evolved since the 19th century (McCain, 2023), with forensic firearm identification used in criminal cases since the early 1920s (Dack, 2014:3). Thompson (2017:8) noted that, although other complementary microscopic and photographic instruments may still be used in forensic science laboratories, comparison microscopes remain a critical tool for firearm identification.

The comparison microscope was invented in 1913, but it lacked reflected lights for examinations and mounting objects, such as bullets and cartridge cases. However, it had two identical and independent scopes, sharing a standard eyepiece bridge that allowed objects to be viewed under each scope side-by-side (Jones, 2022). Dr Calvin Goddard used his comparison microscope and methodology in the investigation of the St. Valentine's Day massacre in Chicago in 1929 (Ankney, 2021).

An improved version of the comparison microscope, which allows for proper live-view side-by-side examination of bullets and cartridge cases, was developed in 1925 (Jones, 2022). To view two cartridge cases or bullets simultaneously, Dr Goddard invented a comparison microscope (Dack, 2014:18). The comparison microscope was designed in a way that allows the mounting of fired cartridge cases and bullets (Thompson, 2017:8). Comparison microscope comprises two compound microscopes joined together, allowing the firearm experts to view both fired cartridge cases or bullets at the same time. With the invention of the improved comparison microscope, two objects could be compared simultaneously under magnification. The ability to view two bullets or cartridge cases allowed for a more thorough examination of the unique marks on the fired cartridge cases and bullets. Since 1925, forensic firearm identification has stood on that foundation (Jones, 2022).

Following the history of forensic firearm identification, it is evident that it has improved over the years. The evolution of this process demonstrates that, at first, comparing

fired bullets and cartridge cases to identify the specific firearm responsible was a challenging task. It evolved from relying on the use of weapons to microscopic comparison. Technology has played an important role in enhancing the process of forensic firearm identification. Although various means have been explored in the history of forensic firearm identification to determine a specific firearm that discharged fired cartridge cases and bullets recovered from the crime scene, microscopic comparison remains a reliable method to date.

3.3 FORENSIC FIREARM IDENTIFICATION IN BALLISTICS

Forensic firearm identification refers to a field in forensic science that deals with the identification of firearms through microscopic comparison of fired bullets and cartridge cases (Mutsavi & Meintjies van der Walt, 2020:4). It is concerned with the determination of the origin of the fired cartridge cases or bullets (Lacalamita, 2022:1). Forensic firearm identification can also be described as the microscopic comparison of exhibits, such as fired bullets or cartridge cases recovered from the crime scenes, with the test-fired ones from suspect's firearms. Its main objective is to identify a firearm that has fired the recovered bullets and cartridge cases recovered from the crime scenes.

In forensic science, forensic firearm identification plays an important role in the investigation and prosecution of firearms-related crimes. The analysis findings of these comparisons can include or exclude the firearms' involvement in shooting incidents. Every piece of forensic firearm identification evidence tells a unique story (Dwight, 2020). Forensic firearm identification falls within the field of ballistics in forensic science. Ballistics is a scientific discipline that focuses on how the bullet acts, moves, and its impact on the target (Sharma, 2019a). Ballistics is subdivided into three categories: internal, external, and terminal ballistics.

Forensic firearm identification, as part of the ballistics discipline, falls within the internal ballistics category. This category is based on what happens within the firearm from the moment the trigger is pulled until the bullet exits the muzzle. As already indicated, this category is followed by external ballistics, which refers to the motion of the bullet from the time it leaves the barrel until it reaches the target. The last category is terminal ballistics, which entails the impact of the bullet on the target. The researcher discusses the three categories, providing clarity on how they differ from one another. Since

forensic firearm identification falls within the internal ballistics, that remains the focus of this study.

3.3.1 Internal ballistics

Internal ballistics focuses on the action of the cartridge components from the primer's ignition until the bullet exits the muzzle (Starnes, 2024). Internal ballistics also involves examining the forces that propel the bullet from the cartridge case into the barrel, and the interactions between the bullet and the propellant (McCain, 2023). This includes the spinning of the bullet in the barrel as it exits the muzzle. The way firearm parts, such as the firing pin and breech face, impart marks on the softer material of ammunition components, such as fired cartridge cases and bullets, falls within this category. Essentially, internal ballistics refers to the events that occur within the firearm upon firing.

3.3.2 External ballistics

External ballistics continues from where internal ballistics ends. It is the study of the bullet motion as it leaves the muzzle until it hits the target (Sharma, 2024). Ballistics experts focus on the factors that affect the bullet's path, which helps establish its trajectory (McCain, 2023). External ballistics can determine the shooter's position and the distance between the shooter and the target. Once the bullet exits the barrel, it enters the realm of external ballistics. This process ends when the projectile hits the target, initiating terminal ballistics.

3.3.3 Terminal ballistics

Terminal ballistics focuses on the effect of the bullet on the target (Sharma, 2024). It is also known as wound ballistics. This category of ballistics is concerned with how a bullet transfers its kinetic energy to the target (Robertson, 2022) and explains the severity of the impact of the bullet on the target (McCain, 2023). Terminal ballistics concentrate on the damage caused by the bullet to the target, such as the kind of wounds inflicted and how the bullet deforms after hitting hard surfaces, such as walls and bones, and the other softer human tissues, such as skin. Depending on the nature of the target, once the bullet hits the target, some deform while others remain intact. The wounds inflicted on the target guide the ballistics experts on the type of firearm and bullet used. For example, whether the firearm used to commit a crime was a pistol

or a rifle. The following section presents the AFTE Theory of Identification. This theory regulates forensic firearm identification. This theory regulates forensic firearm identification.

3.4 THE AFTE THEORY OF IDENTIFICATION

The AFTE, founded in 1969, is an international association of professionals dedicated to the examination of tool marks and firearm identification (AFTE, 2025). Forensic firearm identification falls within a specialised sub-speciality of toolmark identification related to the working surfaces of the firearms mechanisms (Thompson, 2017:8). The theory behind forensic firearm identification was developed by the AFTE (AFTE, 2025). According to AFTE (1992), the ballistics expert's training and experience are important for forensic firearm identification. Based on scientific principles, this theory guides ballistics experts in forensic firearm identification (Gutierrez, 2024:1542). The theory emphasises the uniqueness of each firearm, which means that no two firearms can produce identical marks (AFTE, 1992). Based on this theory, two or more firearms cannot produce similar marks. It is claimed that firearms have unique ballistics signatures, like inherently distinct fingerprints.

The AFTE Theory of Identification serves as a reference in forensic firearm identification. It relies on the ability of the ballistics experts to establish sufficient agreement on the firearms marks on fired cartridge cases or bullets through microscopic comparison (Patteet & Champod, 2024). According to this theory, there must be a significant duplication of individual marks on two bullets or cartridges being compared (AFTE, 1992). This implies that if two cartridge cases are compared under a microscope, the particular marks identified on each must also be found on the other cartridge case.

3.4.1 The three principles of the AFTE Theory of Identification

In 1985, the 'Theory of Identification and its relation to toolmarks was formalised by the AFTE Criteria for Identification Committee. The committee stipulated that the conceptual basis for comparing fired bullets (or other toolmarks) should be guided and informed by the following three principles (NIJ, 2023).

Principle 1: The theory enables an opinion to be made when there is sufficient agreement between the unique surface contours of two toolmarks (vis-à-vis bullet, cartridge case, etc.) (NIJ, 2023; RSE, 2021:27).

Principle 2: Sufficient agreement refers to the duplication of random marks or patterns appearing on the compared items. The relevance of duplication is assessed through a comparative analysis of two contour patterns, which include distinct peaks, ridges, and furrows (AFTE, 1992). The duplicated marks identified must exhibit similarities, with at least two sets of patterns that share characteristics in terms of shape, size, and position on the fired cartridge case or bullet. Sufficient agreement exists when there is a likelihood that it is impossible the compared forensic firearm marks on the fired cartridge cases or bullets can be produced by another firearm (NIJ, 2023; RSE, 2021:27).

Principle 3: The theory recognises that the interpretation of either identification or individualisation, although grounded in scientific principles, remains subjective and is influenced by the level of training and degree of experience the examiner has (NIJ, 2023; RSE, 2021:27).

Having explained the theory behind forensic firearm identification, it is necessary to discuss various types of firearms and to provide an overview of their operating mechanisms.

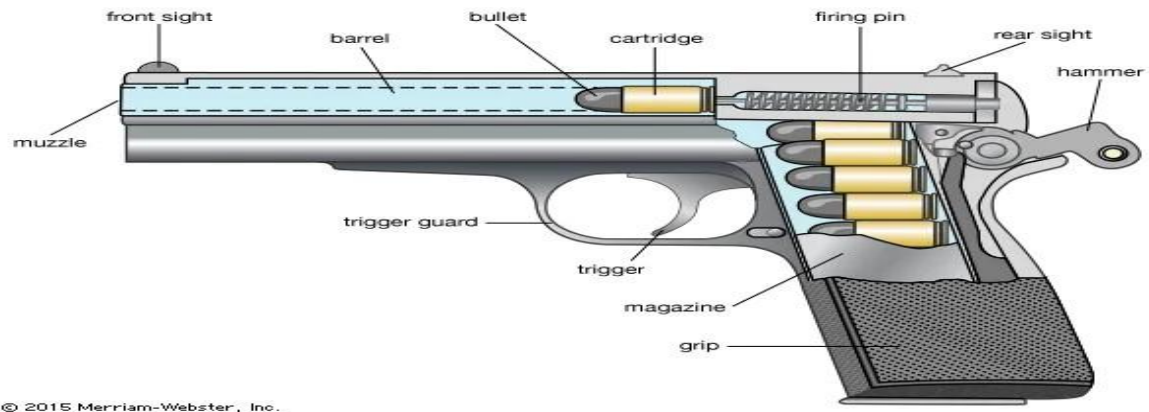
3.5 TYPES OF FIREARMS

Firearms have undergone significant evolution and are now manufactured in a variety of forms (RSE, 2021:7). Handguns and shoulder arms (shoulder-fired weapons) are considered the basic types of firearms (Thompson, 2017:12). The same author describes handguns as firearms designed to be fired by one hand without support from the body. Shoulder arms are designed to be fired while supported by the shoulder. Handguns are designed to shoot short ranges (Kriss, 2023). Pistols and revolvers are categorised as handguns, while rifles and shotguns are classified as shoulder arms (Thompson, 2017:12). The two categories of guns will be discussed in the next section.

3.5.1 Handguns

Any firearm with a short barrel is regarded as a handgun (Kirkpatrick, 2023). They separate themselves from other firearms through their compact size and single-handed operation (Taylor, 2025). Handguns typically fire small-calibre ammunition, such as 9mm (Kirkpatrick, 2023). Pistols and revolvers are the two primary types of handguns (Daniel, 2025). Pistols are designed as semi-automatic or automatic (Kirkpatrick, 2023). Semi-automatic pistols cannot discharge ammunition automatically; each shot requires pulling the trigger. However, they can automatically eject fired cartridge cases and load rounds into the chamber (Kirkpatrick, 2023; RSE, 2021:8). They generally come with a magazine that takes 12 rounds, but extended magazines can be used, which hold more rounds. Revolvers hold ammunition in a rotating cylinder, which typically holds six rounds.

(a) Pistol



(b) Revolver

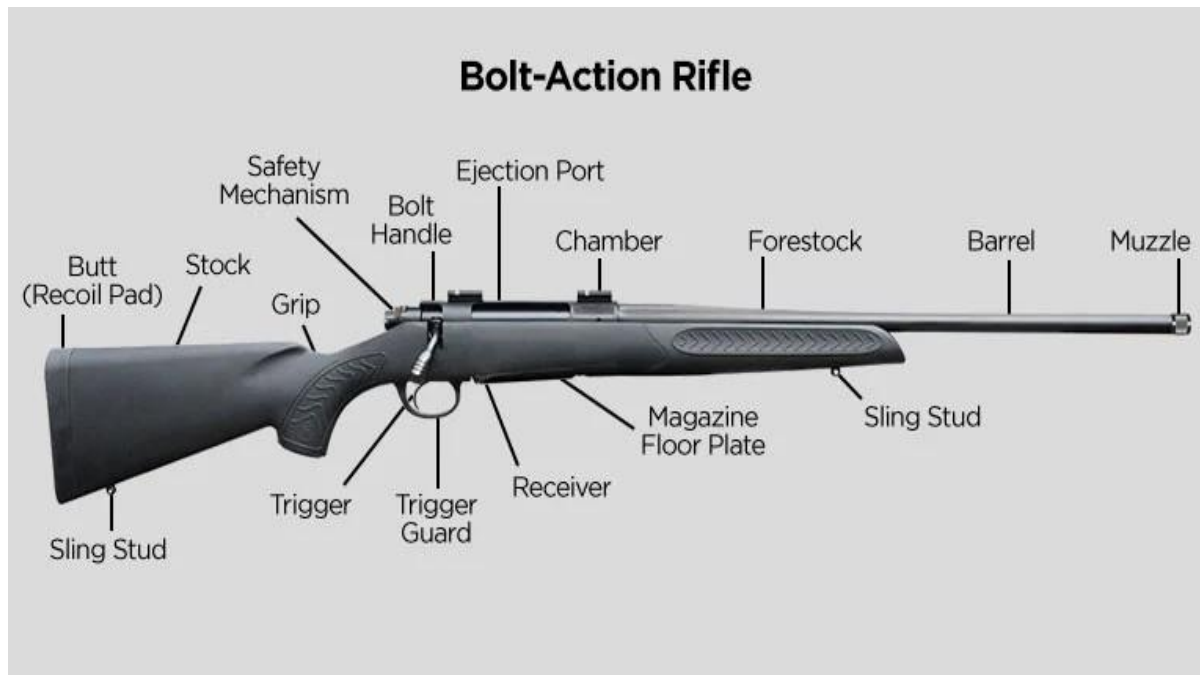


Figure 3. 1: Schematic of (a) a pistol and (b) a revolver (Groarke, 2025)

3.5.2 Rifles

A rifle is a firearm designed to be fired from the shoulder (Rattenbury, 2025). Rifles are classified into several types, including bolt-action, semi-automatic, automatic, lever-action, pump-action, and break-action (McCloud, 2024). Shotguns are commonly designed to be pump-action, break-action, or semi-automatic. They are categorised into two primary classes: self-loading and manual-loading (Kirkpatrick, 2023).

(a) Bolt-Action Rifle (Manual-loading)



b) M16 Rifle (Self-loading)



Figure 3. 2: Schematic of a (a) manual-loading and (b) self-loading rifle (Tactical Gear, 2025).

A shotgun is a firearm designed to discharge ammunition containing pellets rather than bullets (Richard, 2024). There are pump-action, semi-automatic, and break-action shotguns (Garcia, 2025). Shotguns, unlike rifles and pistols, discharge multiple pellets that spread out as they exit the barrel (Mattos, 2023).

(a) Break-Action Shotgun



(b) Pump-Action Shotgun



Figure 3. 3: Schematic of a (a) break-action and a (b) pump-action shotgun (Tactical Gear, 2025).

There are various types of firearms, and they are categorised into handguns and rifles as discussed in section 3.5. The CIT armed robbers use different firearms, but the most notable firearm that serves as their tool of trade is an AK-47 rifle. Based on the discussion in Chapter 3 about the modus operandi of CIT armed robbers, it is evident that they prefer high-calibre weapons, such as AK-47 rifles, when attacking the CIT AV. These firearms are used to threaten the security guards to comply with their instructions, and to force the AVs to halt by shooting the tyres.

3.6 AMMUNITION CONSTRUCTION AND TERMINOLOGY

Firearms have their own specialised ballistics language (Rao, 2022). The layperson's understanding of these concepts is often incorrect, leading to confusion. For example, the term ammunition is often misunderstood (RSE, 2021:14). Understanding ammunition and its components can help investigators, lawyers, and prosecutors identify the specific evidence they are referring to when describing this type of firearm evidence. Usually, the word bullet is used instead of ammunition in the media, on television, in movies, and even in court. For example, a suspect was found in possession of bullets in his pocket while referring to the ammunition. Webb (2019) described a cartridge as an assembled piece of ammunition. A cartridge is the correct name for ammunition, which consists of the bullet (projectile), the cartridge case, propellant, and the primer (RSE, 2021:14; Thompson, 2017:15).

3.6.1 Primer

A primer is a metal cup that holds a tiny amount of explosive in the cartridge. When the trigger is squeezed, the firing pin strikes the primer cup, compressing the explosive priming mixture and generating enough flame to ignite the propellant (Webb, 2019). There are two types of primers: centrefire and rimfire primers (Monturo, 2019:21).

The centrefire primer is divided into Boxer and Berdan primers. The presence of flash holes can differentiate these two types of primers. The Boxer primer consists of a primer cup, explosive mixture, and an anvil. After the cartridge has been fired, it can be reloaded by replacing the fired primer with a new primer (Monturo, 2019:21; RSE, 2021:16). It is characterised by one flash hole. Berdan primers consist of the primer cup and explosive compound. It differs from the Boxer primer because its anvil is incorporated into the cartridge and has two flash holes.

The rimfire primer is the other priming system, which has the priming component along the entire rim of the cartridge case base. During the firing process, when the firing pin strikes the rim of the rimfire cartridge, the propellant is ignited (Monturo, 2019:21). This type of priming system is commonly used in 0.22-calibre ammunition (RSE, 2021:16).

3.6.2 Propellant

Propellant combines saltpetre, sulphur, and charcoal. It is also called gunpowder. It burns faster than rocket fuel, causing gas inside the cartridge to expand rapidly. It

propels the bullet through the barrel until it reaches the target (Monturo, 2019:21; RSE, 2021:17).

3.6.3 Bullet (aka the projectile)

The bullet (projectile) is the part of the cartridge that hits the target after the shot has been fired. Bullets are manufactured in various types, each engineered to deliver specific performance characteristics. Bullets are classified by their design, composition, diameter, and weight (Monturo, 2019:21; RSE, 2021:15). Bullet weight is measured in grains. The types of bullets include full-metal-jacket, lead, and copper-plated, among others.

3.6.4 Cartridge case

A cartridge case is the container that holds all the other components of ammunition together. It is the part of the cartridge that the extractor removes from the firing chamber after the shot has been fired (Webb, 2019). The image in Figure 3.4 presents the structure of a handgun cartridge, with its components.

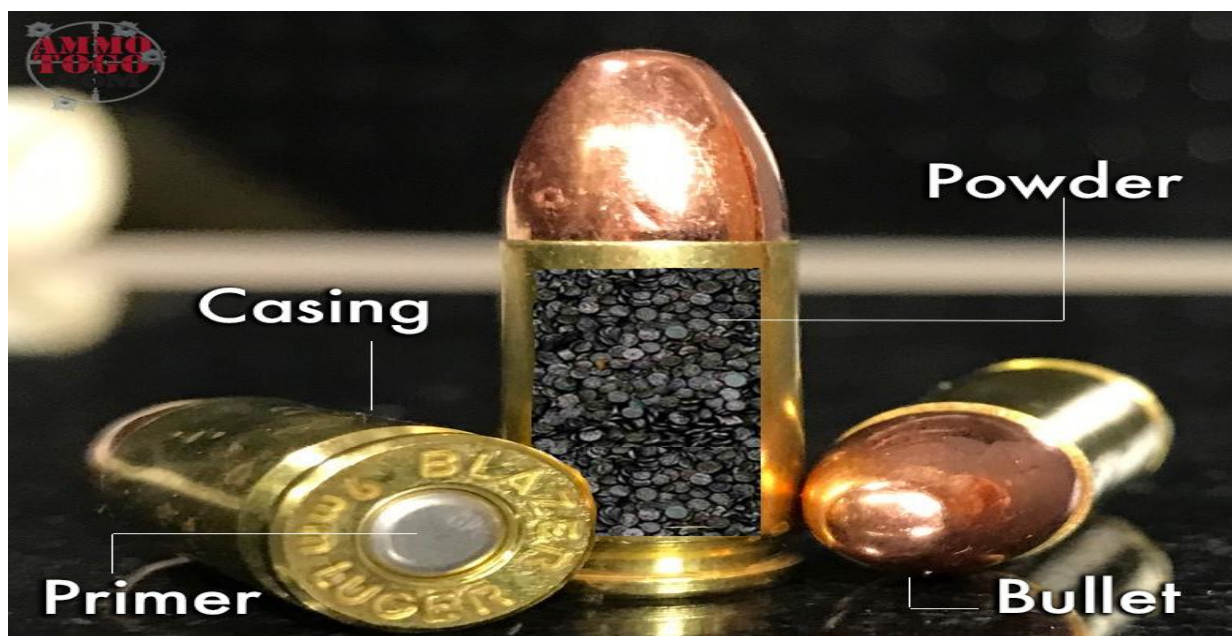


Figure 3. 4: Anatomy of a cartridge (Webb, 2019).

3.7 THE UNIQUENESS OF FIREARMS

The basic principle of forensic firearm identification is that every firearm produces its own unique marks on the fired cartridge cases and bullets (RSE, 2021:33; Smith, 2022:11). Forensic firearm identification is based on the principle of uniqueness that no other firearm can produce the marks made by a specific firearm (Olaborede & Meintjies Van der Walt, 2020:23). Carlson (2024) expands on this and argues that no two firearms, even those manufactured consecutively, can produce the same marks. Every gun tells a unique story.

Firearm parts create two categories of marks: impressions and striations (Patteet & Champod, 2024; RSE, 2021:31). Impressions occur when firearm parts, such as the breech face and firing pin, are pressed against the base of the cartridge during the firing process (RSE, 2021:32-33). The marks are imparted to the fired cartridge case. Striations are created by the firearm barrel when it scratches the bullet surface as it spins in the barrel. A firearm can produce impressed and striated marks on fired ammunition components such as fired cartridge cases and bullets.

While research has indicated that no two firearms will produce the same unique marks on the fired cartridge cases or bullets, more recent research appears to debunk this assertion, with the use of three-dimensional printers being used to print undetectable weapons (RSE, 2021:53). This study did not factor in using three-dimensional printers, but focused on the construction of firearms, using the original metallurgical method (RSE, 2021:52). Law enforcement must take this anomaly into consideration.

Forensic firearm identification techniques involve the examination of fired cartridge cases and bullets by ballistics experts (Dack, 2014:2). Through microscopic comparison, the recovered fired cartridge cases and bullets are matched to test-fired ones, allowing ballistics experts to analyse the firearm marks on them (Pieterse, 2025). These marks are unique, akin to a firearm's fingerprints, and can be used to link a particular cartridge or projectile to a specific firearm or to a specific crime scene (Khan, 2023). According to Werner, Berhod, Rhumorbarbe, and Gallusser (2020), firearm identification is the primary issue to discuss in the context of criminal cases involving firearms. This is to determine the gun that discharged the recovered fired cartridge cases and bullets from the crime scenes.

3.8 THE FIRING PROCESS OF A FIREARM

The firing process of a firearm commences with the loading of ammunition into the firearm, the hammer is cocked back, and the trigger is pulled back (Dhabal, Nandi, Sen, & Saha, 2022:270), resulting in internal ballistics as discussed in paragraph 3.3.1. When the trigger of a firearm is squeezed (or pulled), it causes the hammer to drop, which strikes the primer of the centerfire or priming compound in the rim of rimfire cartridges (Fitzpatrick, 2023; RSE, 2021:23). Pulling the trigger activates the firing pin to strike the primer of the loaded cartridge (Dhabal, Nandi, Sen & Saha, 2022:270). The trigger press rotates the sear, which sends the firing pin against the primer (Hall, 2014). Once the firing pin hits the primer, the primer ignites the propellant.

The burning propellant produces gases that build pressure inside the cartridge case, which pushes the bullet forward and out of the cartridge case (Fitzpatrick, 2023). As the propellant burns, gases build up inside the cartridge, and the bullet gets pushed forward into the barrel. The bullet is forced down the barrel by the expanding gases, and the cartridge case is slammed back against the breech face. Imperfections in the barrel and on the breech face are transferred to the surfaces of the fired bullet and cartridge case. As the bullet moves down the barrel and exits the firearm, the cartridge case either remains in the back of the barrel or is ejected by an ejector mechanism (Dhabal et al., 2022:270; RSE, 2021:8). The way the fired cartridge case is ejected determines which cartridge is next to chamber, depending on the type of firearm action, such as single, double, or bolt-action (Fitzpatrick, 2023).

3.9 THE FORMATION OF FIREARM MARKS ON FIRED CARTRIDGE CASES AND BULLETS

Unique surface features are created during firearm manufacturing that cannot be duplicated by other firearms (Smith, 2022). Firearms have features determined by what the manufacturer includes, such as the calibre of the cartridge chambered by the firearm, the orientation of the extractor and ejector, and the number, width, and twist direction of the land and grooves of the barrel rifling. These features can be imparted as toolmarks on fired cartridge cases and bullets during the firing process (Thompson, 2017:8).

Forensic firearm identification marks are toolmarks imparted on the topography of a fired bullet or cartridge case surface when it encounters a more rigid surface of firearm

parts, such as the firing pin, breech face, or barrel, during the firing process (Vorburger et al., 2016). Because firearms consist of multiple components, when these parts come into contact with the softer materials of cartridge cases and bullets, distinctive forensic marks are imparted to the fired cartridge cases and projectiles. Their formation occurs when a primer detonates, and the propellant starts burning; the cartridge case then expands, resulting in the imprint of the firearm's breech face on the fired cartridge case. When a shot is fired, the firearm's barrel imparts striations on the surface of the bullet, and the firing pin, breech face, chamber, extractor, and ejector imprint the cartridge case with distinct forensic firearms marks (Mahanta et al, 2019). Forensic firearms marks are imparted on the softer material of the cartridge case and bullet because the internal part of the firearm is made of a harder metal. Whenever the firearm parts and cartridge case (Mutsavi & Meintjies van der Walt, 2020:4) interact, the interaction between a more rigid firearm surface and a softer surface of ammunition components, such as fired cartridge cases and bullets, results in distinctive patterns (Patteet & Champod, 2024).

Transferring forensic firearm identification marks from firearm parts to fired ammunition components requires direct contact (Vorburger et al., 2016). Sufficient force is essential during the formation of forensic firearm identification marks to have enough force when contacting the ammunition components, such as bullets and cartridge cases, to permanently and clearly indent marks on the receptive surface, which includes fired cartridge cases and bullets (Kumar, Saxena, & Gautam, 2021). Sufficient force allows the firearm parts to impart dominant marks on fired cartridge cases and bullets. Where the force was insufficient during the contact of the firing parts and ammunition, the firearm marks are slightly imparted on the ammunition components, such as the bullet and cartridge cases.

3.10 FORENSIC FIREARM IDENTIFICATION MARKS ON FIRED CARTRIDGE CASES AND BULLETS

The breech face, extractor, firing pin, ejector, chamber marks, and rifling patterns are forensic firearm identification marks that can be visible under a comparison microscope (Patil, 2018; RSE, 2021:31). These identification marks are produced in handguns, rifles, and shotguns. The only difference is that the shotgun ammunition does not have bullets, but pellets. The rifling patterns do not apply to shotguns. The researcher finds it essential to illustrate the identification marks on the fired cartridge

cases and bullets. She further mentions and discusses these types of marks, presenting them through microscopic images.

3.10.1 Firearm identification marks on fired cartridge cases

- **Breech face marks**

Breech face marks occur when the cartridge case is pushed back, and the bullet moves forward (Dhabal, Nandi, Sen & Saha, 2022:270). When the base of the fired cartridge case moves backwards, it strikes the breech face of the firearm. As a result, the unique marks of that firearm get imparted on the fired cartridge case (Patil, 2018). The following image in Figure 3.5 depicts breech face marks on two fired cartridge cases.

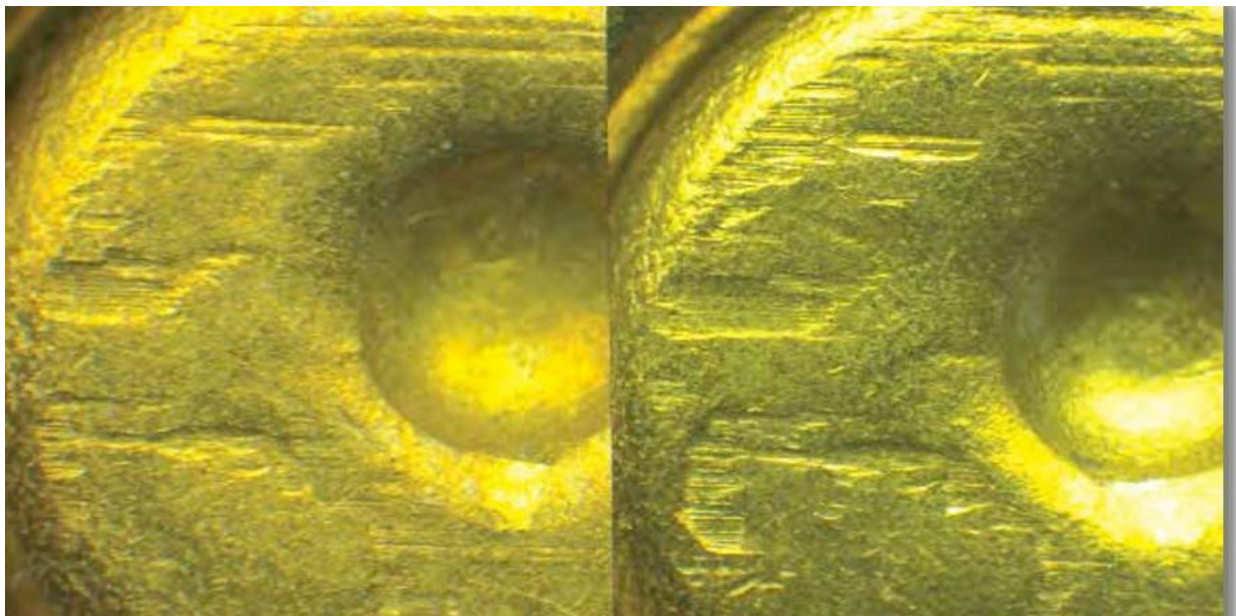


Figure 3. 5: Breech face marks on two fired cartridge cases (Thompson, 2017: 21)

- **Firing pin marks**

Firing pin marks are indentations created when the firing pin of a firearm strikes the primer of a centrefire cartridge or the rim of a rimfire cartridge (Patil, 2018; RSE, 2021:30, 67). Among other kinds of firearm markings left on fired bullets and cartridge cases, those imparted by the firing pin are informative. As the firing pin dents the primer cup and ignites the primer, the indentation of the primer cup by the firing pin transfers the imperfections and shape of the firing pin's tip to the primer cup (Manzalini,

Frisia, Scomazzoni, Angel, & Causin, 2020). Figure 3.6 depicts the firing pin marks on fired rimfire cartridge cases.

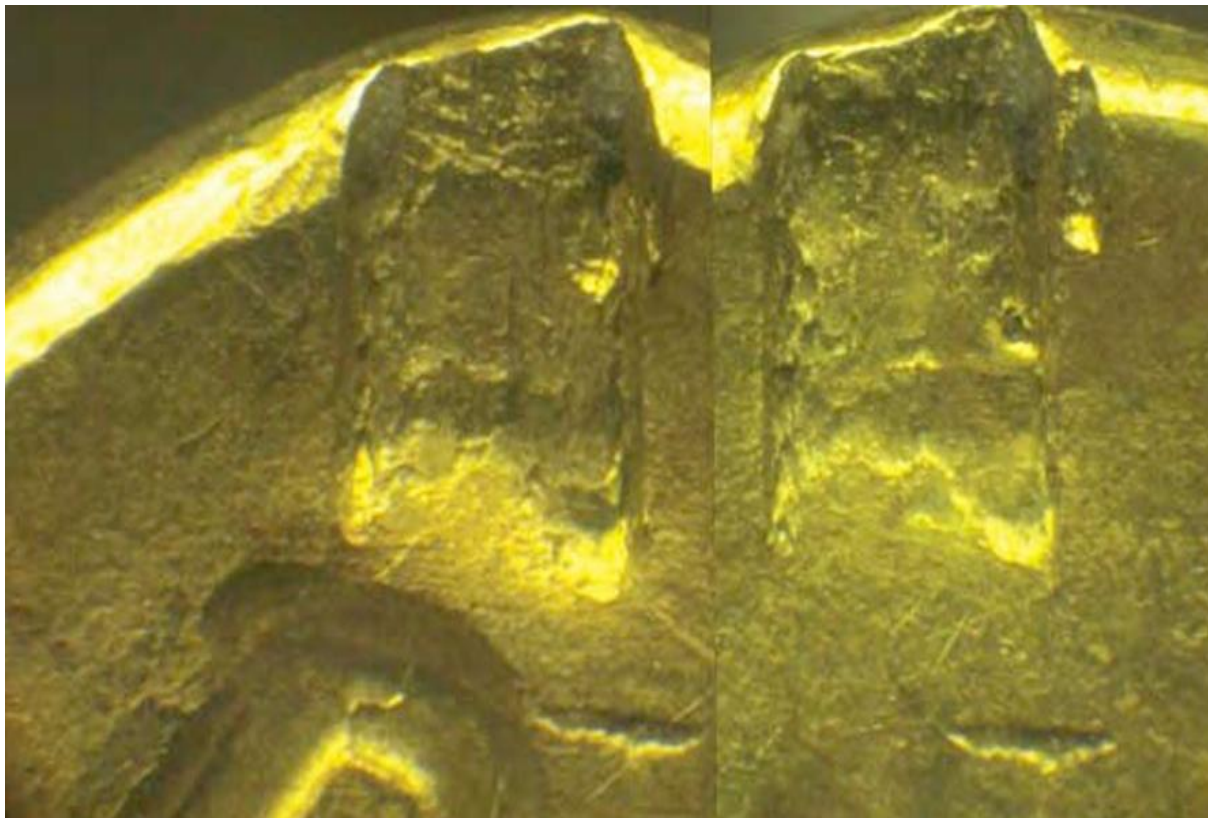


Figure 3. 6: Firing pin marks on two fired cartridge cases (Thompson, 2017:19)

- **Chamber marks**

Chamber marks are found on the body of the fired cartridge case, created by the irregularities of nips inside the walls of the chamber (Patil, 2018). According to Taruvu (2023), the expansion of the cartridge case during the firing process contributes to these marks. The following picture depicts the chamber marks on two fired cartridge cases.

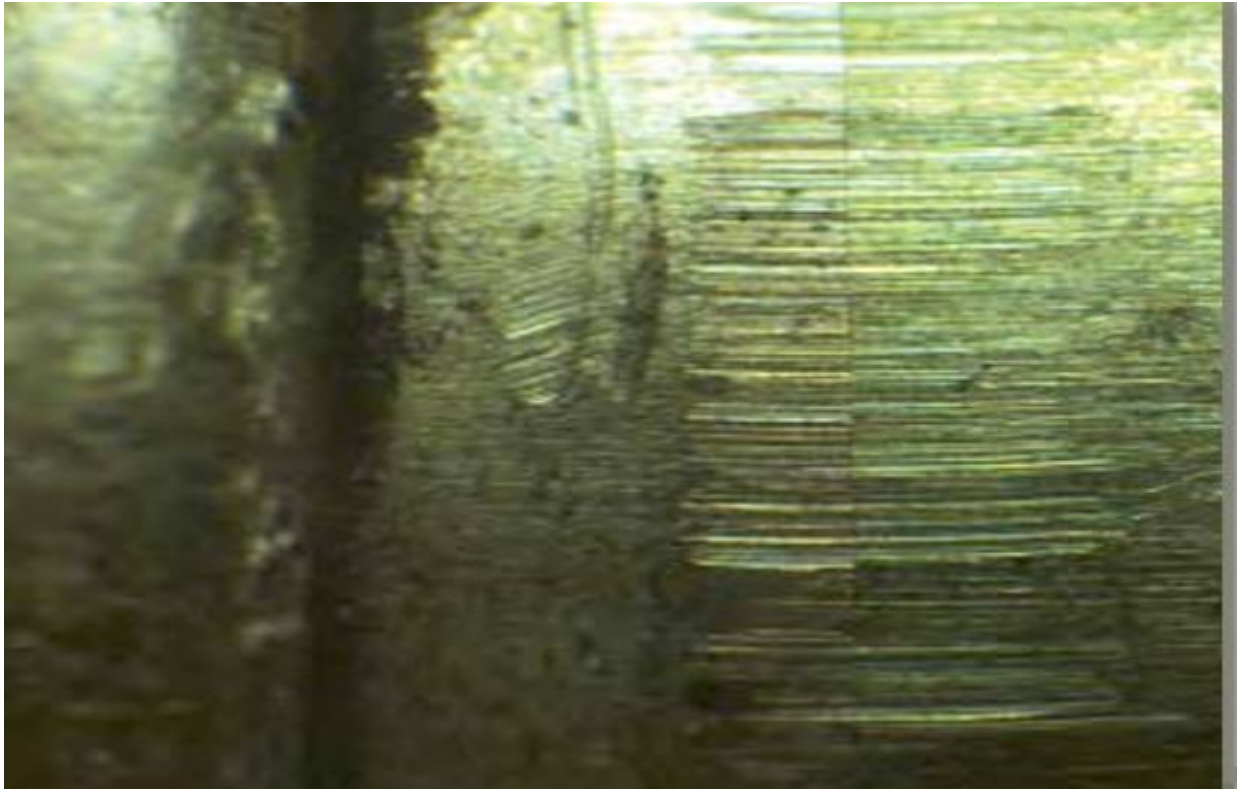


Figure 3. 7: Chamber marks on two fired cartridge cases (Thompson, 2017:20)

- **Ejector marks**

Ejector marks are created on the fired cartridge case when it gets ejected from the firearm action (Patil, 2018). Ejector marks can be identified considering their size, shape, and position on the cartridge case (Taruvu, 2023). Figure 3.8 (below) illustrates the ejector marks of two fired cartridge cases under the microscope.

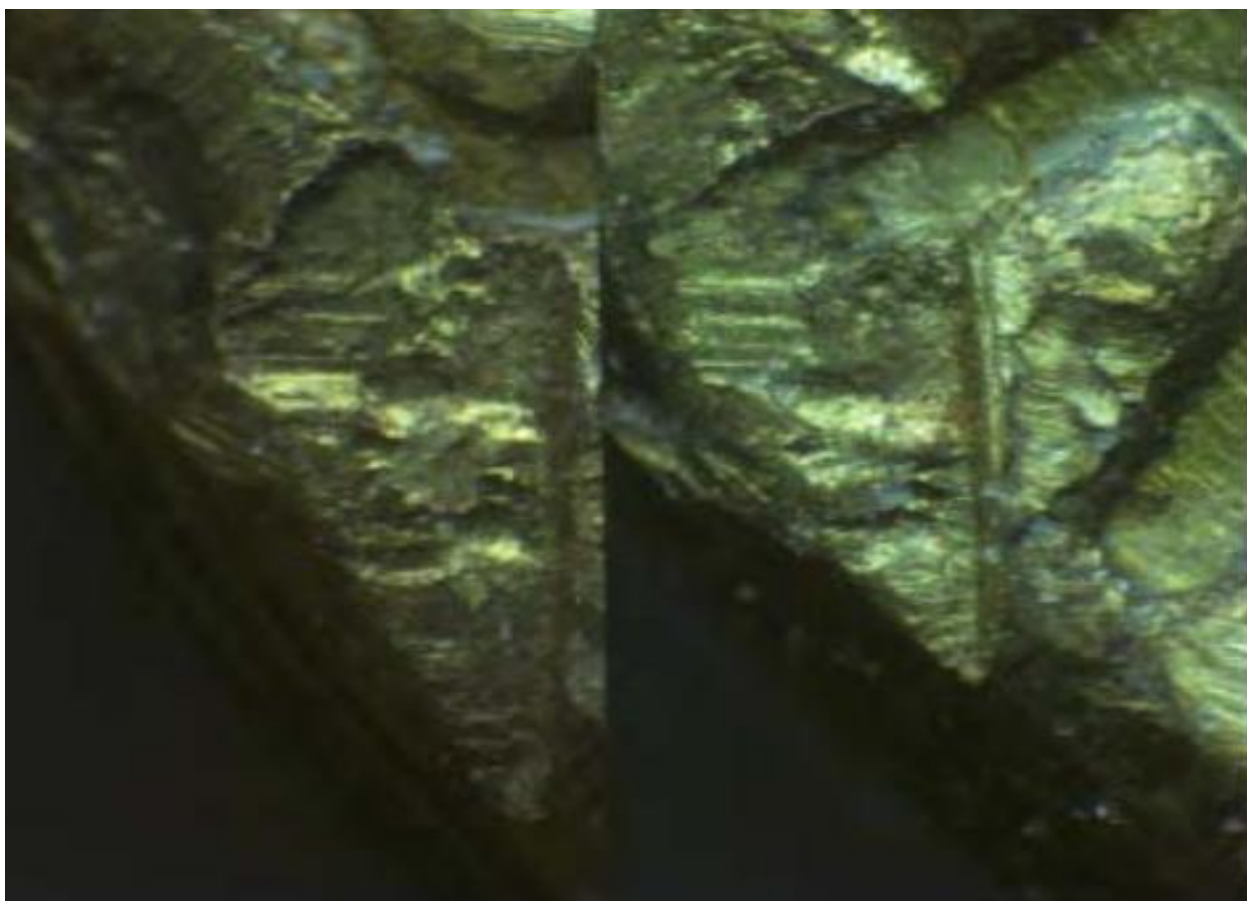


Figure 3. 8: Ejector marks on two fired cartridge cases (Thompson, 2017:22)

- **Extractor marks**

The part of a firearm that extracts the cartridge case from the chamber, after the shot has been fired, is the extractor (RSE, 2021:66). Extractor marks are observed at the extraction groove of a fired cartridge case (Patil, 2018). They are caused by the withdrawal of the fired cartridge case from the chamber after the shot has been fired (RSE, 2021:30).

3.10.2 Firearm identification marks on fired bullets

A fired bullet serves as a source of information that can be used to link the suspect firearm with a crime scene. This applies to firearms that can fire ammunition that comprises a bullet, such as pistols and rifles. This does not apply to shotguns because their ammunition has pellets rather than bullets. According to Saribey, King, Cetin, & Uysal (2025), fired cartridge cases from shotguns are the primary means of conducting forensic firearm identification. During the firing process, as the bullet travels through the barrel of the firearm, rifling patterns from the barrel are imparted on the fired bullet

(Dhabal, Nandi, Sen, & Saha, 2022: 268). Using a bullet for forensic firearm identification relies on the microscopic comparison of rifling patterns imparted on the test-fired bullet and the recovered one from the crime scene.

- **Rifling patterns**

Rifling patterns are created when the bullet moves through the barrel of a firearm during the firing process (RSE, 2021:68). Monturo (2019: 6) described rifling patterns as the rifling striations on the surface of a fired bullet. The characteristics of this barrel get transferred to the surface of the fired bullet. The rifling patterns can be clockwise or counterclockwise, depending on the rifling direction of the barrel of the firearm that fired these bullets. Figure 3.9 (below) illustrates the rifling patterns on a fired bullet fragment and a bullet.

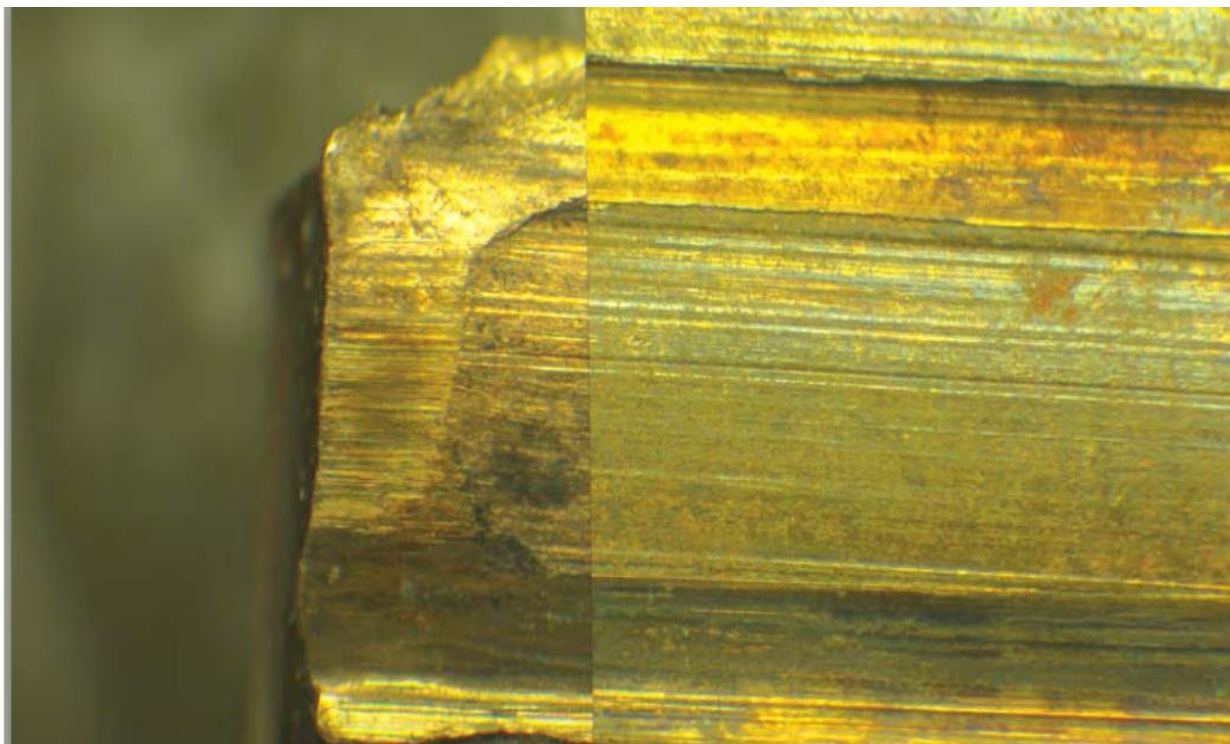


Figure 3. 9: Rifling patterns on a fired bullet fragment and a bullet (Thompson, 2017:18)

3.11 CHARACTERISTICS OF FIREARMS

The characteristics imparted on the fired cartridge cases and bullets are categorised into classes, subclasses, and individual characteristics (Ankney, 2021). These characteristics are discussed below.

3.11.1 Class characteristics

Evaluating class characteristics is the initial stage in forensic firearm identification (Gutierrez, 2024:1541). Class characteristics are the first classification of forensic firearm identification evidence (Thompson, 2017:8) and help narrow the population of potential firearm sources (RSE, 2021:30). Class characteristics are the features that associate an object with a particular source or group (Smith, 2022:12), such as the calibre, shape of the firing pin, number and twist of lands and grooves on a fired bullet. These characteristics play a significant role in eliminating fired cartridge cases and bullets from being fired from a particular firearm, thus restricting the pool of potential firearms. For example, a bullet's class characteristics include its calibre, number of lands and grooves, and the direction of twist, left or right, its composition material, headstamp, bullet weight, and priming material (Ankney, 2021).

While class characteristics are the characteristics of firearms that indicate a common group source, ballistics experts cannot base their findings solely on class characteristics (Lacalamita, 2022:4). Class characteristics narrow the identification to a specific manufacturer, still not to a particular firearm (Dack, 2014:3). Class characteristics are primarily used for classifying forensic firearm identification evidence. When two fired cartridge cases, or bullets, display different class characteristics, an elimination conclusion can be reached (Gutierrez, 2024:1542). For example, two fired cartridge cases, one is 9mm calibre, and the other is 12-gauge calibre. It can be concluded that they were not fired from the same firearm, considering a 9mm calibre can be chambered in a 9mm calibre pistol, while the 12-gauge is typically used for shotguns of this calibre. Here, there is no need for microscopic comparison, and these cartridge cases do not share the same class characteristics.

3.11.2 Sub-class characteristics

Sub-class characteristics are then the next part of the forensic firearm identification process (Gutierrez, 2024:1543). Dack (2014:3) described sub-class characteristics as the marks that temporarily become part of the manufacturing process and are created on a few firearms in each production run. They are not permanent features of the design but indicate an imperfection in the method used to produce a limited number of firearms, which changes over time and usage (RSE, 2021:30). Sub-class characteristics are characteristics produced incidentally during manufacture and are related to a smaller group source than class characteristics (Lacalamita, 2022:4). Like class characteristics, ballistics experts cannot rely only on sub-class characteristics for their conclusions because they are inconsistent. Another characteristic is required, which is scientifically verifiable.

3.11.3 Individual characteristics

Ballistics experts go beyond the classification phase and conduct a microscopic comparison of the fired cartridge cases and bullets, recovered at a crime scene, with the test-fired ones from the suspected firearms, to determine a particular firearm that discharged them. This microscopic comparison of fired cartridge cases or bullets focuses on individual characteristics (Gutierrez, 2024:1542). Individual characteristics are random, typically arising from the tool's working surface or incidental to its

manufacture. They result from use, wear, and abuse of the tool over time and may be considered as unique to each tool (RSE, 2021:30; Thompson, 2017:8).

Individual characteristics are firearm characteristics that can be attributed to a common source with high certainty (RSE, 2021:31; Smith, 2022:12). They are imparted during firearm production (Dack, 2014:3) and are unique. They also occur due to corrosion, damage, and marks resulting from the tool that creates the land and groove of a bullet (Ankney, 2021). Similarly, Lacalamita (2022:4) pointed out that individual characteristics are formed during the manufacturing process of the firearm and due to use, abuse, corrosion, and wear. Forensic firearm identification relies on individual characteristics that are unique to each firearm (Gutierrez, 2024:1543). These individual characteristics cannot be duplicated in other firearms; hence, they are reliable for forensic firearm identification.

3.12 FORENSIC FIREARM IDENTIFICATION THROUGH MICROSCOPIC COMPARISON

A microscopic comparison of fired bullets or cartridge cases plays an important role in forensic firearm identification. It is essential to explain the principle behind comparison. The forensic principle of comparison purports that only like cases can be compared (Kumar, Saxena, & Gautam, 2021). In forensic firearm identification, cartridge cases can only be compared with cartridge cases, and the same principle applies to bullets. Only objects of the same nature can be compared. The prime objective of this microscopic comparison is to identify the firearm that discharged the fired cartridge cases and bullets in criminal investigations or any firearms-related incidents.

Figure 3.10 depicts the process of forensic firearm identification, covering the recovery and handling of firearms-related evidence at the crime scene; the examination and analysis of such evidence; the categories of formal findings; the acquisition of fired bullets and cartridge cases as evidence on IBIS; and issuing ballistics reports. During the CIT armed robberies that involve shootings, or any other firearms-related incidents, forensic firearm identification evidence such as firearms, fired bullets, and cartridge cases is recovered at the crime scenes by the investigating officers. Such evidence will be photographed, marked, collected, and packaged in forensic evidence bags. The investigating officers submit the recovered evidence to the FSL for ballistics

analysis. The process of forensic firearm identification is discussed in sections 3.12 to 3.13.

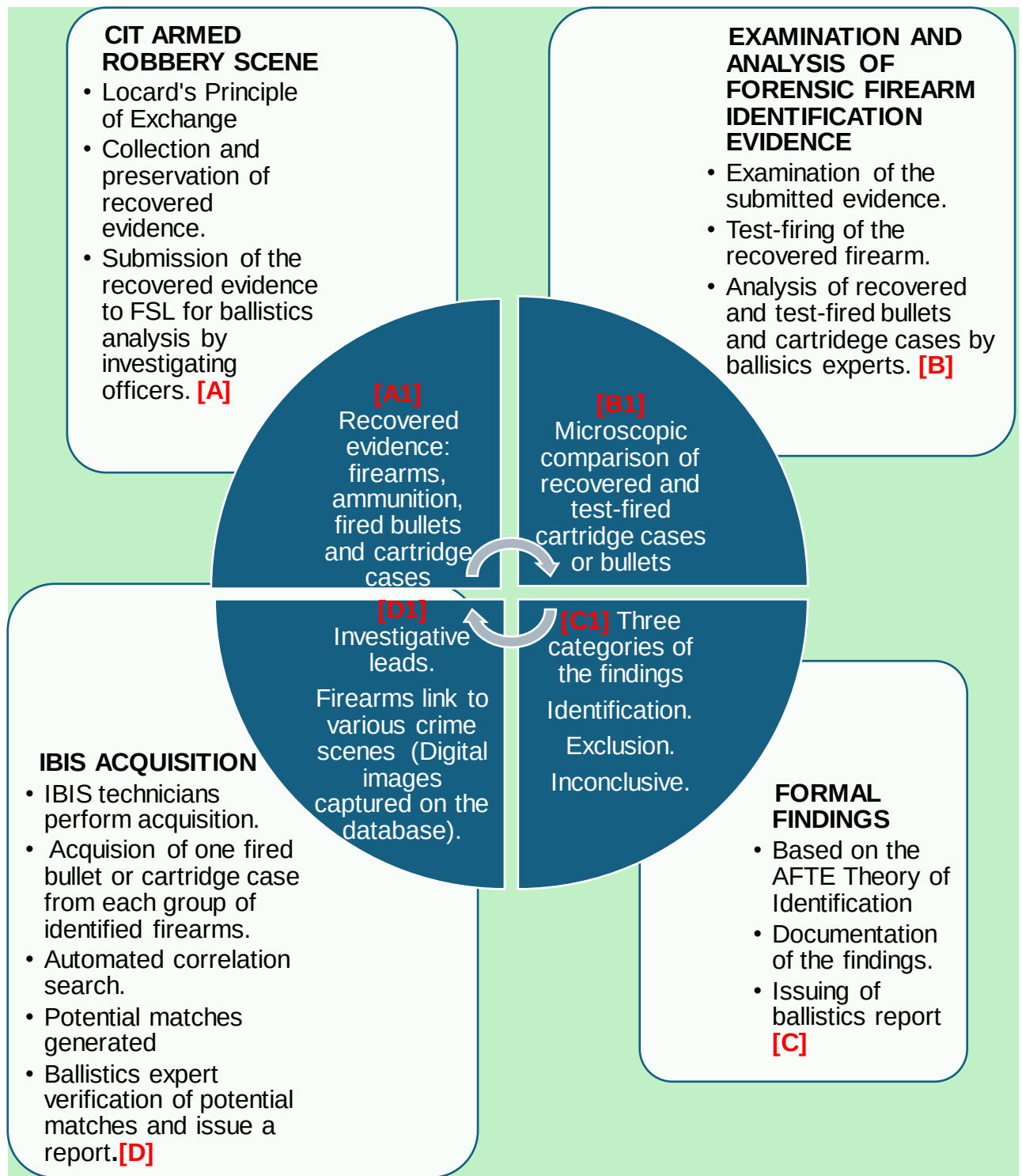


Figure 3. 10: Process of forensic firearm identification (Researcher, 2026)

There is no single approach to examining forensic firearm identification evidence (Thompson, 2017:26). Although various forensic science laboratories follow different protocols, it all depends on the need for investigation, based on what the request letter entails in terms of the forensic firearm identification firearm evidence that need to be examined (Thompson, 2017:24). The purpose of comparing forensic firearm identification evidence such as fired cartridge cases or bullets is to identify the specific firearm that discharged them (Kumar, Saxena & Gautam, 2021).

Ballistics experts in forensic firearm identification intend to match the fired cartridge cases and bullets recovered from the crime scene with the test-fired ones from the suspect firearm or to exclude such suspect firearm (Mutsavi & Meintjies van der Walt, 2020:4). Forensic firearm identification is based on the preliminary examination of the evidence for similar class and individual characteristics (Sharma, 2019a). The microscopic comparison of fired bullets and cartridge cases helps the examiner link them to the suspect firearm or otherwise exclude them (Akansha, 2020). The forensic firearm identification process has several stages, which are outlined below.

3.12.1 Examination of firearms, ammunition, and ammunition components

The overall characteristics of the firearms such the manufacturer, serial number, model, safety features and functionality, action design, cartridge capacity, submitted ammunition and magazines, trigger pressure, and operability are documented by the ballistics expert (Thompson, 2017:27). The ballistic expert will study the class characteristics of the firearm evidence such as the firearms, cartridge cases and bullets, to exclude several suspected firearms (Nandi, Sen & Mahanti, 2022:2545).

Class characteristics are not sufficient to identify a firearm; instead, they narrow the number of possible firearms and guide ballistics experts in determining the type of firearm that might have been used in the commission of a crime (Oetken, 2024).

3.12.2 Test-firing of a suspected firearm

The recovered firearm will be test-fired to get fired cartridge cases and bullets that will be compared with the recovered fired cartridge cases or bullets from the crime scenes. Suppose the class characteristics of the test-fired cartridge cases or bullets, the recovered fired cartridge cases or bullets from the crime scene, differ. In that case,

this will conclude the examination with exclusion or elimination findings (Thompson, 2017:27).

3.12.3 Microscopic comparison of test-fired bullets and cartridge cases with those recovered from the crime scenes and their acquisition on IBIS

The science of forensic firearm identification relies on comparison microscopy of test-fired cartridge cases or bullets with those recovered from crime scenes (Carlson, 2024). Cartridge cases can only be compared with other cartridge cases, and the same principle applies to bullets. Suppose the class characteristics of the test-fired cartridge cases or bullets are the same as those of the recovered fired cartridge cases or bullets. In that case, the ballistics expert will perform a microscopic comparison to determine if the individual characteristics have sufficient agreement to conclude. The test-fired cartridge cases and bullets will be microscopically compared with the recovered fired cartridge cases or bullets (Lacalamita, 2022:2).

During the microscopic comparison of fired bullets or cartridge cases, the ballistics expert analyses striations and impressions to show sufficient agreement between the evidence and test-fired bullets or cartridge cases as presented in section 3.10 (Carlson, 2024). The ballistics experts are focusing on the matching patterns on the compared bullets or cartridge cases. In instances where the firearm in question was not submitted to the FSL for any reason, the class characteristics of fired cartridge cases and bullets will be identified. Cartridge cases or bullets with the same class characteristics will be microscopically compared to determine whether they were fired from the same firearm. The identification will be based on individual characteristics (Lacalamita, 2022:2). When comparing fired cartridge cases, focus should be on the shape of the firing pin impression and the position of ejector and extractor marks. The fired cartridge cases and bullets will be acquired on IBIS for further comparison with those already in the database.

Possible conclusions of evidence analysis whereby only fired cartridge cases or bullets were sent to the FSL for ballistics analysis include the calibre of the ammunition and the type of the firearm that discharged this firearm evidence (Lacalamita, 2022:2). It can also be determined whether the fired cartridge cases or bullets were fired from the same firearm (Lacalamita, 2022:2). But unless the suspect firearm was not recovered

along with the recovered fired cartridge cases and bullets, it is impossible to scientifically prove which specific firearm was used (Lacalamita, 2022:2). The only definitive conclusion that can be made is related to the calibre of the firearm used, based on the recovered evidence. Different fired bullets and cartridge cases will be acquired on the IBIS for further comparison with the stored images or patterns of the fired cartridge cases and bullets already in the database. If there is a match, usually called a hit, the identified firearm was used to commit a crime in various places. If it was found in one of the linked crime scenes, then the firearm is found. If there is no hit, the image of the fired cartridge case or bullet, along with its forensic characteristics, will be captured in the database for future reference.

3.12.4 Possible findings based on the AFTE Theory of Identification

Possible outcomes for forensic firearm identification evidence include identification, elimination, and inconclusive (Lacalamita, 2022:2). In 1992, the AFTE issued three distinct forensic firearm identification conclusions:

- **Identification**

Identification outcome is when the fired cartridge cases or bullets were fired from the same firearm. It is also known as a positive finding. Identification is declared when class and individual characteristics of the microscopically compared fired bullets or cartridge cases agree (Lacalamita, 2022:5). Identification can be concluded when sufficient agreement is established on the observed firearm marks characteristics of the compared fired cartridge cases or bullets (AFTE, 1992). Sufficient agreement involves the duplication of forensic firearm identification marks, corresponding in terms of size, pattern, and position of the fired cartridge cases and bullets under microscopic comparison.

- **Exclusion**

Exclusion is also known as a negative conclusion or elimination. When there is a significant disagreement in characteristics, it eliminates the firearm in question as the source of the fired cartridge cases or bullets being compared (AFTE, 1992). Elimination refers to a situation in which fired cartridge cases or bullets were not fired from the same firearm. Regarding elimination, class characteristics agree, but

individual characteristics disagree on two or more compared cartridge cases or bullets (Lacalamita, 2022:5).

- **Inconclusive**

Insufficient similarities or differences to determine whether the fired cartridge cases or bullets under microscopic comparison were fired from the same firearm (AFTE, 1992). The findings become inconclusive when it cannot be determined whether the fired cartridge cases or bullets were fired from the same firearm, due to insufficient marks or damage (Lacalamita, 2022:2).

3.12.5 Confirmation of the microscopic comparison findings

Forensic firearm identification requires microscopic comparison findings to be confirmed by a second ballistics expert. The ballistics expert should not know previous forensic firearm identification results before making their own judgement. This will ensure that both ballistics experts have done the microscopic comparison objectively (Lacalamita, 2022:8). Ballistics experts present testimony based on their training and level of expertise (Thompson, 2017:27). The ballistics report, produced by the ballistics expert, should describe the received evidence, observations during the examination, and conclusions based on the examination.

3.12.6 Documentation of the analysis findings report and court charts

The findings must be documented and supported by photographs, measurements, and court charts (Carlson, 2024). The microscopic comparison findings of the firearm evidence must be supported by documents in the case file, sketches, court charts, photographs, and request letters from the investigating officers. These details weigh the testimony in favour of the prosecution or defence. The documentation of the findings is followed by a detailed ballistics report that outlines the quantity and description of the firearm evidence received and the type of analysis performed. The results of the analysis are also included in the report. It is also essential to indicate the exact dates on which the exhibits were received, analysed, and disposed of. This will help maintain the chain of custody. The forensic evidence bag numbers of the bags in which the exhibits were received, and those used to reseal them, are also specified on the ballistics report, case docket diary, and examination proformas of bullets, cartridge cases, and firearms.

3.12.7 The process of returning the firearms and ammunition as exhibits to the investigating officers.

After examining and analysing forensic firearm identification evidence, the firearm and the remaining ammunition are packaged in a forensic bag and submitted to the Case Administration Management of the Ballistics section. The investigating officers will collect them through the Property Control and Exhibit Management (PCEM) system. It is a biometric system that tracks and manages the movement of exhibits to maintain the chain of evidence.

3.12.8 Review of the ballistics case

The forensic firearm identification cases, like any other ballistics cases, are subjected to peer review by more experienced ballistics experts. This occurs once the ballistics experts are done with the forensic firearm identification evidence analysis. The findings on the report and the proforma should correspond. The reviewer must be qualified in the level of expertise they are reviewing the case and must have been tested in the tasks being examined to ensure that the FSL's technical procedures are complied with (Lacalamita, 2022:8). In forensic firearm identification, the reviewer will verify that the information provided in the ballistics report corresponds with what the case docket entails. For example, if the report is about a 9mm calibre Norinco pistol, which was found to have discharged three fired cartridge cases recovered from the crime scene, the proformas in the case docket should reflect as such. If the reviewer notices any discrepancy, the ballistics expert who performed the analysis will be notified and must correct it before it can be approved.

3.12.9 Issuing of ballistics report in terms of the Criminal Procedure Act 51 of 1977

Once the ballistics case has passed the reviewing stage, the report can be issued on a finalised case. The ballistics report will be handed over to the Ballistics Case Administration Management by the ballistics expert, who will then upload it to the Integrated Case Docket Management System (ICDMS). This system enables investigating officers to access the ballistics report from their respective computers. The investigating officers will be notified of the readiness of their reports; this can also be achieved through their follow-ups on their submitted ballistics cases.

3.13 INTEGRATED BALLISTICS IDENTIFICATION SYSTEM (IBIS)

The IBIS is an automated software that produces, acquires, stores, and compares images of firearm markings on fired cartridge cases and bullets recovered from the crime scene. Forensic Technology Inc. developed it. It utilises electronic technology to digitally capture images and compare them with those of fired cartridge cases and bullets recovered from the crime scene, already stored in the database (Garpade, 2024).

Automation is identified as the most critical trend reshaping the forensics landscape (Lowden, 2023). In the context of forensic firearm identification, automated systems such as IBIS analyse and compare fired cartridge cases or bullets recovered from crime scenes with the test-fired ones to determine whether they are of the same origin. This is achieved through algorithms that compare the unique marks imparted on the fired cartridge cases and bullets during the firing process (Lowden, 2023). The same author further indicated that algorithms could match these marks against the stored ones in the IBIS database, thus speeding up the identification of potential matches.

The comparison of images using filters, such as date of analysis, rifling specifications, and calibre, utilises sophisticated algorithms. The IBIS technician will get a list of possible matches with the highest score. The two images will then be compared on the monitor. If the association is confirmed, a visual examination will be made using a comparison microscope (Garpade, 2024). IBIS saves time spent manually comparing two fired cartridge cases or bullets under the comparison microscope (Morgan & Jorna, 2018).

3.14 CHALLENGES AND LIMITATIONS OF FORENSIC FIREARM IDENTIFICATION

Although forensic firearm identification plays an important role in the investigation of firearms-related crimes and incidents, there are challenges and limitations associated with it. Khan (2023) highlighted that the science behind forensic firearm identification relies on the availability of firearms and recovered fired cartridge cases and bullets for comparison. Based on the researcher's experience as a former ballistics expert, there are instances where the recovered fired cartridge cases and bullets from the crime scenes are submitted to the FSL for ballistics analysis, without a suspected firearm. In that case, the fired cartridge cases or bullets will only be compared with each other to

determine whether they were fired from the same firearm. To identify the specific firearm that discharged them will require a known standard; in this case, it should be the suspected firearm. Apart from that, the other alternative depends on the availability of the suspected firearm sample on the IBIS database. Through the acquisition of the recovered fired cartridge case and bullet on the IBIS, they can be linked with other exhibits on that system. This is when it is established that the firearm was used in various crime scenes.

The subjective nature of forensic firearm identification, which relies on the training and experience of ballistics experts, was also identified as a challenge (Patteet & Champod, 2024). Interpreting the analysis is based on their training, observations, and experience. This may lead to overconfidence, resulting in exaggerated claims and errors. According to Cuellar (2025:2), false negative and false positive conclusions are identified as challenges, as they mislead the court. The same author described a false positive as an error that occurs when the ballistics expert concludes that two different fired bullets or cartridge cases were fired from the same firearm. At the same time, a false negative occurs when it is concluded that bullets or cartridge cases from the same source were not fired from the same firearm.

Inconclusive findings are also challenging, especially when used where the ballistics expert is undecided whether the analysis results in a positive or negative outcome. Usually, inconclusive conclusions are used as an intermediate conclusion, whereby the ballistics expert cannot make a specific conclusion about forensic firearm identification evidence analysis. This form of conclusion indicates that the ballistics expert cannot tell whether the analysed evidence was fired from the same firearm. Inconclusive findings also hinder the estimation of error rate in forensic firearm identification evidence, as discussed in the next section.

3.15 AN ESTIMATION OF FORENSIC FIREARM IDENTIFICATION ERROR RATE

Although an estimated error rate is achieved through research, proficiency tests, and validation studies, the error rate is not established (Lacalamita, 2022:2). Estimating the error rate of firearm identification evidence is a challenge in forensic science (Song, Vorburger, Chu, Yen, Soons, Ott, & Zhang, 2018:15). Errors in tests reflect a specific ballistics expert's failure in forensic firearm identification (Lacalamita, 2022:2)

Dorfman and Villiant (2022) argued that when ballistics experts declare the fired cartridge cases or bullets inconclusive, it is a kind of failure to determine whether they are of a common origin. As a result, inconclusive findings fail to contribute to the prosecution of the suspect if the fired bullets or cartridge cases were fired from the same firearm; and conversely, if they were fired from different firearms, they will fail to contribute to the defence of the suspects (Dorfman & Villiant, 2022). Inconclusive findings create uncertainty about whether findings are positive or negative, and a lack of standardisation influences whether it should be regarded as an error (Cuellar, 2025:11). When assessing the error rate of forensic firearm identification, inconclusive findings remain a challenge, since the results are not absolute.

3.16 TRAINING OF THE BALLISTICS EXPERTS

Although every criminal case is unique, one commonality among them is the use of an expert witness (Pumphrey, 2022). The author further indicated that the expert testimony is based on scientific, technical, and other specialised knowledge to solve crimes and assist the court in prosecuting criminal cases. In this study, a ballistics expert is utilised in CIT armed robbery cases for examination and analysis of firearms-related evidence (Pumphrey, 2022). The ballistics experts' ability to perform their duties, which include firearm identification, is shown through their academic qualifications, training, experience, and successful completion of competency tests. They undergo internal training before resuming case work and providing reports for court purposes. After completing their training sessions, they are assessed through competency tests and oral examinations by ballistics trainers (Lacalamita, 2022:7).

Once the ballistics experts have completed training and are authorised to perform case work, they are expected to complete proficiency tests annually (Lacalamita, 2022:7). Proficiency tests are samples provided to the ballistics experts to analyse, in which the ground truth is known. Ballistics experts gain experience in recognising patterns of firearm characteristics during the training process by examining and conducting microscopic comparisons of fired cartridge cases and bullets. This skill is achieved through sufficient practice with dummy dockets before handling actual cases (Lacalamita, 2022:7). Ballistics experts enhance their knowledge of firearms by working under the supervision of more experienced ballistics experts (Pumphrey, 2022).

3.17 THE ROLE OF FIREARM IDENTIFICATION EVIDENCE IN THE INVESTIGATION AND PROSECUTION OF CIT ARMED ROBBERIES

The role of forensic firearm identification in the investigation and prosecution of CIT armed robberies and other firearm-related crimes or incidents involves the linking of fired cartridge cases and bullets to a specific firearm recovered from the crime scene or seized from the suspected armed robbers (Davies, 2023). Morgan and Lorna (2018:2) pointed out that forensic firearm identification evidence determines whether the recovered firearm fired the cartridge cases found at the crime scene. Forensic firearm identification results are supported by other evidence, such as fingerprints, DNA, witness interviews, and other physical evidence found at the crime scene to link the recovered firearm with the suspected armed robbers (Morgan & Lorna, 2018:2).

Any form of evidence has a unique value in a crime investigation. The investigating officers must keep in mind the value of all types of evidence (Morgan & Lorna, 2018:2). As part of the investigation process of CIT armed robberies, firearms, fired cartridge cases and bullets are usually recovered from the crime scenes (Morgan & Lorna, 2018:2). The forensic firearm identification results, after the analysis of the firearm evidence by ballistics experts, guide the investigating officer on the make, calibre, model, safety features and the working mechanism of the firearm recovered from the crime scene. Through microscopic comparison of the recovered fired cartridge cases or bullets and the test-fired ones from the recovered firearm, the findings include or eliminate the possibility of the recovered firearm having been discharged at the crime scene. This information is used in the prosecution of CIT armed robberies and other firearms-related crimes or incidents (Schiro, 2023).

3.18 THE RELIABILITY AND ADMISSIBILITY OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN COURT

It is the responsibility of ballistics experts to present evidence in court, considering disclosure, transparency, and impartiality in their testimony. This will assist the court in comprehending the process of evidence collection, processing, and analysis to determine the probative value of forensic firearm identification evidence and the credibility of the ballistics experts (Mutsavi & Meintjies van der Walt, 2020:4). According to Taylor (2024), the accuracy of the findings depends on the training and use of validated methods. Although the overall skills of the ballistics experts are not in

question, forensic firearm identification evidence must be supported by scientific methods and principles (Patteet & Champod, 2024).

Prosecutors have exclusive control over evidence and decide how to use it. Prosecutors sometimes present forensic science and leave the defence to identify and explain its weaknesses and limitations through cross-examination (Mutsavi & Meintjies van der Walt, 2020:4). However, prosecutors should independently obtain information about the limitations and oversights regarding expert opinion evidence. The same authors argued that defence lawyers might lack resources and not be literate enough to recognise and explain the weakness in forensic evidence.

Cross-examination plays an important role in ensuring that forensic firearm identification evidence is reliable and valid. Cross-examination is the questioning of a witness in a trial by the opposing party (Mutsavi & Meintjies van der Walt, 2020:4). Every party has the right to confront the testimony from an opposing witness. As a result, no statement should be excluded as testimony in court until it has been challenged by the opposing party (Mutsavi & Meintjies van der Walt, 2020:4).

The admissibility of forensic firearm identification is based on its relevance (Mutsavi & Meintjies van der Walt, 2020:4). The reliability of expert testimony plays an important role during trial, particularly through cross-examination, when the opposing party presents evidence. Few studies on forensic firearm identification exist, and those that indicate that ballistics experts cannot reliably determine the origin of fired cartridge cases and bullets (Faigman, Scurich & Albright, 2022). The same authors emphasised the importance of firearm identification to adhere to consistent and evidence-based standards, because the lack of such standards may result in the conviction of innocent people and the release of the guilty.

3.19 SUMMARY

The science behind forensic firearm identification, the history of forensic firearm identification, forensic firearm identification in ballistics, Theory of Identification by the AFTE, the types of firearms, ammunition construction and terminology, the uniqueness of firearms, the firing process of a firearm, the formation of forensic firearm identification marks, forensic firearm identification marks on fired cartridge cases and bullets, and the characteristics of forensic firearm identification marks were discussed

in this chapter. The process of forensic firearm identification through microscopic comparison and the IBIS was also examined, along with the challenges and limitations of forensic firearm identification. An estimation of the error rate in forensic firearm identification and the training of ballistics experts were also included. The role of forensic firearm identification evidence in the investigation and prosecution of CIT armed robberies, and its reliability and admissibility in court, was covered. The research methodology of this study is presented in the next chapter.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

The research approach and design of the study are presented in this chapter. The research methodology was guided by the research aim and objectives of this study. The researcher adopted a qualitative research approach. A case study was employed as the research design to explore the investigative value of forensic firearm identification evidence in the context of CIT armed robberies in the West Rand District Municipality. Semi-structured interviews were conducted with the participants to obtain data, which was later transcribed and analysed thematically. This is discussed in detail under the relevant headings below.

4.2 PHILOSOPHICAL WORLDVIEW OF THE STUDY

A philosophical worldview is the process of acquiring research knowledge (Zukauskas, Veinhardt & Andriukaitiene, 2018:122). Creswell (2014:6) emphasised the significance of a philosophical worldview in research and indicated that it guides the researcher in planning how the research will be conducted. According to Creswell (2014:4), there are constructivist, post-positivist, pragmatic, and transformative worldviews. According to Panda (2022), they can also be regarded as various approaches to discovering knowledge, interpreting, and using the findings. The researcher studied the literature on these worldviews, and for this study, the constructivist worldview is adopted.

4.2.1 The Constructivist worldview

Constructivist researchers interpret how other people perceive the world. They inductively develop a pattern of meanings (Creswell, 2014:8). Social constructivists believe that people are eager to understand their social world (Creswell, 2014:8). How they perceive the world is based on subjective interpretations (Creswell, 2014:8). Qualitative researchers depend on the participants' views about the research phenomenon. The participants' experience determines their views. The situations that they have been exposed to allow them to interpret their social world. Qualitative researchers explore the participants' views through this context and data collection. The research questions are clear to ensure that participants express themselves with understanding. The rationale for choosing a constructivist worldview is to explore the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies, considering the research aim.

4.3 RESEARCH APPROACH AND DESIGN

As already mentioned in section 4.1, a qualitative research approach was adopted in this study. It focuses on collecting and analysing qualitative data obtained from the participants regarding the research topic and problem (Bhandari, 2020). This research approach enabled the researcher to understand the research topic and problem through the views and experiences of DPCI investigating officers, former ballistics experts, and prosecutors regarding the investigative value of forensic firearm identification evidence.

Research design is described as a strategy that specifies sampling, data collection, and analysis methods (Nieuwenhuys, 2016b:72). The researcher chose a case study as a research design. McCombes (2019b) defined a case study as a thorough examination of a certain concept in social research. According to McCombes (2019b), case studies describe the research problem by discussing the relevant dynamics. The researcher explored the investigative value of forensic firearm identification in CIT armed robberies within the West Rand District Municipality.

4.4 TARGET POPULATION

As already mentioned in section 4.3, the study was conducted in the West Rand District Municipality, Krugersdorp. The researcher chose this area because of the high number of CIT armed robberies reported to have taken place there. The SAPS crime statistics for the third quarter of the 2021/2022 period indicated that Krugersdorp ranked second among the top 30 stations in the country, with a 200% increase in CIT robberies (Botha, 2022). Ngo-Ndjana (2020) described the target population as the potential participants. The target population in this study comprised investigating officers from the DPCI SOCIU in the West Rand District Municipality, specifically those based in Krugersdorp, who are tasked with investigating CIT armed robberies. Initially, the researcher planned to interview ballistics experts from the Ballistics section at the FSL in Pretoria. However, when permission to access them was denied, a decision was made to identify former ballistics experts from the Ballistics section at the FSL in Pretoria, who were tasked with analysing forensic firearm identification evidence, as an alternative source of data gathering. The prosecutors based in Kagiso Regional Court in Krugersdorp, responsible for prosecuting CIT robberies, were also included. According to Maree and Pietersen (2016:192), it is impossible to study the whole

population due to time and cost constraints, and for that reason, a target population was identified.

Table 4. 1: Target Population

SAMPLE GROUP	N	n
SAMPLE A: DPCI SOCIU in the West Rand District Municipality	3	2
SAMPLE B: FSL Pretoria Ballistics experts (Former)	5	4
SAMPLE C: Prosecutors at the Kagiso Regional Court	2	1
TOTAL	10	7

The sampling of the target population is discussed next.

4.5 SAMPLING

Sampling is the process of choosing the participants from the entire population (Bhardwaj, 2019). Datta (2018) defined population as all individuals who meet a specified criterion. A non-probability sampling technique was used to select the participants. Howard (2019) described non-probability sampling as any sampling technique based on non-random selection. This sampling technique is used during the exploratory phase, with a specific target population in mind (Elliot, 2020). This study consisted of three samples, A, B, and C. The participants were experts in the subject matter. Purposive sampling was used in all samples, and snowball sampling was also applied.

Purposive sampling is a form of non-probability sampling in which the selected sample represents the entire target population (Stratton, 2024:121). Maree and Pietersen (2016:198) pointed out that purposive sampling is used when the sampling is done with a specific purpose in mind. The criteria of inclusion and exclusion must be detailed in the report. McCombes (2021) mentioned that an effective purposive sample must have clear criteria and a rationale for inclusion and exclusion. According to Makwana, Engineer, Dabhi, and Chudasama (2023:766), the inclusion criterion is based on individuals who are relevant to the study through experience. Snowball sampling is

also a non-probability technique in which selected sample individuals refer the researcher to potential participants (Nikolopoulou, 2023). The three sample groups are discussed below.

4.5.1 Sample A: DPCI Serious Organised Crime investigating officers in the West Rand District Municipality: Krugersdorp

The DPCI SOCIU in the West Rand District Municipality, Krugersdorp, had three investigating officers specialising in investigating CIT robberies. The researcher discovered that the unit was understaffed due to retirements, resignations, and employees pursuing new career paths. As a result, the researcher, with her supervisor's advice, worked with the available potential participants. Of the three investigating officers, the researcher conducted a pilot interview with one with less experience. The remaining two investigating officers participated in the interviews conducted for this study.

4.5.1.1 Biographical data: Investigating officers

Two investigating officers were interviewed, as indicated in section 4.5.1. It was a male and female investigating officers. One of the investigating officers does not have a post-matric qualification, while the other one has a Diploma in Police Practice. Regarding their working experience, one has more than 10 years, and the other has more than 40 years.

4.5.2 Sample B: Former ballistics experts from FSL in Pretoria

Initially, this sample was intended to comprise the ballistics experts serving at the FSL in Pretoria, specifically the Ballistics section. Due to access limitations, the researcher utilised the expertise of former ballistics experts who had worked at FSL in Pretoria, analysing forensic firearm identification evidence and other ballistics-related evidence. Since the researcher is a former ballistics expert from the same office, she knew some of the retired and resigned ballistics experts. Other participants were identified through referrals from those who had been interviewed. The researcher worked with a total of five former ballistics experts. One of them was used for the pilot interview. The four former ballistics experts participated in the actual interviews of the study.

4.5.2.1 Biographical data: Former ballistics experts

Four former ballistics experts were interviewed, as explained in section 4.5.2. They were all males. Their post-matric qualifications included a Diploma in Policing, a Diploma in Applied Physics and Mathematics, a BSc, and a B.Tech. Degree in Policing. Two have more than 30 years of experience, and the other two have less than 10 years.

4.5.3 Sample C: Prosecutors in the West Rand District Municipality, Kagiso Regional Court, in Krugersdorp.

The Kagiso Regional Court consisted of two prosecutors tasked with prosecuting CIT robberies. The researcher conducted a pilot interview with one of the prosecutors. For the actual interview, the other prosecutor was interviewed.

4.5.3.1 Biographical data: Prosecutor

As already mentioned in section 4.5.3, one prosecutor was interviewed. He has an LLB degree and has more than 10 years of experience.

The samples in this study were small, but the researcher believes the data obtained from the participants is enough to answer the research question and draw conclusions from this study. According to Kallio (2025), small samples are not inferior datasets. The intention is not to make the sample look big; it is to accurately present findings that represent the views of the participants and the target population. The sample size of the study consists of seven participants.

4.6 DATA COLLECTION

Data collection refers to gathering information that can be used to answer research questions (Kabir, 2016:202). The data collection instruments were piloted before the actual interviews of each sample.

4.6.1 Pilot study

A pilot study refers to a preliminary, small-scale investigation that a researcher conducts before the main study to estimate the time and resources required to conduct the main study (Crossman, 2019). This study enabled the researcher to pre-test the research methods and instruments before the actual study. A pilot study was conducted, reflecting all the procedures of the main study and validating its feasibility

by assessing the inclusion and exclusion criteria for participants. It further determined whether the actual study could be conducted by testing with a few participants who were not part of the actual study (In, 2017). The pilot study tested the logistics and research methods under similar circumstances to this study (Knight, 2019). Three pilot interviews were conducted, one per sample.

Before conducting the actual study, the researcher pre-tested the research schedule, methods, and instruments for data collection, including the interview schedule and the audio recorder. The researcher and her supervisor discussed the outcome of the pilot interviews. Necessary changes were made, and the instrument was refined before the actual interviews commenced. The pilot study also helped the researcher determine whether the questions were phrased correctly, whether relevant data were collected, and to estimate the duration of the interviews.

4.6.2 Interviews

Nieuwenhuys (2016b:92) defined an interview as a two-way conversation between the researcher and the participants to collect data. The researcher conducted semi-structured interviews with the participants. According to Davies (2021), a semi-structured interview refers to a qualitative data collection strategy in which the researcher asks participants pre-determined but open-ended questions (Davies, 2021). Parveen and Showkat (2016) pointed out that semi-structured interviews are more open than structured interviews. They allowed the researcher and the participants to diverge when following the ideas in more detail. The researcher and the participants engaged in formal interviews. Although the researcher had an interview schedule for every sample, the interviews were guided, but not dictated by it. The researcher obtained permission from the participants before recording the interviews (Nieuwenhuys, 2016b:94). The interviews resumed after the participants had signed the informed consent forms. The audio recordings of the interviews were later transcribed verbatim.

For sample A, the researcher set an appointment for a meeting with the section commander of the DPCI Serious Organised Crime Investigation in the West Rand District Municipality, in Krugersdorp. The appointment was set over the phone. On the set date, the researcher met the section commander in her office in Krugersdorp. The section commander advised the researcher of the total number of investigating officers

in her section and provided the researcher with the contact details of the participants. The researcher contacted the participants and planned for the interviews. The researcher allowed the participants to set the date and time that suited their schedules. The researcher conducted face-to-face semi-structured interviews with the participants. The interviews took place in their respective offices. A digital audio recorder was used to record the interviews, with the participants' permission.

Since gatekeeper permission from SAPS was not forthcoming to interview the ballistics experts at the FSL, the researcher opted to focus on experts who had left employment with SAPS. The researcher reached out to several former ballistics experts she knew, letting them know about the study. The researcher provided the participants with copies of their signed informed consent forms. Similarly, with these participants, the researcher allowed them to schedule the interviews at a time that suited their other commitments. The participants were interviewed online through Microsoft Teams because they were based in various locations. The Microsoft Teams recorder was enabled and recorded the interviews. The audio recordings of these interviews were downloaded and sent to the researcher's email, which were later transcribed.

The researcher visited the Krugersdorp Regional Court and met with the Senior Public Prosecutor to discuss this study. From her office, the researcher received the contact details of the prosecutors tasked with prosecuting CIT robberies, and it was indicated that they are based at the Kagiso Regional Court in Krugersdorp. The researcher contacted the prosecutors and set up an appointment for the interviews. The appointment dates and times were at the participants' convenience. The researcher conducted face-to-face semi-structured interviews with the participants. The interviews took place in their respective offices.

The interview guides for Samples A, B, and C are attached as Annexures C1 to C3.

4.7 DATA ANALYSIS

Data analysis refers to the process of logical data evaluation and analysis of collected data to obtain research results (Chapman, 2018). The same author indicated that it is important for the researcher to maintain data integrity for accurate analysis. The data was analysed thematically.

4.7.1 Thematic data analysis

Thematic analysis is a technique used to analyse qualitative data thematically (Caulfield, 2019). According to Caulfield (2019), thematic analysis is appropriate where the researcher intends to explore the views of the participants from the collected qualitative data. Rosala (2019) described the thematic analysis as analysing qualitative data to identify themes. Braun and Clarke (2012:60) identified familiarisation, coding, generating and reviewing themes, defining and naming themes and producing a report as the six steps of thematic analysis.

As the first step of thematic analysis, the researcher familiarised herself with the entire data to have the orientation of the data. The transcribed and the audio recorded interviews were used to familiarise herself with the data (Kiger & Varpio, 2020:6). The researcher immersed herself in the data by reading and re-reading the transcripts and listening to the interviews' audio recordings several times (Braun & Clarke, 2012:60). Field notes were also used to refresh the researcher's memory. This assisted the researcher in the next steps of thematic data analysis (Maguire & Delahunt, 2017:5). Following the first step, the researcher generated the initial codes by taking notes on the potential data and identifying connections of ideas. During this step, the researcher generated codes, not themes (Kiger & Varpio, 2020:6). The researcher read every part of the data. The researcher coded each data completely before coding another (Braun & Clarke, 2012:62). The data was organised meaningfully and systematically by coding it (Maguire & Delahunt, 2017:5).

The third step entailed the search for themes, whereby the researcher noted all potential themes. (Kiger & Varpio, 2020:6). Although this step is referred to as searching for themes, practically themes are generated rather than discovered (Braun & Clarke, 2012:7). Each theme was characterised by its importance (Maguire & Delahunt, 2017:6). Kiger and Varpio (2020:7) indicated that in the fourth step of thematic analysis being reviewing of themes, the researcher analysed the coded data within the themes to ensure that they fit. Themes were combined or separated based on the presence of commonality and coherence. According to Braun and Clarke (2012:65), this step is about the quality check. The researcher ensured that the codes were not viewed as themes. The themes identified in the third step were reviewed and modified where necessary (Maguire & Delahunt, 2017:8).

The fifth step focuses on defining and naming the identified themes. During this step, the researcher identified the themes that formed part of the final report in terms of what each theme covers (Kiger & Varpio, 2020:8). Defining and naming themes was based on what each theme entails and what makes it unique (Braun & Clarke, 2012:66). The last step was to produce the report. The reviewed literature supported the research findings (Kiger & Varpio, 2020:9). Producing a final report provided data findings based on the analysis (Braun & Clarke, 2012:69).

The researcher used an inductive approach for data analysis. The inductive approach allowed the data to determine the themes (Caulfield, 2019). According to Crosley (2021), the researcher commenced with data analysis without an idea of what themes would emerge and allowed the themes to be determined by the data. The themes emerged with no preconceptions, but instead from the collected data.

4.8 METHODS TO ENSURE TRUSTWORTHINESS OF THE STUDY

Trustworthiness in qualitative research is imperative to the usefulness and integrity of the research findings (Cope, 2014:89). It refers to the level of trust in data, interpretation, and methods used to ensure the quality of the research (Pilot & Beck, 2014). Fouche, Strydom, and Roestenburg (2021:393) identified transferability, dependability, confirmability, and credibility as the key measures of trustworthiness in qualitative research. In the context of this study, these measures are briefly discussed below.

4.8.1 Transferability

Transferability enhances the possibility that other researchers can rely on the research methods (Fouche et al., 2021:392). According to Pilot and Beck (2014), transferability implies that the research findings can be applied in similar situations. The researcher provided a thick description of the research process and methods used in this study (Nieuwenhuys, 2016a:124). The researcher further outlined the challenges encountered in this study and how she overcame them. Transferability is not synonymous with generalisation. Thus, since the study is qualitative in approach, the results are not intended to be generalised to the entire population.

4.8.2 Dependability

Dependability in qualitative research refers to the reliability of the study (Nieuwenhuys, 2016a:124). Korstjens and Moser (2018:121) described dependability as the stability of the research findings. The researcher presented the research findings verbatim to ensure that they represent the views and experiences of the participants. Dependability is based on the consistency of the data over similar research settings (Pilot & Beck, 2012). The research methods used in this study were discussed to enable other researchers to obtain the same results in similar settings.

4.8.3 Confirmability

Pilot and Beck (2014) noted that confirmability refers to the researchers' ability to demonstrate that the research findings accurately represent the views of the participants. To achieve this, the researcher quoted the participants' words when presenting the findings. During the interviews, the participants could express their views without interruptions.

4.8.4 Credibility

Credibility assures readers that the findings are accurate and credible (Nieuwenhuys, 2016a:123). The researcher provided adequate descriptions and discussions throughout the study so the readers and other researchers could realise how the researcher arrived at the findings. The researcher was guided by her supervisor throughout the research process, which enhanced the credibility of this study.

4.9 ETHICAL CONSIDERATIONS

Research ethics refers to the principles that govern what is morally and legally right in research (Parveen & Showkat, 2017). The significance of ethical standards lies in promoting values essential to collaborative work, such as trust, accountability, respect, and fairness (Resnik, 2020). All participants were respected and informed of their rights, including the right to withdraw from participation at any stage (Belmont Report, 1979). According to the Singapore Statement on Research Integrity, the value and benefits of research depend on the integrity of the research (Marusic, 2010). The researcher complied with the Singapore Statement on Research Integrity by being honest throughout the study. The researcher further adhered to the following ethical guidelines in this study.

4.9.1 Permission to conduct research

The researcher applied for and obtained an Ethical Clearance Certificate from UNISA's College of Law before the commencement of the study (UNISA, 2013:1). Ethical Clearance for this study is attached as Annexure A. The researcher applied for and obtained permission to conduct research from the SAPS and National Prosecuting Authority (NPA). The researcher adhered to UNISA's research policy (UNISA, 2007). It is important to obtain the gatekeepers' permission to ensure a proper research process. Gatekeepers' letters are attached as Annexure B, Permission letter from SAPS (DPCI) is attached as Annexure B1, denied access letter from SAPS (FSL) is attached as Annexure B2, and NPA permission letter is attached as Annexure B3.

4.9.2 Informed consent form and voluntary participation

The participants received the information sheet and the informed consent forms to enable them to make informed decisions. The researcher informed the participants about the aim and benefits of this study. It was emphasised that the study was voluntary, and every participant had the right to withdraw at any stage of the research process (Srivastava, 2020:10).

4.9.3 Non-Maleficence

The researcher did not subject the participants to any form of harm. The risk was not greater than what the participants faced daily. The researcher protected the participants from physical and emotional harm (Grey, 2014:74). Throughout the study, the researcher took precautions to guard against any possible harm (Fouche et al., 2021:119).

4.9.4 Protection of anonymity and confidentiality

The collected data was protected by storing the interview audio recordings in a password-protected computer, and the transcripts were kept in a locked cupboard. This data will be retained for 5 years. The personal details of the participants were not used in the report, and they remained anonymous (Wagle, 2020). The data were stored by the researcher for the period necessary to achieve the objective of collecting them in the first place and to verify the analysis. The personal information of the participants was restricted to the researcher and her supervisor (Gray, 2014:79).

4.9.5 Honesty and professionalism

The researcher was honest throughout the study. Any deceptive practices that might mislead the participants were avoided. The researcher was honest about the research methods used and findings.

4.10 SUMMARY

The methodological framework of the study, including the research approach and design, was discussed in this chapter. Target population and sampling were discussed. Data collection, pilot study, and the interviewing process were also presented. Methods to ensure the study's trustworthiness and ethical considerations were presented. The following chapter presents the research findings.

CHAPTER 5: PRESENTATION AND DISCUSSION OF THE FINDINGS

5.1 INTRODUCTION

This chapter presents and discusses the research findings. The participants' experiences and viewpoints on the investigative value of forensic firearm identification in the investigation and prosecution of CIT armed robberies in the West Rand District Municipality form the basis of this chapter. The participants' responses are insightful in addressing the research objectives of this study and are presented verbatim. Each theme is mentioned, explained, and supported by the literature presented in the previous chapters. The researcher did not specifically mention the elements of the AFTE Theory in the discussions, so as to avoid repetitions. The link between the data provided and the theory is sufficiently evident and did not require additional mention. The researcher synthesises the discussion of each theme.

5.2 THE PARTICIPANTS

The SAPS and the NPA of South Africa are the sources of the participants in this study. The participants comprise of two investigating officers from the Krugersdorp DPCI (known as the Hawks), at the West Rand SOCIU, four former ballistics experts from the FSL in Silverton (Pretoria) Ballistics section, and two Krugersdorp Regional Court Prosecutors, based in Kagiso. Chapter 4 discusses the difficulties encountered in accessing current ballistics specialists at the FSL. Thus, the researcher opted to approach ballistics experts who had either resigned from the SAPS or who had gone on pension.

5.3 FIVE THEMES EMANATING FROM THE DATA

The following research findings represent the participants' views and experiences regarding the investigative value of forensic firearm identification in the investigation and prosecution of CIT armed robbery cases in the West Rand District Municipality. Since the three samples were not asked identical questions, the responses will only cover the relevant sample.

The interview schedules were divided into four sections: Section B through to section E. In all three interview schedules, section B covered the participants' backgrounds as they relate to the primary research question.

Section C for samples A and B dealt with a variation of the role and the science of forensic firearm identification evidence in the investigation of crime. The evidential value of forensic firearm identification in the prosecution of CIT armed robberies was discussed in section D (sample B) and section C (sample C). Only sample A was asked about modus operandi and specific questions relating to CIT robberies. The nuanced approach to each section was informed by the expertise of the respective samples.

A fuller exposition of each section in the three interview schedules, along with the questions asked of each sample, is attached as per Annexure C. Sample A interview guide is attached as Annexure C1, Sample B interview guide is attached as Annexure C2, and Sample C interview guide is attached as Annexure C3.

This chapter will follow the following thematic flow and include the empirical data and in vivo quotes relevant to each theme:

- Theme 1: An overview of the CIT armed robbery in the West Rand District Municipality.
- Theme 2: The scientific analysis of forensic firearm identification evidence.
- Theme 3: The investigative value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies and other crime types that involve shootings.
- Theme 4: Challenges associated with the investigative value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies and other crime types that involve shootings.
- Theme 5: Suggestions to enhance the investigative value of forensic firearm identification evidence.

5.3.1 Theme 1: An overview of the CIT armed robbery in the West Rand District Municipality

To explore the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality, the researcher realised that an overview of CIT armed robberies in that area is important. It is about what CIT armed robbery entails, its root causes, the most targeted CIT armed robberies, and the modus operandi of the CIT armed robbers. The discussion

on an overview of CIT armed robberies in the West Rand District Municipality will be analysed to determine how they manifest compared to other countries in the Global North and South. This is a unique theme for the investigating officers tasked with investigating CIT armed robbery cases. The results are presented below, organised by the five primary themes derived from the interview guides.

5.3.1.1 General understanding of CIT armed robbery

As indicated in Chapter 2, paragraph 2.1 *supra*, there is no crime such as a CIT robbery. Robbery, according to South African Criminal Law, is the act of taking property from another person, using violence. However, when a dangerous weapon or a firearm is used, it is considered robbery with aggravated circumstances. In this study, CIT armed robbery refers to a violent robbery where criminals target the CIT AVs, transporting money from one point to another, by using a firearm as a tool of crime to access the money, by firing shots. Section 2.1 *supra* (SAPS, 2023:30) indicates that it is a CIT robbery only if the robbery occurs while the cash is in the hands of the CIT security company; if it happens after the cash has already been signed off to the client, it is a business robbery. In response to the general understanding of the CIT armed robbery, the participants replied as follows:

IO 1 described CIT armed robbery as:

...unlawful and violent interception of cash while on the jurisdiction of a security company (IO 1:2024).

But IO 2 indicated that:

...I don't agree with cash-in-transit because you can drive a bicycle with the cooler box on the back, with cash in it, and they rob you, that is cash-in-transit. I say cash-in-transit should be for armoured vehicles (IO 2:2024).

Then, in response to a follow-up question posed to the participants on the main forms of CIT armed robberies, IO 1 indicated that:

It is the CIT where they actually explode the armoured vehicle and then what is called cross-pavement, where they collect money from a specific shop or retail or shop, and they walk back towards their vehicle, and they get attacked (IO 1:2024).

IO 2 explained the main forms of CIT armed robberies as follows:

... You get armoured vehicle attack...then you get a cross-pavement attack. You get a merchandise, which DPCI is not dealing with that. When the armoured vehicle stops in front of the business, while the money is still in transit with the security guards there with the shop owner or the financial manager of the shop is still cross-pavement. But the minute those people sign for the money, and they rob the money it becomes a business robbery because is not under the control of security guards. And then there is a robbery of a statutory vehicle, that's when the vehicle has just stopped, it is not in transit, it's just stopped, and it gets bombed (IO 2:2024).

The participants' responses indicate that they understand what CIT armed robbery entails. The elements of CIT armed robbery are present in their explanations. However, participant IO 2 argues that CIT should be for AVs only, and any other mode of transport that is not specifically designed to carry and transport money, such as a bicycle with a cooler bag loaded with cash, should be excluded. In response to the various forms of CIT armed robberies, CIT AV attacks, cross-pavement attacks, CIT robbery of a statutory vehicle, and merchandise robbery. Of the four types of CIT armed robberies, merchandise robbery is not investigated by DPCI because robbers take the cash after it has been given to a retail shop's financial manager. In that instance, the CIT security guards are no longer in control of that cash. As was already mentioned in section 1.7.2, CIT armed robbery refers to a premeditated robbery of cash from cash-in-transit vehicles by firing shots and sometimes using explosives (Burgess, 2018). In this study, CIT armed robbery refers to a violent robbery where criminals target the CIT AVs, transporting money from one point to another, by using a firearm as a tool of crime to access the money by firing shots.

5.3.1.2 The root causes of CIT armed robberies

This sub-theme examines the motivations that drive CIT robbers to commit these robberies. In response to a question about the root causes of CIT armed robberies, the participants replied that greed was the primary driver.

I will say greed, and as an easy way of making money (IO 1:2024).

Greed (IO 2:2024).

The CIT armed robberies pose a significant threat to the safety of society and the South African economy. This is evident in cases where people, especially security guards from CIT companies, lose their lives in the line of duty while trying to protect cash-in-transit. As already mentioned, it is also economically deductive, considering the amount of money that criminals get away with during these robberies. Cash-in-transit stakeholders, including SABRIC, CIT companies, the South African Cash-in-Transit Industry, SAPS, and other law enforcement agencies, must identify the root causes of this crime to effectively address it. The participants identified greed and the easy way of making money as the root causes of CIT armed robberies.

As discussed by Adams (2021) in section 2.10 *supra*, the depressed economic situation and high unemployment rate contribute to the increase in CIT armed robberies. In section 2.4, Geldenhuys (2022:12) identified greed, illegal firearms and explosives in South Africa, parole, and corruption as contributing factors to CIT armed robberies. In section 2.2, it was further mentioned that the rise in CIT armed robbery rate is due to failures in law enforcement, crime intelligence, and criminal justice (Burger, 2018). BBC News (2018), in the same section, indicated that corruption plays a role in the successful execution of CIT armed robberies, where the police are involved, and the CIT personnel provide the criminals with confidential information.

The CIT armed robbers believe that without the complicity of the police, criminal justice, and those in the CIT industry, such as security guards, it would be difficult to execute (Burger, 2018). The author indicated that this was supported by research findings conducted by Dr. Mahlogonolo Thobane, a senior lecturer at UNISA. The research was about the criminal careers of armed robbers. The research findings revealed the extent to which CIT robbers relied on police members and the personnel in the CIT industry to execute CIT armed robberies. The author found that police are frequently involved in CIT-related armed robberies or in receiving bribes. Among other things, the police may provide information in case dockets to criminals, such as the names of witnesses, destroy physical evidence, or, worse, transport cash and hide criminals.

In section 2.10 *supra*, it was also mentioned that often CIT personnel including security guards and police officials are involved in the actual CIT armed robberies (Geldenhuys, 2022:12). The author pointed out that this situation was presented in the

case of Henrico Fourie, Fannie Morris Mbuyani, Josias Lucas Maseko, and Lazarus Ntlatleng, who were sentenced on the 21st of July 2022 at the Pretoria High Court, to 30 years' direct incarceration for robbing a SBV CIT vehicle of more than R25 million. This was a typical inside job, where Henrico Fourie was the SBV Watloo Cash Centre's head of department. He recruited two SBV employees, Lazarus Ntlatleng, who was a crew member, and David Tolo, a driver of the SBV CIT vehicle on the N4 freeway outside Bronkhorstpruit, on its way to Pretoria, on the 7th of July 2022.

The involvement of the police and CIT personnel in the commission of this crime, by providing confidential and critical information to the robbers, escalates the problem (Burger, 2018). The police and CIT personnel, such as security guards, are supposed to ensure the safety of the cash-in-transit and the lives of the people transporting it. It becomes a problem when the same people entrusted with protecting this cash are giving out critical information to criminals. Based on these findings, while some robbers are pushed by socio-economic factors to commit CIT armed robberies, sometimes it is just greediness, and corruption takes the lead as it contributes to this type of crime.

5.3.1.3 The most targeted CIT companies and the reasons thereof

The videos of CIT armed robberies are usually trending on various media platforms, and some are physically witnessed by bystanders. Sometimes, certain CIT companies appear to be more consistently targeted than others. This sub-theme focuses on the companies primarily targeted by CIT in the West Rand District Municipality. The researcher posed a question about which companies are often targeted by CIT armed robbers. Responding to this question, the participants also provided the motivation behind targeting these specific CIT companies. Both participants indicated that, in their experience, the most targeted company was G4S. Their reflection on possible reasons for this ranged from employing undocumented workers who more readily provide inside information to syndicate members to a company policy that does not fight back when robbed.

IO 1 explained that:

...it is a G4S ... and their policy is rather to give than to fight... that is why I think they are targeted more because they don't normally put up a fight with these guys ... the best way is just to give away... (IO 1:2024).

...G4S ... cheap labour. Any time Dick and Harry walks in, Hey mina, I haven't got an ID Ke batla mosebetsi (I am looking for a job) they go for work, ok, You can work for me, and I will pay you R3000.00 per month" whereby a registered PSIRA guard is going to get R17000.00. That person goes and says Yoh... tshete ye (What a money!) is too much. I will give information out because I am going to be paid 300 times what I am getting now. That's how the insiders coming from (IO 2:2024).

The participants identified G4S as the most targeted CIT Company in the West Rand District Municipality. IO 1 believes that G4S security companies are not armed to deal with the CIT robbers. That leaves them in a position where they surrender to the criminals to save their lives. If they do not do this, they may lose their lives and the cash. IO 2 believes that G4S is targeted because it prefers cheap labour. According to this participant, this leaves room for inside jobs. Cheap labourers are easily tempted to give out inside information to CIT robbers. These participants have raised critical concerns because, in most instances, the way CIT robbers carry out robberies suggests they are well informed. Considering how they are aware of when a CIT AV will pass at a specific route, loaded with money, the tightness of security, and the exact safes carrying a lot of cash. As discussed in section 2.7 supra, the G4S, Fidelity, and SBV are the main CIT companies in South Africa (PMG, 2018).

5.3.1.4 Modus Operandi of the CIT armed robbers

The modus operandi in this study refers to how CIT robbers operate in the commission of CIT armed robberies. It includes the instruments, such as firearms, the mode of transport used, and how and when criminals prefer to carry out such robberies, the usual things they do at each CIT armed robbery scene, such as how they stop the AV, and access the money. The modus operandi covers everything robbers do to meet their goal. Even the way they used to exit the crime scene forms part of it.

The meaning of modus operandi

The participants were asked about their understanding of modus operandi. Both explained it with insight.

A particular way or method of doing things with regard to crime. Criminals have the specific way. They only do it during this time of the day, they use certain vehicles...only certain firearms... (IO 1:2024).

Modus operandi is like similar facts, is a certain pattern that's been used by a person. There is a certain pattern that the specific groupings will be using (IO 2:2024).

Based on participants' responses regarding their general understanding of modus operandi, they are familiar with what modus operandi is. In section 2.3 supra, Lochner, Horne, and van Wyk (2018) described modus operandi as one method that can be utilised to identify the offender.

Using modus operandi

A follow-up question was posed to the participants regarding the extent to which they use the modus operandi in the investigation of CIT armed robberies.

Responding to this question, IO 1 said that:

...vehicles, firearms, explosives type, time of incidents...that's how we make use of it (IO 1:2024).

IO 2 explained the use of modus operandi in the investigation of CIT armed robberies as:

...all scenes, modus operandi will tell me the story. It will tell me, here we are dealing with the Soweto boys, because every time, it's got its own modus operandi. The Pretoria boys they've got their ways, the Soweto bombers are the extreme bombers. They will shoot that truck; only the front cab will stand there, half gone. The Mamelodi ones are the extreme shooters because they are the riflemen; KZN is the same. So, modus operandi is very important to me. What I see there, I can already start the story (IO 2:2024).

The participants maintain that the modus operandi of the CIT armed robberies provides a wealth of information about the robbers. This includes the types of vehicles, firearms, and explosives they use, and the timeframe during which a particular group of CIT armed robbers carries out the robberies. According to the participants, the way these CIT armed robbers execute their robberies serves as a clue to who they are

dealing with. This was explained in detail by IO 2, which provided various operational methods.

Various modus operandi of the CIT armed robberies in the West Rand District Municipality

This sub-category focuses on various modus operandi identified in the West Rand District Municipality. IO 1 identified a modus operandi of the CIT armed robbers, who prefer to carry out these robberies when it is dark and around informal settlements, so people from these neighbouring areas can contaminate the crime scenes once they are done.

So we had a new Boss group that will only operate from six o'clock in the afternoon... when it is almost dark, the light is not good, and so that means the footage is not good and they will always do the same story, it will be near the informal settlements ... so once ... after they have left, the people from the informal settlement will storm the armoured vehicle and they will try and take whatever money was left behind by these robbers, so ...they are contaminating our crime scenes. That is basically what they do (IO 1:2024).

IO 2 also discussed the following various modus operandi:

We've got one group that will ram the vehicle from the front ... no shooting except when they disable the guards ... vary from two different scenes ... those that I call the care-takers in a specific group ... on that side of Vereeniging ... the suspects will tell the guards "Get out of the car we don't want to kill you ... we want the money; we don't want to hurt you." So, it is ramming. From the care-taker, then the explosives, and there is a group that will take the electric wiring running from the truck, let's say for 100...200 metres from the truck, and they will detonate it from a car battery, then it will detonate the explosion. Then we've got a group that...when it comes to placing of explosives, as I've explained, they've got the speaker...then they put the explosive, it's a magnet, they stick it. Once the van is open, they will take the doors, and they will tie it with the nylon rope. They will tie it with ropes to the nearest car or tree so those doors don't close. The next explosion, if they don't open the safe, there will be a second explosion. The

safe will only be bombed, and the money will be taken but in that case, they will not take all the safes. They will take one or two because they usually know which safe carries the most because there's an informer inside who is giving them the money. Then it's the ramming, there's a lot. You get the grouping that drives, pull out next to the AV and start to shoot. You get the grouping that goes for the window of the AV, which now distracts the driver. He either loses control or the vehicle goes off the road or he drives off the road and that's easier for them to make that AV to halt or slow down. Even to slow down, just for them to stick that magnet ...Most of the scenes ... especially in Mpumalanga ... they take the AV where there is an uphill ... it cannot turn left or right ... starts to slow down, so it's easy for them to drive, and that's why sometimes they use the bakkie (van). They stand at the back of the bakkie (van), and somebody just sticks that magnet (IO 2:2024).

Based on the modus operandi mentioned by the participants, it shows that CIT armed robberies are not instant crimes. These are well-organised, and everyone has a role to play. Every member of the CIT armed robbers seems to specialise in their role. CIT armed robberies require a team of skilled individuals to execute them. Although various modus operandi were identified and discussed by the participants, they further pointed out the most common one in the area. The following sub-category presents the common modus operandi.

The common Modus Operandi in the West Rand District Municipality

The common modus operandi in the West Rand is ramming, shooting, and burning the ramming vehicle at the scene.

The common one in West Rand is...is where they ram the AV...with another vehicle, and after they've rammed it, the AV cannot move, and they shot at the AV with the crew out, will blow it up, and while they are doing that, they will also burn the ram vehicle...So that there's no evidence of a person left behind on the ram vehicle...and sometimes they blow up the armoured vehicle totally like there was nothing (IO 1:2024).

...it's ramming from the front, shooting from the side, and then the extensive blowing. You know we've picked up a grouping, we suspect that they come from Soweto. They blow that van to pieces. And your petrol is found in the

car, and then they burn the ramming vehicle to destroy the evidence. The ramming and the burning of the cars (IO 2:2024).

The participants identified the ramming of the CIT AVs and then burning the vehicle that they rammed as a common *modus operandi* in the West Rand District Municipality. The robbers burn the ramming vehicles to get rid of evidence that can be used to link them to the scene. This suggests that the robbers are adapting to the changing times.

5.3.2 Theme 2: The scientific analysis of forensic firearm identification evidence

To explore the investigative value of forensic firearm identification in prosecuting CIT-armed robberies, participants were asked questions on the theme. These include understanding what a firearm is and more technical questions, such as the theory behind forensic firearm identification. The forensic firearm identification analysis process will provide knowledge to all role players in the criminal justice system and other researchers on what it involves.

5.3.2.1 Types of firearms

The following types of firearms were identified by the participants:

BE 2 mentioned:

Revolvers (BE 2:2024).

BE 3 also said:

A pistol, rifles...shotguns (BE 3:2024).

Participants mentioned revolvers, pistols, rifles, and shotguns as types of firearms. Thompson (2017:12) identified handguns and shoulder arms as basic firearms. The author described handguns as firearms designed to be fired by one hand without support from the body, while shoulder arms are designed with a stock to be fired while supported by the shoulder. Pistols and revolvers are handguns, rifles and shotguns are categorised as shoulder arms. These are the main categories of firearms, despite their different calibres, working mechanisms, and manufacturers.

5.3.2.2 *The firearm parts that contribute to the development of marks on fired cartridge cases and bullets*

Participants were also asked to identify the firearm parts that contribute to the development of marks on fired cartridge cases and bullets. The participants responded as follows.

BE 2 replied as follows:

What is important there is the barrel. So, the marks are striations marks. The next thing is impression because remember when a bullet drives forward, there's expansions all directions, even the cartridge case is expended. That expended cartridge case will get the impressions from the breech face, the chamber, or the support on the side, because without the support, the cartridge case, there is no resistance in those directions, is going to be less work to expend the cartridge case or drive the bullet out of the barrel. So, those are basically manufacturing the marks used for forensic firearm identification (BE 2:2024).

BE 4 indicated that:

The part of a firearm that make contact with the bullet and the cartridge case. So, in case of a bullet, the barrel leaves marks on the bullet, and with the cartridge case, there will also be the chamber, the chamber leaves marks, the breech face of the firearm also leaves. It also in contact with the slide of a firearm that will leave marks. The firing pin mark is the reliable mark to use. Ejector and extractor (BE 4:2024).

The firearm parts that contribute to the development of forensic firearm identification marks are the barrel, chamber, breech face, firing pin, ejector, and extractor. For example, the forensic firearm identification marks on fired bullets are imparted by the barrel during firing. This occurs when the bullet passes through the barrel. In cartridge cases, the firing pin leaves its mark on the back of the cartridge as it strikes the primer. The same thing applies to chamber, breech face, Extractor, and ejector marks. The firearm marks are imparted to fired bullets and cartridge cases because the ammunition is softer.

As indicated in section 3.9 supra, forensic firearm identification falls within a specialised sub-specialty of toolmark identification related to the working surfaces of the firearms mechanisms (Thompson, 2017:8). Since firearms consist of various parts, whenever these parts come into contact with the softer material of the cartridge case and bullets, tool marks are transferred to the fired cartridge cases and bullets. Smith (2022:11) indicated that the basic principle of forensic firearm identification and individualisation is that every firearm produces unique marks on fired cartridge cases and bullets.

5.3.2.3 *Ammunition components*

The participants identified the following ammunition components.

BE 1 mentioned that:

A complete ammunition consists of the cartridge case, bullet, the primer and the, and the propellant (BE 1:2024).

Similarly, BE 4 said that:

According to Firearm Act, that is a cartridge case, propellant, primer, and the bullet (BE 4:2024).

Participants mentioned that complete ammunition consists of a cartridge case, propellant, primer, and a bullet. In section 3.6 supra, Webb (2019) described a cartridge as completely assembled ammunition. A cartridge is also a proper name for ammunition, and consists of a bullet, cartridge case, propellant, and primer (Thompson, 2017:15). Sometimes, cartridge cases are incorrectly called cartridges.

5.3.2.4 *General understanding of forensic firearm identification*

Forensic firearm identification is the process of microscopic comparison of the fired cartridge cases or the bullets recovered from the crime scene, with the test-fired ones from the suspect firearm, to determine whether the recovered fired cartridge cases or bullets were fired from the suspect firearm. This will link the suspect firearm to the crime scene. In this study, the focus is on CIT armed robberies; however, forensic firearm identification serves the same purpose in all crime types where a firearm was used as a tool of crime, and a shooting took place. As the researcher explains, forensic

firearm identification involves microscopic comparison of fired cartridge cases or bullets, because there is no way a fired cartridge case can be compared with a bullet. The microscopic comparison involves two objects of the same class characteristics. Even the cartridge cases or bullets being compared should be of the same calibre. For example, a 9mm Parabellum fired cartridge case can only be compared with a fired cartridge case of the same calibre. A 9mm Parabellum fired cartridge case cannot be compared with a .40 Smith and Wesson fired cartridge case. Two fired cartridge cases or bullets of different calibres indicate they were fired in different firearms. This conclusion can be made during the examination phase, without placing them under the microscope. A firearm can only chamber ammunition of a specific calibre. Fired cartridge cases or bullets of the same calibre do not necessarily show the same origin. This determination can be done after microscopic comparison. The participants were asked about their general understanding of forensic firearm identification, and their responses were as follows.

In response to the question, IO 1 said:

When you collect a cartridge from the scene, it can be linked to a certain firearm, and that firearm is basically like a fingerprint. There is no other firearm that will make the same markings like that one that was used to hit the cartridge at the crime scene (IO 1:2024).

BE 1's response was:

The cartridge cases and the bullets that were recovered from the crime scene, will get to be compared to the firearm recovered, that identifies the firearm that shot those cartridge cases and the bullets (BE 1:2024).

P1 said that:

It assists in identifying the firearm, the ammunition, everything that is involved, that has to do with firearm (P1:2024).

Participants' explanations of forensic firearm identification indicate they understand it well. They are aware that no two or more firearms can produce the same marks. Every firearm is unique, like fingerprints. As discussed in section 3.2 *supra*, the literature review revealed that forensic firearm identification refers to the forensic science

discipline that deals with the identification of bullets, cartridge cases, and other ammunition components, to determine a firearm that fired the shots (Mutsavi & Meintjies, 2020:4). Similarly, it is concerned with the determination of the origin of the fired cartridge cases or bullets (Lacalamita, 2022:1). Research has indicated that no two firearms can produce the same unique marks on the fired cartridge cases or bullets.

5.3.2.5 *Theory behind Forensic Firearm Identification*

The theory behind forensic firearm identification is based on Locard's exchange principle. Whenever two objects come into contact, they leave traces. The firearm parts that come into contact with the cartridge cases and bullets, such as the firing pin, chamber, barrel, breech face, ejector, and extractor, transfer marks on them during the firing process. These marks are imparted to the fired cartridge cases and bullets due to the softer material of the ammunition. The AFTE Theory of Identification (as discussed in para 3.4 supra) builds on the Locard exchange principle and serves as the basis for forensic firearm identification. Based on this theory, for two fired cartridge cases or bullets to be declared or determined to have been fired from the same firearm, there must be sufficient agreement of marks. The ballistics experts cannot make an identification based on a single set of marks. Where a mark corresponds on both fired cartridge cases or bullets, a follow-up must be made to locate more similar marks. There are three characteristics of forensic firearm identification marks, namely, class, sub-class, and individual characteristics. Individual characteristics are used to positively identify fired bullets or cartridge cases. These marks are unique, and no two firearms can produce the same marks. The class characteristics are used only to categorise fired cartridge cases or bullets. Participants were asked to explain the AFTE Theory of Identification. According to the AFTE Theory of Identification, the analysis findings for fired cartridge cases or bullets can be divided into four categories: positive, negative, inconclusive, and unsuitable for microscopic comparison. Positive findings mean that the fired cartridge cases or bullets were fired in or from the same firearm. Negative results indicate that the fired cartridge cases or bullets were not fired in or from the same firearm. Inconclusive findings mean that there are insufficient marks to determine whether the fired cartridge cases or the bullets were fired in or from the same firearm. Unsuitable findings indicate that the fired cartridge cases or bullets are unsuitable for microscopic comparison due to damage. Unsuitable findings

are usually found in bullets due to the damage they incur when they hit hard surfaces, such as walls or bones. Some bullets turn into fragments after hitting their targets. The question was directed to the ballistics experts, as this theory guides forensic firearm identification analysis. The participants provided the following insightful responses.

BE 2 replied:

The AFTE Theory of Identification pertains; the comparison of toolmarks enables of common origin to be made when the unique surface contours of the toolmarks are in sufficient agreement. That takes experience to get to this position. The sufficient agreement is related to the sufficient duplication of random marks as evidence by the correspondence of patterns or combination of patterns on surfaces contours. That makes it very unique. The significance is determined by the comparative of two or more sets of surface contours, patterns compromising individual peaks, ridges, and farrows. Specifically, the relative depth, height, width, curvature, spate show relationship to the individual peaks, ridges, and farrows within a set of surface contours are defined and compared to the corresponding features in the second set of surface contours. Agreement is significant when agreement of individual characteristics exceeds the best agreement, they must write that between toolmarks known to have been produced by different tools and is consistent with the agreement, they must write it there by toolmarks known to have been produced by the same tool. The statement that says sufficient agreement exists between two toolmarks means that that the agreement of individual characteristics is of a quantity and quality that the likelihood that another tool that might have made the mark is so remote as to be concerned a practical impossibility. Currently, the basis of individual identification is subjective in nature, founded on scientific principles, and based on the examiners' training and experience. So, that makes it objective. It might be subjective that is made objective by the examiners' training and experience (BE 2:2024).

BE 4 explained the Theory of Identification as:

In short, it entails that when you do identification on the microscope, the ID or the identification that you see between the exhibit and the test must be more sufficient, than the identification that you can get from two non-exhibits. In other words, if you have two Beretta, different Beretta pistols, if you look,

you compare the tests, then the identification that you have between the exhibits from the scene must be better than the best comparison of the two non-exhibits or non-items. We look at what is known as the consecutive matching striae; in other words, we look at the amount of marks that are compared, that correspond. Here in South Africa, we also make use of what is known as follow-up. So, when there is one ID, there is also another ID somewhere else. So, you always have to make a follow-up (BE 4:2024).

The participants explained the Theory of Identification in detail. They indicated that this theory entails the microscopic comparison of bullets or cartridge cases to determine whether they originate from or were fired in the same firearm. Based on this theory, there must be sufficient agreement between the compared bullets or cartridge cases to conclude that they were fired in or from the same firearm. Sufficient agreement means the findings do not rely on a single matching pattern or mark. There should be more marks to support the finding. Participant BE 2 emphasised that training and experience play an important role in the application of the Theory of Identification. To ensure that sufficient agreement exists between the compared bullets or cartridge cases, participant BE4 mentioned a follow-up method, which allows ballistics experts to search for more corresponding unique marks during the microscopic comparison of these specimens and the test-fired ones.

Forensic firearm identification is based on the principle of uniqueness, whereby the marks produced by a firearm cannot be produced by another firearm (Olaborode & Meintjies Van der Walt, 2020:23). Based on the AFTE Theory of Identification, the participants indicated that there must be sufficient agreement between the compared bullets or cartridge cases to conclude that they were fired in or from the same firearm. Sufficient agreement means that the analysis findings rely on matching firearm marks on fired cartridge cases and bullets. The conclusion of forensic firearm identification analysis is not based on a single pattern of firearm marks.

5.3.2.6 *The types of forensic firearm identification evidence*

The participants were asked about the types of forensic firearm identification evidence, and this is how they replied.

BE 1 said:

That is the cartridge case that is found at the crime scene, and the marks on the cartridge cases and the bullet, and the firearm itself (BE 1:2024).

Similarly, participant BE 2 indicated that:

It could be a cartridge case and a bullet. I can elaborate further on the cartridge case, you've got the breech markings, you've got the extractor markings, you've got the ejector markings, and you've got the chamber markings on the cartridge case (BE 2:2024).

P1 also responded as follows:

The most important one is the comparison. Is this firearm the one that shot these cartridges, comparison? That is the key important firearm identification (P1:2024).

The participants mentioned cartridge cases, bullets, and the firearm as types of forensic firearm identification evidence. BE 2 elaborated further and mentioned that firearm marks that can be found on fired cartridge cases include the breech face, Extractor, ejector, and chamber marks. Similarly, Thompson (2017:26), in section 3.10 *supra*, identified the same types of forensic firearm identification evidence that the participants had mentioned.

5.3.2.7 The process of collecting forensic firearm identification evidence

The collection of forensic firearm identification evidence includes the marking and packaging of the exhibits. When dealing with firearms and firearms-related exhibits, safety is of the essence. Every firearm needs to be treated as loaded and should not be pointed at any person, but in a safe direction. The cartridges or ammunition should not be packaged in the same forensic evidence bag as the firearms to avoid accidental discharge. Focusing on the main objective of this study, when collecting these exhibits, nothing should be placed inside the barrel, as it is the source of the marks found on the fired bullets. Any scratches in the barrel will create unnecessary marks that could be transferred to the test-fired bullets during the firing process. The participants explained the collection procedure of forensic firearm identification evidence as follows.

IO 1 mentioned that:

Then you seal that specific firearm, you handle it with gloves, you put cartridges, live ammo separate together with the magazine and then put the pistol or firearm itself in another seal bag, you seal it properly, you write down the case number, you go and book it in the SAP13 of that station area and you book it out you go to your nearest office, you complete your application form then you take it to Pretoria, ballistics. Then you hand it in, and then you wait for your results when they are done...and they do what you have asked them to do (IO 1:2024).

IO 2 also explained the procedure as follows:

I take photos, mark them. You mark it and take photos then I'll put the seal bag next to the firearm I will take the photo of the seal bag, I am gonna seal it in with the firearm then pick it up we usually take a piece of a wire or something to pick it up but the problem is now if that firearm is still loaded, then you have to handle it, then you have to put on the gloves but then comply with your buccal sign we buy gloves that are not contaminated, the reverse side that you put the gloves. Make it safe, and then you pull it. If it is safe, you can see most of the time the through the gun. If you handle guns most of the time if you handle guns, you can see that the barrel is open if there's no magazine if maybe is dropping. If that is the case, I will get a second opinion. I am not an expert, but if we think it is safe, I will put it as it is in the seal bag, seal it in front of a witness, and then get my statement (IO 2:2024).

The participants highlighted the use of gloves when handling forensic firearm identification evidence, taking photos of the exhibits before touching them for marking, and emphasising safety. One of the participants mentioned an important aspect of requesting the opinion of ballistics experts when necessary.

5.3.2.8 *The process of forensic firearm identification evidence analysis*

The researcher posed a question to the ballistics experts about the process that is followed and the actual analysis of forensic firearm identification evidence. The analysis process includes the tools that the ballistics experts need to analyse forensic firearm identification evidence, the unique firearm parts that impart marks on the fired

cartridge cases and bullets during the firing process, ammunition components, disposal of exhibits after analysis, the issuing of ballistics reports, and the turnaround period for ballistics cases.

The process of forensic firearm identification evidence analysis was described as follows.

BE 2 described the analysis process as:

The first part is essential. That is the chain of custody, to retain the chain of custody and to note everything that you have received and how it was received. The second part is to examine the firearm to ensure it is in working condition and everything is working on the firearm. And even before you fire it, it will not put danger to yourself when you fire it. The next thing is to recover, for firearm specifically, to recover specimen fired through the firearm on the water tank. As well as the bullet in the water tank, the cartridge case discharged by the firearm. But it must be during the firing process. You can't simply...because there must be pressures and forces which transfer marks to the cartridge case and the bullet. After that, and these must be marked during the process. At every part of the process, after that it will be taken to the microscope, it will be analysed under microscope, test-fires with the evidence. Evidence under microscope to determine whether there is link between those specimens from the test-fires and the firearm specimens, all received from the crime scene. And the process will be finalised (BE 2:2024).

Similarly, BE 4:

Firstly, you will examine the firearm, then you mark all your exhibits, and then you'll shoot the tests with new ammunition with the suspect firearm. You go to your comparison microscope, and you will compare. First of all, you will see if your microscope is operating correctly. Will do a test, you will use your two tests to determine if your microscope, the setting on your microscope is correct. Once you have looked at your tests, then you will compare all the exhibits to see if all the exhibits were fired in one firearm, so you will make groups of firearms, how many firearms it is. Once you determine that, you will compare these groups with your tests. And after you have done that, you will take a photo of a comparison (BE 4:2024).

The forensic firearm identification analysis process by the participants covered the importance of maintaining the chain of custody, examination of the firearm, test-firing, microscopic comparison of fired bullets or cartridge cases, and the presentation of the findings. In addition to these similar inputs, it was noted that the microscopic comparison findings must be photographed. This photograph is utilised for court chart presentations. During the presentation of the ballistics expert testimony in court, this court chart will illustrate what is seen during the microscopic comparison of this evidence. Based on the principle of comparison, only objects that are similar in nature can be compared (Sharma, 2023). The emphasis is on providing similar ballistics specimens for comparison. Cartridge cases can only be compared with other cartridge cases, and the same thing applies to the bullets.

In section 3.12.5 *supra*, Lacalamita (2022:8) pointed out that forensic firearm identification requires microscopic comparison verification by the second ballistics expert. It is necessary for the ballistics expert (confirming the firearm identification findings) not to be aware of the findings they are confirming before giving their own findings. This will ensure that both ballistics experts have properly conducted the microscopic comparison. The author further explained that all microscopic comparisons of fired bullets or cartridge cases need to be reviewed, focusing on the report and proformas, the exhibits examined, and the findings in the report and the proforma should correspond. The reviewer must be qualified at the level of expertise of the case they are reviewing and must have been tested in the tasks being reviewed to ensure that the FSL's technical procedures are complied with.

5.3.2.9 *The tools needed to analyse forensic firearm identification evidence*

Ballistic experts need specific tools to analyse forensic firearm identification evidence. The participants identified the following tools needed for forensic firearm identification evidence analysis.

BE 3 said that:

They need that microscope to check your marks; you also need the IBIS machine. I think those ones are the ones that are critical for identification. You can identify, you will get a hit from IBIS, and you will confirm it under

microscope. I think those two are critical for those kinds of investigations. IBIS and confirming them under microscope (BE 3:2024).

BE 4 indicated that:

The main thing is a comparison microscope with a camera, shooting tank, a new ammunition, that you don't use old ammunition. Hand tools such as screw driver to dismantle the firearm, and also an engraver to mark your exhibits. Bullet scale, bullet scale is also important to identify the bullet. The bullet puller to see if the ammo actually contains the propellant. And of course, for reporting purposes, a laptop and a printer (BE 4:2024).

The comparison microscope, IBIS acquisition machines, shooting tank, ammunition, screw drivers, engravers, bullet scale, bullet puller, a laptop or Personal Computer were identified by the participants as the tools needed for the analysis of forensic firearm identification evidence. Due to the nature of forensic firearm identification evidence, a comparison microscope serves as an essential tool, since this evidence cannot be seen with the naked eye. Forensic firearm identification evidence relies heavily on the comparison microscope.

In section 3.2 supra, it was noted that Cornel Calvin Goddard and Phillip Gravelle invented a comparison microscope to view two cartridge cases or bullets simultaneously (Dack, 2014:18). The ability to view two cartridge cases or bullets simultaneously allowed for more accurate examination of the unique marks on fired cartridge cases and bullets. With the invention of a comparison microscope, two ballistics specimens, such as fired cartridge cases or bullets, can be compared simultaneously under magnification. A comparison microscope comprises two compound microscopes joined, allowing the firearm experts to view both fired cartridge cases or bullets simultaneously. The comparison microscope was designed to allow the mounting of fired cartridge cases and bullets (Thompson, 2017:8).

In section 3.3 supra, it was noted that the primary tool for firearm identification is the comparison microscope. Before this tool was invented, firearm experts relied on photomicrographic comparisons to identify fired cartridge cases and bullets. This method was time-consuming and laborious (Thompson, 2017:8). Before the invention of the comparison microscope, ballistic experts had to remember identifying marks on

each specimen (Dack, 2014:18). The science of forensic firearm identification advanced forensic investigations worldwide. Thompson (2017:8) indicated that although other complementary microscopic and photographic instruments might still be used in forensic science laboratories, the comparison microscope remains an essential tool for forensic firearm identification. A comparison microscope is a primary tool for analysing forensic firearm identification evidence.

5.3.2.10 Turnaround period for analysis of forensic firearm identification evidence

Since the presentation of evidence in court is an important part of the prosecution's strategy, it is essential to ensure the timely submission of evidence for analysis and analysis of evidence for court purposes. The turnaround time for analysis of forensic firearm identification evidence was explained by the participants as follows.

BE 1 said:

In my days, they used to have 14 days turnaround time (BE 1:2024).

Similarly, BE 2 mentioned that:

It should be, actually, if we are fully capacitated, we have the correct infrastructure, sufficient humans, it should be 2 weeks at most on 99% of the cases. However, with the challenges we have experienced, it was, it increased significantly from that quantity than it should be. It was at that stage, some of them were over a year, over 12 months, which is actually unacceptable for the criminal justice process to be efficient (BE 2:2024).

The participants indicated that the turnaround time for forensic firearm identification analysis is 14 days. However, BE2 mentioned that due to the challenges they are experiencing, the analysis of these cases can take over a year to finalise. The participant further emphasised how this delay negatively affects the criminal justice system.

5.3.2.11 Formal findings of the analysis of forensic firearm identification evidence

The participants indicated the following formal findings for the analysis of forensic firearm identification evidence.

BE 1 mentioned that:

The findings can either be positive, positive means the marks that were found on the bullet or the cartridge cases, we are talking about, on the cartridge cases we are talking about the chamber marks, the ejector marks, the firing pin marks and if they are matching with the bullet found at the crime scene, we say the findings are positive, and if we are saying they are negative it means all those marks like the firing pin marks, the chamber marks, the ejector marks, they are not corresponding with the ones of the exhibits found at the crime scene. So, the inconclusive marks are those marks that we are in between; we are not sure whether they are positive or negative. We find them inconclusive, more especially on the bullets; some you find that they are damaged, they are seriously damaged, you see that they are positive, but we are not completely sure that they are positive. That is where we are making them inconclusive (BE 1:2024).

BE 4 explained:

First of all, the AFTE is got it as an identification, that is a positive finding, the cartridge case and bullet was fired in the same firearm. The cartridge cases and bullets were fired in the firearm that is called identification. That is positive results. Then elimination means it is negative, so it was not fired in that firearm. Eh, then you get the inconclusive, inconclusive results, which can be various inconclusive results. Not enough marks to eh there's comparison of class characteristics, but not enough individual characteristics, so yah so the inconclusive results are what you can give when is inconclusive. Then you get bullets that are so damaged that you cannot see anything on, it will be declared as unfit for comparison, for comparison purposes (BE 4:2024).

These participants mentioned identification, which is a positive finding. This finding category indicates that the compared bullets or cartridge cases were fired from/in the same firearm. In case the bullets or cartridge cases under the microscope are found to have been fired in/from the same firearm, the finding is called elimination or negative. Then we have the inconclusive finding. These results occur when there are insufficient marks to determine whether bullets or cartridge cases are positive or negative. Insufficient marks are caused by damage, rust, or erosion. Sometimes, it

could be due to less pressure being applied to the ammunition during firing because the firearm is defective. There is also an unsuitable one for microscopic comparison. Unsuitable for microscopic comparison occurs when bullets or cartridge cases are severely damaged to the point where the marks are no longer visible. In section 3.12.4 supra, it was mentioned that possible outcomes for forensic firearm identification evidence include identification, elimination, and inconclusive (Lacalamita, 2022:2).

5.3.2.12 *Issuing of ballistics reports*

The issuing of ballistics reports was explained by the participants as follows.

BE 1 indicated that:

After the analysts are finished with the report, the report goes through the group leader who will go through it, check for the mistakes, and review it. The report will be taken to the admin, whereby the investigating officer will come and collect it personally or all the reports were scanned. So, they can also retrieve them from their stations on ICDMS (BE 1:2024).

Similarly, BE 3 said:

I think when I left, they were already using a system whereby we were scanning the exhibits, and they can access it on the CAS or ICDMS system. Those who didn't know the functionality, they were still coming to get the printed document from us (BE 3:2024).

The ballistics reports are collected by investigating officers from the FSL. They can also be retrieved from ICDMS. This system allows ballistics administration personnel to scan the reports, which are then available for investigating officers to retrieve. This is cost-effective because the investigating officers need not travel from their respective environments to the Lab to collect ballistics reports. In section 3.10 supra, Thompson (2017:27) explained that ballistics experts present testimony based on their training and level of expertise. The examination report should include a description of the evidence received, observations during the examination, and conclusions based on the examination.

5.3.2.13 *Admissibility requirements for forensic firearm identification evidence in court*

The admissibility requirements for forensic firearm identification evidence in court were explained as follows.

IO 2 identified the following requirement:

You need to prove that you are an expert in what you are doing (IO 2:2024).

Also, BE 1's response was:

The chain of evidence from the crime scene, to the lab, to the hands of the expert, from the hands of the expert back to the station, back to the administration, back to the station, with the report that mentioned all the process that the expert received the firearm in which manner and then with the sealed back that was sealed at the crime scene, and only opened by the analysts and then the analyst re-sealed it inside the new back and sent it back to the station. So, the correct manner of the chain of evidence. I think it will be admitted in court (BE 1:2024).

P1 said that:

Requirements for admissibility of forensic firearm identification. Firstly, the person must be an expert. He must meet our forensic expert requirements of being an expert. Then, if you are going to use his evidence through a document, like an affidavit or 212 statement in terms of the Criminal Procedure Act, he must be an employee of the State, but it is very important that the person who determines these forensic must meet the requirements of being an expert. Whether vivo voce or it is in a written form, the court must be satisfied (P1:2024).

The admissibility requirements for forensic firearm identification evidence in court include that the person who analysed this evidence must be a ballistics expert. The presentation of forensic firearm identification evidence must be by 212 statement or viva voce, in terms of the Criminal Procedure Act 51 of 1977. The participants further said the courts also focus on the chain of evidence.

As pointed out in section 3.18 supra, the reliability of forensic firearm identification has caused contention among defence attorneys and prosecutors for many years (Pumphrey, 2022). It is the responsibility of ballistics experts to present evidence before the court, with due regard to the disclosure, transparency, and impartiality of their testimony. This will assist the court in comprehending the process of evidence collection, processing, and analysis to determine the probative value of forensic firearm identification evidence and the credibility of the ballistics experts (Mutsavi & Meintjies van der Walt, 2020:4).

In section 3.18 supra, it was indicated that the admissibility of forensic firearm identification is based on its relevance (Mutsavi & Meintjies van der Walt, 2020:4). The reliability of expert testimony plays an important role during the trial, through cross-examination when the opposing party adduces evidence. Few studies on forensic firearm identification exist, and those that indicate that ballistics experts cannot reliably determine the origin of fired cartridge cases and bullets (Faigman, Scurich & Albright, 2022). The authors emphasised the importance of firearm identification to ensure adherence to consistent, evidence-based standards, because a lack of such standards may result in the conviction of innocent people and the release of guilty ones.

5.3.3 Theme 3: The evidential value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies and other crime types that involve shootings

The evidential value of forensic firearm identification evidence applies to every crime involving shootings. The CIT armed robbery is just one such area of research in which the problem was identified. Since this theme is central to the study, it was explored within the three samples from various angles.

5.3.3.1 *The evidential value of forensic firearm identification evidence for investigations and prosecutions*

The participants explained the evidential value of forensic firearm identification evidence-based on the investigation and prosecution of crime.

BE 2 indicated that:

The evidential value is to link the specific firearm to the crime scene. So, it is not to link the firearm to the person but to the crime scene. So, it is the only conclusive method to link the firearm to the crime scene via forensic firearm identification. So, after the firearm was linked to the suspect, which could be due to recovery or other trace evidence found on the crime scene, the firearm will link the individual to the crime scene. So, it is the chains of events which is required (BE 2:2024).

BE 4 also said:

It is absolutely essential; it identifies the tool of crime with the crime scene evidence, such as, the bullet or the cartridge case. Identification of firearms also relates to the Firearms Control Act 60 of 2000. It is also to identify the firearm, machine gun and so on. So, it is absolutely essential (BE 4:2024).

IO 2 mentioned that:

Investigation wise it can help me to give me the way forward, where I can go and look for more information on the possible suspects, this firearm was used in Limpopo, KwaZulu-Natal, and Gauteng and that is the importance thereof. Prosecution, as I have explained is a little bit daunting (IO 2:2024).

P 1 pointed out that:

The evidential value of forensic firearm identification is very important. You know it helps in prosecuting this kind of cases. Remember most, if not all, robberies or cash-in-transit, as you call them, cash-in-transit robbery, firearms are used and different types of firearms. Rifles, pistols, and so on. So, the forensic firearm identification is very important and valuable. You must remember the firearms, carries different minimum sentences that are applicable in most of these firearms. Remember a firearm like is a semi-automatic pistol, the prescribed minimum sentence in terms of the Minimum Sentence Act, minimum sentence is 15 years. I am giving you an example. So you need to identify that firearm, and you need that expertise, and for instance, an automatic firearm like AK47, you must know that in terms of the Minimum Sentence Act, the minimum sentence is about 25 years, same like a prohibited firearm, what is a prohibited firearm? With my little knowledge,

prohibited firearm, if you have a pistol and the serial number is filed off, is a contravention of Section 4 of the Firearm Control Act 60 of 2000, it carries a different sentence if a person is caught with it. So forensic firearm identification evidence is very much important in prosecuting these types of cases, getting the correct sentence or punishment at the end of the trial. It is very important; we need this type of expertise to really prove your case. What type of firearm was used and what type of sentence the court must impose on the suspects. So it assists in many ways, for instance, I will give you an example. If the shots being fired by the suspects and the police during the crossfire, in the case of this robbery, cash-in-transit, and then you need a forensic expert to compare, for instance, the cartridges that were found on the crime scene with the firearms that were later recovered from the suspects. To compare you need this evidence of firearm, forensic firearm identification, and that helps. It places the firearm found from one person to the scene, where the incident took place. Or maybe even the bullet, perhaps one person was shot, whether he survived or not, perhaps the bullet was retrieved from the body of the victim, can be compared with the firearm recovered from the suspect. It is a valuable evidence, so it is important to always use such evidence from our forensic experts to prosecute cases of that nature (P1:2024).

BE 2 emphasised that:

Without that evidence, they won't even be able to prosecute because somewhere you must prove that that firearm which was found with the accused was used in that crime scene. That's where this evidence is essential (BE 2:2024).

As for investigating crime, the participants said forensic firearm identification links the suspect firearm to the crime scene. It was further emphasised that forensic firearm identification does not link the suspect firearm with the suspect; instead, it places the suspect firearm at the crime scene as a tool of crime. The participants also mentioned that after the suspect firearm has been linked with the crime scene through firearm identification, trace evidence plays a significant role in linking the suspect with the crime scene. Also, the participants noted that forensic firearm identification confirms whether the device sent to ballistics for analysis complies with the Firearm Control Act 60 of 2000 and is considered a firearm. Participants also viewed forensic firearm

identification as essential, as it guides investigation processes. For example, if the ballistics report reveals that this firearm was linked to multiple crime scenes, it can assist the investigating officers in further investigations.

The participants described the role of forensic firearm identification in prosecution, explaining that various types of firearms have specific minimum sentences. As a result, during the prosecution, the type of firearm determines the sentence. This information assists the court in making relevant convictions that are proportional to the type of firearm used. The court will also ensure they are dealing with a firearm, not a similar device. The participants further said that, without forensic firearm identification, it is impossible to prosecute because the court is obliged to prove that the firearm is linked to the crime scene. Failure to do so will result in the withdrawal of cases.

5.3.3.2 *The role of forensic evidence in criminal investigations*

Although this study is focused on the investigative value of forensic firearm identification in investigating and prosecuting CIT armed robberies, the researcher found it important to explore its overall impact on criminal investigations. The participants explained the role of forensic evidence in criminal investigations as follows.

Responding to the question posed to the participants regarding the role of forensic evidence in criminal investigations, IO 2 indicated that:

To give me answers to something that cannot talk to me or I cannot see. Like I am telling you now...I can see this spent cartridge for I can see this is an AK47, two weeks ago I had an AK47 on that scene but I cannot tell you that this, inside these little marks and identification marks in this spent cartridge, the same as spent cartridge that tells me both spent cartridges on different occasions come out of this gun that I've found now. So, it tells me that for me...the things that I don't know, and I can't see (IO 2:2024).

B4 indicated that:

It is absolutely essential without which a conviction is not possible. And as I have said, the evidence of ballistics expert is also needed to show the court that the firearm also complied with the Firearm Control Act (BE 4:2024).

Based on the response of IO 2, forensic evidence provides scientific clues that play a significant role in solving crimes. The participant said certain evidence relies on forensic science, which cannot be seen with the naked eye. For example, forensic firearm identification evidence depends heavily on microscopic comparisons and requires specialised expertise for analysis and interpretation.

As discussed in section 3.17 *supra*, the role of forensic firearm identification in the investigation and prosecution of CIT armed robberies involves the linking of fired cartridge cases and bullets to a specific firearm recovered from the crime scene or seized from the suspected armed robbers (Davies, 2023). Morgan and Lorna (2018:2) pointed out that forensic firearm identification evidence confirms whether the recovered firearm fired the cartridge cases found at the crime scene. The authors further indicated that forensic firearm identification results are supported by other evidence, such as fingerprints, DNA, witness interviews, and other physical evidence found at the crime scene to link the recovered firearm with the suspected armed robbers.

5.3.3.3 *Locard's principle of exchange*

Locard's principle of exchange forms the basis of criminal investigations, as it guarantees that evidence exists at every crime scene. This principle holds that whenever two objects come into contact, they leave or exchange traces. The principle is also relevant to forensic firearm identification. There are certain parts of the firearms, which are later discussed in this chapter, that, whenever they come into contact with the ammunition components during the firing process, they impart their unique marks on the fired cartridge cases and bullets. Transferring marks from parts such as the barrel, firing pin, chamber, and ejector to the fired bullets and cartridge cases occurs because these firearm parts' materials are harder than the softer materials of the fired ammunition components. The participants explained Locard's principle of exchange as follows.

IO 1 mentioned that:

A suspect of a crime will bring something to your crime scene, but will also take something from your crime scene, so you come with a firearm you will

take whatever but it will leave something...it will bring, and it will leave something for you behind (IO 1:2024).

In contrast, IO 2 found it difficult to explain Locard's principle. This is how the participant replied:

I know about Locard's principle. I can't remember the definition (IO 2:2024).

Based on the participants' responses, some understand what Locard's principle entails, while others find it difficult to explain it. The researcher discussed that the crime scene investigation must be conducted with Locard's principle in mind in section 2.13 supra. It holds that whenever two objects come into contact, they leave or exchange traces (Baldwin & May, 2017).

5.3.3.4 *The importance of the chain of custody*

The chain of custody encompasses the responsibility of everyone handling the exhibits to protect them from being contaminated and lost until they serve their purpose in court. It will be properly disposed of. The participants explained the importance of the chain of custody as follows.

BE 1:

To prevent tampering with the evidence. It is important because each and every person who receives the exhibit must mention that they received the exhibit in good order. So that if the third person received it tampered with, it will show that the first person or the second person tampered with the evidence, so this prevents the tampering with evidence (BE 1:2024).

BE 3:

For me, maintaining the chain of custody is to keep record and have a proof that this is the same exhibit that they have found at the crime scene; the one that I've analysed, because it gives you a chain of custody that is the same exhibit. It gives you the proof that this is the same exhibit. So, if you don't have a chain of custody, they can easily manipulate the system because we won't have a trace that this thing was kept under this chain. It gives us that assurance that this is the same exhibit that they got from the crime scene and the one that I have analysed (BE 3:2024).

P1:

Chain of custody is very important, is very important and I know that the police are aware of the chain of custody. They always try by all means to secure the chain of custody of these exhibits, from the scene to the station, to the 13 (SAP 13), from the 13 to Lab, up until the results are determined by the forensic experts. So the chain is very important, so that you know that nothing was tampered with, you deal with correct facts, with correct evidence of the exhibits that are retrieved from the scene or from the suspect or suspects (P1:2024).

The participants revealed that the chain of custody assists in preventing the exhibits from being tampered with, as everyone who handles them is accountable for any damage or loss. It was further indicated that it ensures that the same exhibits recovered from the crime scenes are the same ones analysed by the ballistics experts and presented in court. This assists the court in working on the correct facts of evidence. This can be imagined in a situation where the firearm recovered from the crime scene was swapped with another firearm of the same model and calibre. Whether deliberately or mistakenly, this could mislead the investigation and prosecution processes.

To secure prosecutions, the chain of custody should be considered. The chain of custody, alternatively known as the chain of evidence, was discussed in para 2.13 and 3.12.6 supra, is the most critical process of documenting evidence. According to Badiye, Kapoor, and Menezes (2023), it assures the court of the evidence's authenticity by ensuring that the evidence presented in court is the same as that recovered from the crime scene.

5.3.3.5 The CIT armed robbery scene as a source of evidence

This section covers the general understanding of a crime scene and the types of forensic firearm identification evidence that can be recovered from CIT armed robbery scenes. A crime scene refers to a place where a CIT armed robbery took place. Although CIT armed robberies occur across a wide area due to their nature, a single incident may result in multiple crime scenes. This depends on how the incident evolved. Crime scenes include locations where evidence linked to the CIT armed robbery can be found.

General understanding of a crime scene

The participants described the crime scene as follows.

IO 1 explained that:

There was an offence that happened...there may be evidence that you can collect, that can assist you later on (IO 1:2024).

In response to the understanding of a crime scene, IO 2 explained that:

...is where a crime has been committed. It is the radius wherein the crime was committed. With us with cash-in-transit, you can get a crime scene that could be kilometres because the AV is bombed here and then the money flies the whole world, and then you have to cordon off, that's another scene, and to follow tracks or you may get in 5 kilometres. A crime scene is actually where there's evidence that can help you to take this case to court or to tell you the story of what happened there (IO 2:2024).

The participants explained that a crime scene is the place where a crime has been committed, including the area where evidence related to the crime has been recovered. One participant indicated that a crime must be committed before we have a crime scene.

The types of forensic firearm identification evidence that can be found at the CIT armed robberies scenes

The researcher asked the participants to mention the forensic firearm identification evidence that is usually recovered from the CIT armed robbery scenes. The following responses were provided.

Responding to the question posed to the participants, IO 2 replied as follows:

That is spent cartridges, that will be firearm itself, that will be magazines, it will be live rounds that are lying around... it could be pieces of the projectile, so all depends on where and what they did with the firearm. The cartridges that you have sent in or the firearm that you have sent in can be linked to the crime scene, say KwaZulu, Umlazi, so and so, or Polokwane, so and so, with the statement (IO 2:2024).

BE 2 mentioned the following kinds of forensic firearm identification evidence and elaborated further on the types of marks found on the recovered evidence, such as fired cartridge cases and bullets:

Firearm. It could be a cartridge case and a bullet. I can elaborate further on the cartridge case, you've got the breech markings, you've got the extractor markings, you've got the ejector markings, and you've got the chamber markings on the cartridge case (BE 2:2024).

P1 also responded as follows:

The most important one is the comparison. Is this firearm the one that shot these cartridges, comparison? That is the key important firearm identification (P1:2024).

The firearms, fired cartridge cases, bullets, ammunition, and magazines were identified by the participants as the most recovered forensic firearm identification evidence. These exhibits are recovered by the investigating officers from crime scenes and analysed by ballistics experts to assist with the investigation and prosecution of CIT armed robberies in this study. In criminal investigations involving firearms, the same exhibits play a role. In section 3.17 *supra*, Morgan and Lorna (2018:2) mentioned that firearms, fired cartridge cases, and bullets are usually recovered from the crime scenes where firearms were involved.

5.3.4 Theme 4: Challenges associated with the investigative value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies and other crime types that involve shootings

The participants identified the several forensic firearm identification-related challenges.

5.3.4.1 Lack of resources

Resources cover everything participants need to perform their functions. Lack of resources was described by the participants as follows.

BE 2 said:

Resources was the first thing. The second thing was the insufficient human beings, doing the work (BE 2:2024).

Also, BE 4 indicated that:

The lack of sufficient human resources. I think that was the biggest problem. Lack of essential resources...the printers, ammo, there was not always the correct ammo, vehicles, we had a lot of problems with broken vehicles, all this time, the analysts are struggling. So, analysts shouldn't run around to find vehicles. They shouldn't struggle to get ammunition (BE 4:2024).

IO 2 described a lack of resources as follows:

There is no enough manpower. We haven't got cars that can live up to or can be measured with the people out there. We haven't got the cell phone technology, the same type of cell phones, we haven't got G5. You know all the equipment to do the tracking and stuff (IO 2:2024).

The participants mentioned human resources and other essential resources, such as ammunition and vehicles. BE4 emphasised that ballistics experts are not supposed to struggle to find vehicles and ammunition when they need them.

5.3.4.2 Poor consultation of ballistics experts and investigating officers as witnesses before the presentation of evidence in court

Consultation between the prosecutor, the ballistics expert, and the investigating officer before presenting evidence in court is essential, as the investigating officer and the ballistics expert can ask about what is in dispute. This prepares them for presenting evidence, knowing what the court wants to know or expects them to clarify.

In response, BE 3 mentioned that:

I think the other challenges could be on the side of the prosecutor, the prosecutors were not consulting with us enough, or the IOs (Investigating Officers) were not consulting with us enough. We would just go there, not knowing which part exactly they will need clarity from you. Because everything is on the statement, so they just say come to court. I think there

must be broader consultation to understand. So that they can prepare you in advance, where they need clarity. So, some you just go there, you just don't even know why you are here because whatever I've said is already on the statement. You just go there and read your statement. They say no further question (BE 3:2024).

The participants' concern is that everything that the court needs to know is included in the 212 statements. However, if required to testify in court, there is a lack of consultation with the prosecutors for court preparation. BE 3 mentioned that, sometimes, the testimony will be reading your 212 statement and being excused.

5.3.4.3 *Poor Ballistics Case Management*

The participants identified the way the Ballistics Case Management allocates cases as poor.

The poor Ballistics Case Management was described by BE 3 as follows:

The only challenge that I would get was not having proper management from the issuer of the cases. Sometimes they will give you a case that you have to really analyse within 3 days. It was long on their disposal, but they are only issuing it, when it is left with 3 days. So, I think maybe their systems in terms of receiving and allocating somehow, it was inefficient. Because there was no proper flow. They can give you a case that is still having 20 days but, but tomorrow they give another one of 2 days or maybe their system in that place was not proper to prioritise or group them accordingly in terms of their first in, first out. I think the only challenge was from the Case Management. It will compromise on the quality because you will be having pressure to quickly wrap up the case and submit it back. So, I think if they can manage that process, or if the analysts get enough time to work on these cases, in a way it will impact on the quality of your analysis. But if you are rushed, you can, in a way, compromise the quality (BE 3:2024).

This participant raised that the issuance or allocation of ballistics cases is poor because cases are allocated to the ballistics experts even though they have been in the ballistics safe for a long time. Once they are assigned to the ballistics experts, the expedited handling of these cases results in unnecessary pressure to finalise them. Forensic firearm identification evidence requires enough time to compare the fired

cartridge cases and bullets. There is no proper strategy for allocating the ballistics cases to the experts. Since ballistics experts are not given enough time for analysis, the quality of their work is compromised. It is like they are pushing statistics on completed cases rather than focusing on the quality of their analysis. If forensic firearm identification is rushed, it might result in wrong findings or resorting to inconclusive findings, just to be on the safe side.

5.3.4.4 *Inability to maintain chain of custody*

The chain of custody is essential to ensure that the same exhibit recovered from the CIT armed robbery scene is the one presented in court, without tampering. Failure to maintain the chain of custody has negative implications for forensic firearm identification evidence, as no one will be held accountable for any damage, loss, or mixing of such exhibits. The chain of custody allows everyone who handles the forensic firearm identification evidence to mention how it was received or found, where and when, as well as the reason for having this evidence, and when it was handed over to the next person.

BE 4 explained the inability to maintain the chain of custody as follows:

I think the biggest challenge that I had was that the CIT cases were always linked to other cases. And the chain of custody of all this evidence of these cases were all complicated to explain. Some cases that are connected to this case, and the analysts, some of the analysts have resigned, some have passed away and so and so. So, it was always a bit difficult to get all this evidence before the court. So, what I can do is maybe, what will be a good idea is to make a summary of a chain of custody for the court, in case the court wants each examiner, it will make the process much easier. The last time I testified about CIT in Polokwane, there was something like this statement. It was complicated; I don't think the court understood their affidavits (BE 4:2024).

The participant indicated that when the court questions the chain of custody of forensic firearm identification evidence, especially in CIT armed robberies, it becomes a challenge because some ballistics experts are no longer available for various reasons. Since ballistics cases are registered in entries every time new evidence related to a specific Lab number or case is added, the chain of custody breaks when the person

who analysed the first and second entries is no longer available, and the available ballistic expert you find analysed the third entry. During the presentation of forensic firearm identification in court, the chain of custody must cover even the first and second entries, for example. BE 4 suggested that for every entry, there must be a summary of the chain of custody to avoid complications in court.

5.3.4.5 *Lack of support from the judges, magistrates, and prosecutors when presenting evidence in court*

It was also highlighted that during the presentation of forensic firearm identification evidence testimony in court, there is no support from the judges, magistrates, or prosecutors.

BE 3 said:

I feel like the Judges and the Magistrates are not doing their part in terms of protecting us. But the intimidation tactics were there, and we were able to deal with them (BE 3:2024).

The participant said intimidation tactics are always used when testifying in court. Although there is a lack of support, BE 3 confirmed that they dealt with them.

5.3.4.6 *Incompetent ballistics experts*

The training of ballistics experts was discussed in para 3.16 supra. The participants identified incompetent ballistics experts as a challenge. The incompetent ballistics experts can be associated with producing wrong forensic firearm identification findings and lack the qualities of an expert. This negatively affects or misleads the investigation and prosecution processes.

Regarding the incompetent ballistics expert, BE 4 said:

I think that was the biggest problem. Incompetent analysts. I think the Lab can appoint more competent people. So, I don't think more competent people are always appointed (BE 4:2024).

BE 4 believes that the Forensic Science Laboratory needs to appoint more competent people to curb this problem of misleading investigations and prosecutions.

5.3.4.7 *Delayed ballistics reports*

The delayed ballistics reports were also identified by the participants as a challenge.

P1 said:

You know the challenge now is that the reports are delayed. I don't want to lie, the forensics, whenever we issue the subpoena, maybe because we are just nearby Pretoria, they are available. The problem is the delay to get the forensic reports. I don't know what the problem is, but that is the only challenge that I have personally...the forensic reports take long. Before, they will take six weeks...eight weeks to get the report. But for now, the challenge is, it takes 12 months waiting for the reports, and that has an impact on prosecuting our cases. Remember, once you don't have that report, that forensic report, you cannot allege that the person was in possession of a firearm. That is the challenge. Once you don't have the forensic report that says this is a firearm in terms of the Firearm Control Act. Before you can even look at the identification, the firearm must be identified that it is a firearm in terms of the Act, because of the following reasons. You will see section 1 of Act 60 of 2000, it describes what the firearm is in terms of the Firearm Control Act. Up until you get that report, you cannot charge somebody in terms of the possession of the firearm. So, the impact is very huge in prosecuting these robberies in cases where firearms were involved and were recovered (P1:2024).

IO 1 also said:

We've got a lot of challenges because time is of the essence here, it takes too long for the ballistics reports to link your cartridge from your scene to another scene with the same cartridges that were found at the crime scene with the same firearm. That is our biggest problem...it takes too long; we do not get the results quickly enough, and that becomes a problem. So, whenever you charge someone on a new case and like mine are in custody, they will come with a new bail application. It is time-consuming; you spend your days in court fighting people not to go out on bail... (IO 1:2024).

Although P1 mentioned that whenever ballistics experts come to court, as needed, the biggest challenge is the delay in ballistics reports. The participant highlighted that this delay has a significant impact on prosecuting robberies involving firearms. The delay

in ballistics reports affects the investigation because the investigating officers (IOs) spend more time opposing bail for the suspects while waiting for these reports, which can take a long time. The suspects come with new bail applications.

5.3.5 Theme 5: Suggestions to enhance the investigative value of forensic firearm identification evidence

The following measures were suggested by the participants on how the use of forensic firearm identification can be improved.

5.3.5.1 Forensic firearm identification awareness

Regarding the forensic firearm identification awareness and training, the participants highlighted the following.

BE 3 said:

I am saying the only thing that you can do is awareness. I think maybe those guys are not very much clued up with us, because some things are written there, but you just go there to read your statement, and you go. The cartridge is regarded as a bullet. I would like to believe that maybe is mix up, in a way, for us, our evidence got to lose meaning. I would say, the cartridge, the interpreter will say the bullet, I will say cartridge case, you say bullet, in a way it lost meaning, there was no right translation of or proper translation of our ballistics terms (BE 3:2024).

In contrast, BE 2 said:

I think they all know, sufficiently, to submit things to us, to submit the exhibits. I think the awareness is there; I don't think that is a problem because everybody knows ballistics exists. The big challenge is to get the services up to scratch that is where the emphasis should be placed on (BE 2:2024).

Also, BE 4 mentioned that:

There are huge gaps in training of prosecutors, who deals with CIT robberies. However, it doesn't help to present forensic firearm identification awareness to prosecutors and IOs, and the main reason for the withdrawal of shady cases are due to late and in some cases the absence of reports from FSL, and specifically ballistics. So the cases are withdrawn due to the

Lab. The Lab must rather spend time trying to catch up with backlog than spend time on IOs, because I think at this stage, they know what ballistics is doing. It is much better providing affidavit and get it to court (BE 4:2024).

Although some participants believe there is a need for awareness of forensic firearm identification, others believe the concept is well known. BE 3 believes that there is a need for forensic firearm identification because, during the presentation of ballistics expert testimony, some terminology is not correctly interpreted, resulting in the testimony losing meaning. In contrast, BE 2 believes that awareness is unnecessary because ballistics seems to be known. However, the biggest challenge is to get the services up to scratch. Also, BE 4 emphasised that the focus should be on reducing the backlog and issuing ballistic reports on time.

5.3.5.2 Proper consultation of the ballistics experts and the investigating officers as witnesses, before the presentation of the ballistics expert testimony in court

The proper consultation forms part of court preparation for the ballistics experts, IOs, and prosecutors.

In response to the challenges related to forensic firearm identification, BE 3 said:

I think there must be a broader consultation to understand. So that they can prepare you in advance, where they need clarity. So, some you just go there, you just don't even know why you are there, because whatever I've said, is already on the statement. You just go there and read your statement. They say no further question (BE 3:2024).

Proper consultation before the presentation of testimony in court plays an important role in preparing the IOs and the ballistics experts in advance. This lets them clarify any issues before the actual court presentation.

5.3.5.3 Enough time allocation to the ballistics experts for analysis of forensic firearm identification evidence

The time allocated to the ballistics experts for analysis of forensic firearm identification evidence is important, as every case is unique and needs to be given the attention it requires.

BE 4 explained the allocation of time for analysis of forensic firearm identification evidence as follows:

These cases usually contain many exhibits, so you need a qualified and competent person to do these cases. These cases are highly opposed by the defence. if go to court, you will also have hard time in court. They will question you; they will actually make sure that you know your work. The analysts that do these cases, don't always receive enough time to do these cases. So, once again these cases are very tiring is not nice to do cases like these. You need a lot of attention to do these cases. Oversees people or analysts will spend months on cases like these, whereas in ballistics in Pretoria, or in South Africa, we only get a day or two time doing that kind of cases. It is not official term, but it is accepted internationally or in ballistics cycles. That I call it the inconclusive syndrome. I think they can make much more exhibits, positive or negative. They can do much more pure identification, not to make all exhibits inconclusive (BE 4:2024).

Enough time is important when analysing forensic firearm identification evidence because in cases such as CIT armed robberies, usually there is a crossfire between the police and the robbers or the security guards with the robbers, or otherwise the combination of them all. The forensic firearm identification evidence recovered from such scenes is a lot, which will require enough time to be analysed. As for participant BE 4 and the allocation of sufficient time for the analysis of this evidence, it was emphasised that time is of the essence when dealing with forensic firearm identification. The participant further compared overseas ballistics experts with those in South Africa, precisely in the Pretoria FSL. BE 4 indicated that due to the pressure to expedite these cases within a limited period, the ballistics experts have developed an inconclusive syndrome. The tendency to make forensic firearm identification evidence inconclusive, just to move the cases out of their hands and be removed from their names.

5.3.5.4 Allocation of sufficient resources

Sufficient human resources are the ballistics experts who are enough to analyse the cases. Explaining this suggested measure, BE 1 said:

The main problem now is the lack of manpower, lack of stuff, lack of hands of the analysts, and the proper training. So, we need to have enough hands. Because you know most of the evidence, like they have been handed two years back. And in the space of the whole two years, they have been in their safe. So, the plastic (evidence bag) may be opened, and they stay too long, and also the courts are always withdrawing the cases because of this backlog from ballistics. So, enough manpower is needed (BE 1:2024).

IO 2 said:

So, for now, SAPS hasn't got a proper plan, to say "No, look, this is how we gonna deal with cash-in-transit." There is no enough manpower. We haven't got cars that can live up to or can be measured with the people out there. We haven't got the cell phone technology (IO 2:2024).

BE 1 emphasised the need for enough manpower at ballistics to address the backlog, which is the reason for the withdrawal of most cases due to delayed ballistics reports. Enough manpower will balance the influx of cases and those that are analysed. Similarly, IO 2 identified resources as a problem.

5.3.5.5 *Collection of all possible evidence*

The collection of all possible evidence at the crime scene was found to be a solution to secure the convictions.

Here, P1 said:

To improve is to collect everything possible from the scene. Everything, no stones must be left unturned. Everything must be collected from the scene. That will help the prosecution in many ways to secure the convictions. To secure the convictions, you are, in a way, curbing the problem. Reducing the number of hijackings, number of CIT, and so on (P1:2024).

P1 suggested that all possible evidence should be collected from the crime scene. This will assist the court in linking the suspect with the committed crime. Because forensic firearm identification evidence links the firearm only to a crime scene, not a suspect, other evidence will assist the court in linking the suspect to the recovered firearm.

5.3.5.6 *An establishment of a database for test-fired cartridge cases and bullets of every licensed firearm*

The researcher asked participants whether they would support a database that captures test-fired bullets and cartridge cases before licensing a firearm. The participants replied to the question in various ways.

In BE 4 said:

No. I can tell you why, I've tested this idea since I left the police. I've tested this idea within the firearm community, and it was not accepted very well. There are technical reasons, technically test-fires need to be acquired after each licensing or change of ownership of a firearm. There are several reasons why this was not done nowhere in the world. Of which the changing in identification characteristics is the main reason. So, the firearms are changing over the years. So, you will have to test this firearm every five years when a person applies for a licence or to renew his firearm licence. You will have to do all the IBIS again. There are more than four million licensed firearms in South Africa. Just to acquire each of these licensed firearms once on IBIS, we don't even talk about five years. The current number of systems available will take decades (BE 4:2024).

Different from the previous reply, BE 2 mentioned that:

This is a 50/50 question. What we must keep in mind with the firearm, is over the lifetime. There are some changes in the individual characteristics, so it will change. So, if we look at it from the other hand, the normal firearm owners hardly ever fires that firearm because it is expensive. He's got the firearm, but he does not fire it. So, in 95% of the cases, um to use a database, it will add a lot of value. I say 95%. I would say this is a very strong case that we've got here, to keep a test round at the registry (BE 2:2024).

BE 1 supported a database and said:

Yes, I will be in support of that. Remember, South Africa is now having enough firearms. Many firearms are in the hands of the wrong people, so each and every person who is buying a firearm we need to test it because most, these firearms that are in the hands of these wrong people are the firearm that have been bought by the owners and they have been robbed

from the owners. So now, if we test each and every firearm that has been sold to an individual eh in future we get the cartridge case, it will trace back that firearm to that firearm that has been robbed from the owner. So, we know the owner of the firearm already. So, this one I will support it 100% (BE 1:2024).

BE 4 is not in support of the database because firearms characteristics change over time due to factors such as use, rust, or damage. This database will rely on continuous testing of these firearms and on the acquisition of fired cartridge cases and bullets, for example, every five years. According to BE 4, given the number of firearms in South Africa, the practicality of this idea is highly difficult to achieve, if not impossible. But BE 1 indicated that it is a 50/50 situation. It is a great idea to have all firearms' characteristics and details in that database. However, it will take a long time to materialise. But that is not a permanent solution, as firearms' characteristics change. Then B1 supported the database because it will provide the necessary information to assist when the firearm ends up in the hands of criminals. The owner of this firearm can be traced.

5.4 ALIGNMENT OF THE RESEARCH FINDINGS WITH THE OBJECTIVES

The research findings support the attainment of the objectives as outlined in section 1.5 of the study. This study consists of six objectives and is presented as follows:

- To explore what may be considered as ballistics evidence found at CIT armed robbery crime scenes.

The findings indicate that firearms, fired bullets, and cartridge cases constitute forensic firearm identification evidence, as part of the ballistics evidence examined in this study. These were identified in section 5.3.2.6 of the study.

- To explain what CIT armed robbery is and how it manifests in SA as opposed to other countries in the Global South and North.

The meaning of CIT-armed robbery and how it manifests in South Africa, compared with other countries in the Global South and the Global North, was discussed in chapter 2 and section 5.3.1 of the study.

- To explain what forensic firearm identification entails.

Much of chapter 3 was devoted to explaining the science of forensic firearm identification, and section 5.3.2 of the study further presented empirical findings on what forensic firearm identification entails.

- To explore and explain the evidential parameters that frame the use of forensic firearm identification.

The evidential parameters that frame the use of forensic firearm identification evidence are discussed in paragraph 3.18, and the empirical findings are presented in section 5.3.2.13 of the study.

- To explore the role of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies.

The role of forensic firearm identification evidence is addressed in paragraph 3.17, and the empirical findings are presented in sections 5.3.2.1 and 5.3.2.2 of the study.

- To determine any challenges associated with forensic firearm evidence identification in investigating and prosecuting CIT armed robberies.

The challenges associated with forensic firearm identification evidence in investigating and prosecuting CIT armed robberies were discussed in paragraph 3.14, and the empirical findings are presented in section 5.3.4 of the study.

5.5 SUMMARY

The research findings were presented thematically, with five themes that emanated from the research. This chapter discussed participants' views and experiences on forensic firearm identification. The discussion in this chapter was based on the research problem and question. Chapter 5 saw the culmination of the literature from chapters 2 and 3, alongside the relevant empirical data. The participants' responses were relevant to this study and will be used to answer the research questions. The next chapter focuses on analysing and interpreting these findings.

CHAPTER 6: INTERPRETATION OF THE FINDINGS

6.1 INTRODUCTION

This chapter is about the interpretation of the findings. The researcher will follow the sequence of themes as presented in chapter 5. The findings of this study reflect the participants' views.

6.2 AN OVERVIEW OF THE EMANATING THEMES

Five different themes emanated from the data. These are addressed in chapter 5. Using these five themes, the researcher crafted a conceptual framework in Figure 6.1 to guide the interpretation of the findings in this chapter.

- Theme 1: An overview of the CIT armed robbery in the West Rand District Municipality.
- Theme 2: The scientific analysis of forensic firearm identification evidence.
- Theme 3: The investigative value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies and other crime types that involve shootings.
- Theme 4: Challenges associated with the investigative value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies and other crime types that involve shootings.
- Theme 5: Suggestions to enhance the investigative value of forensic firearm identification evidence.



Figure 6. 1: Conceptual Framework (Researcher, 2026)

6.2.1 Theme 1: An overview of the CIT armed robbery in the West Rand District Municipality

As discussed in section 5.3.1, the researcher found it important to obtain an overview of CIT armed robberies in the West Rand District Municipality. The participants' overall understanding of CIT armed robbery, its root causes, the most targeted CIT companies, and the modus operandi form part of this section. The discussion on an overview of CIT armed robbery in the West Rand District Municipality will further describe how CIT armed robbery manifests in South Africa, as opposed to other countries in the Global North and South, one of the research objectives.

6.2.1.1 The general understanding of the CIT armed robbery

Based on the discussion in section 5.3.1.1, the findings revealed that the participants understand what CIT armed robbery entails. In the same section, some stated that it can constitute a CIT armed robbery only if an armoured vehicle (AV) was used to transport the cash, rather than any other mode of transport. Various forms of CIT armed robberies were also discussed in section 5.3.1.1.

6.2.1.2 The root causes of the CIT armed robberies

Although in section 5.3.1.2 the literature review revealed various root causes of CIT armed robberies, such as corruption, greed, and socio-economic factors, the findings in the same section point out greed as the root cause of CIT armed robberies.

6.2.1.3 The most targeted CIT companies and the reasons thereof

G4S was identified as the company most often targeted, as discussed in section 5.3.1.3. According to the findings, this is due to its use of cheap labour. The same personnel who are underpaid sell information to the CIT armed robbers. This can be seen in how the CIT-armed robbers are well informed about the routes of these AVs, the amount of cash they carry, and even the safe that holds a lot of money.

6.2.1.4 The modus operandi of the CIT armed robbers

This section presents the meaning of the modus operandi and its use, the modus operandi of CIT armed robbers, considering various common methods.

The meaning of modus operandi

The findings revealed that the participants understood the meaning of modus operandi and defined it in section 5.3.1.4 as a method of operation or a specific pattern of doing things.

Using modus operandi

As discussed in section 5.3.1.4, the modus operandi of the CIT armed robberies provides information about the robbers, including the vehicles, firearms, and explosives they use, and the period during which a particular group of CIT armed robbers carries out robberies. It provides the IOs with a clue to establish what may have transpired and possible perpetrators.

Various modus operandi of the CIT armed robbers in the West Rand District Municipality

Based on the findings in section 5.3.1.4, there are various modus operandi for CIT armed robberies. This includes the CIT armed robbers, who commit these robberies in the dark, so video footage can be blurry. The other tactic pointed out was to execute CIT armed robberies near informal settlements, knowing that after the robbery, residents will rush to the scene hoping to get money, during that process, they will contaminate the crime scene. Ramming of the AVs in front to force it to halt, using firearms and explosives, there are shootings involved, and setting alight of the ramming vehicles also formed part of the findings.

The Common modus operandi of the CIT armed robbers in the West Rand District Municipality

Among all various modus operandi of the CIT armed robbers as explained in section 5.3.1.4, ramming of the AVs and burning of the vehicle used to ram the AV to destroy evidence that can be used to link the CIT robbers with the scene of the crime was identified as the common modus operandi in the West Rand District Municipality.

6.2.2 Theme 2: The scientific analysis of forensic firearm identification evidence

In section 5.3.2, it was indicated that to explore the investigative value of forensic firearm identification in investigating and prosecuting CIT armed robberies, the participants were asked various questions related to the theme.

6.2.2.1 Types of firearms

As discussed in section 5.3.2.1, firearms are categorised into handguns and shoulder arms. The handguns include pistols and revolvers, while shoulder arms cover rifles and shotguns. These are the main categories of firearms, despite their different calibres, working mechanisms, and manufacturers.

6.2.2.2 The firearm parts that contribute to the development of marks on fired cartridge cases and bullets

The findings in section 5.3.2.2 indicate that the barrel, firing pin, ejector, breech face, and extractor are the firearm parts that contribute to the formation of marks. These are parts of the firearm that come into contact with the ammunition during firing. The theory behind the formation of these marks is that these firearm marks are harder than the softer material of ammunition. These parts impart their marks on fired cartridge cases and bullets. For example, forensic firearm identification marks on fired bullets are imparted by the barrel during firing. This occurs when the bullet passes through the barrel. Regarding cartridge cases, the firing pin leaves its mark on the back of the case as it strikes the primer. Likewise, with the chamber, breech face, Extractor, and ejector marks. The firearm marks are imparted to fired bullets and cartridge cases because the ammunition is softer.

6.2.2.3 Ammunition components

Ammunition consists of a primer, cartridge case, bullet, and propellant as indicated in section 5.3.2.3.

6.2.2.4 General understanding of forensic firearm identification

Based on the findings presented in section 5.3.2.4, the participants understand what forensic firearm identification entails. As indicated in the same section, the participants

are aware that no two firearms can produce the same marks, and that is the basis of this concept.

6.2.2.5 Theory behind Forensic Firearm Identification

It was pointed out in section 5.3.2.5 that the Theory of Identification purports that every firearm is unique. No two firearms can produce the same marks during firing. It relies on the microscopic comparison of fired cartridge cases and bullets as detailed in section 5.3.2.5.

6.2.2.6 The types of forensic firearm identification evidence

The findings in section 5.3.2.6 identified firearms, fired cartridge cases, and bullets as the types of forensic firearm identification evidence.

6.2.2.7 The process of collecting forensic firearm identification evidence

As discussed in section 5.3.2.7, the collection of forensic firearm identification evidence includes the marking and packaging of the exhibits. The participants in the same section described how they collect forensic firearm identification evidence, stating that they handle it with gloves. They also mentioned that they take photos of the exhibits before touching them for marking and collection. This provides a view of how the exhibits were found at the crime scene. The participants further emphasised the importance of safety when dealing with firearms, and highlighted that, where necessary, a ballistics expert's opinion must be requested. Where the CIT armed robbery investigating officer or crime scene processor is unfamiliar with the working mechanism of such a firearm, a ballistics expert must be contacted for further assistance and handling.

6.2.2.8 The process of forensic firearm identification evidence analysis

As discussed in section 5.3.2.8, the chain of custody was emphasised as important in the process of analysis. The analysis process includes the firearm examination, test-firing, microscopic comparison of fired cartridge cases and bullets, and the presentation of the findings in court.

6.2.2.9 The tools used to analyse forensic firearm identification evidence

The tools used for analysis of forensic firearm identification evidence are identified as comparison microscope, IBIS acquisition machines, shooting tank, screw drivers, ammunition, bullet pullers, engravers, laptops or personal computers in section 5.3.2.9, for analysis of forensic firearm identification evidence.

6.2.2.10 Turnaround time for analysis of forensic firearm identification evidence

The findings indicate that the turnaround period for analysis of forensic firearm identification evidence is 14 days, as presented in section 5.3.1.10. It is important to indicate that every case is unique, considering the number of exhibits that need to be examined and compared.

6.2.2.11 Formal findings of the forensic firearm identification evidence analysis

The formal categories of the formal findings, as discussed in section 5.3.2.11, are identification, elimination, and inconclusive. These categories of formal findings are detailed in section 5.3.2.11.

6.2.2.12 Issuing of ballistics reports

The ballistics reports are collected by the IOs from the FSL in Pretoria and can be retrieved from an electronic system called ICDMS, as indicated in section 5.3.2.12.

6.2.2.13 Admissibility requirements for forensic firearm identification evidence in court

In section 5.3.2.13, it was indicated that the requirements are that the person who analysed this evidence must be a ballistics expert; the report must be made through a 212 statement or viva voce in terms of the Criminal Procedure Act 51 of 1977.

6.2.3 Theme 3: The evidential value of forensic firearm identification evidence in investigating and prosecuting CIT armed robberies

As indicated in section 5.3.3, the evidential value of forensic firearm identification evidence applies to every crime involving shootings. The CIT armed robbery is just one such area of research in which the problem was identified. Since this theme is central to the study, it was explored within the three samples from various angles.

6.2.3.1 *The evidential value of forensic firearm identification for investigations and prosecutions*

The findings in section 5.3.3.1 indicate that forensic firearm identification evidence, regarding investigations, links the suspect with a crime scene. In the same section, it was highlighted that this evidence confirms that the suspect firearm complies with the Firearm Control Act 60 of 2000 and is regarded as a firearm. Although forensic firearm identification evidence is important for investigations and prosecutions, it cannot link the suspect firearm to the suspect. To achieve that, it relies on other forensic evidence such as DNA or fingerprints. It is important to emphasise that the evidential value of forensic firearm identification evidence applies to all crime types that involve shootings.

6.2.3.2 *The role of forensic firearm evidence in criminal investigations*

This section focuses on how forensic evidence contributes to criminal investigations. As discussed in section 5.3.3.2, forensic evidence provides scientific clues that cannot be seen with the naked eye, such as firearm marks, that assist in directing investigations and prosecutions of CIT armed robberies and other firearms-related crimes.

6.2.3.3 *Locard's principle of exchange*

The findings in section 5.3.3.3 indicate that the participants understand the Locard's exchange principle. Locard's principle of exchange assures that every crime scene has evidence. The researcher maintains that approaching a crime scene with this principle in mind creates a positive perception among IOs that evidence will always be found at the scene. Even where the exhibits require further searching, this principle encourages IOs to continue seeking additional clues.

6.2.3.4 *The importance of the chain of custody*

The discussion in section 5.3.3.4 highlights that the chain of custody promotes accountability for the possession of evidence, such as firearms, cartridge cases, and bullets, against contamination and loss. For example, the firearms, fired bullets, and cartridge cases recovered from the CIT armed robbery scenes must be kept safe and protected from any form of damage or loss by the IOs and ballistics experts until they are presented in court. This ensures that the correct evidence is presented in court,

and the convictions are based on accurate and relevant facts. The chain does not end there; it continues until the court has convicted the suspects, and if, for example, a firearm must be handed to the owner, that will be done. If it is not handed over to the owner or is an illegal firearm, it will be officially destroyed by the SAPS.

6.2.3.5 CIT armed robbery as a crime scene

This section, as presented in section 5.3.3.5, is the general understanding of a crime scene and the types of forensic firearm identification evidence that can be recovered from CIT armed robbery scenes.

General understanding of a crime scene

As already indicated in section 5.3.3.5, the participants understand the meaning of a crime scene.

The kinds of forensic firearm identification evidence that can be found at the CIT armed robbery scenes

The kinds of evidence recovered from the crime scene, as discussed in section 5.3.3.5, are firearms, fired cartridge cases, and bullets. To determine whether the suspect firearm fired the bullets and cartridge cases recovered from the crime scene, the ballistics experts test-fire the suspect firearm and compare the test-fired bullets and cartridge cases with those recovered from the crime scene.

6.2.4 Theme 4: Challenges associated with forensic firearm identification in investigating and prosecuting CIT armed robberies

As presented in section 5.3.4, the participants highlighted a lack of resources; poor consultation of the ballistics experts with the prosecutors before the presentation of evidence in court; poor Ballistics Case Management, Inability to maintain chain of custody; lack of support during the presentation of evidence in court; incompetent ballistics experts; and delayed ballistics as the challenges related to forensic firearm identification evidence. These challenges are discussed as follows:

6.2.4.1 Lack of resources

In section 5.3.2.1, it was noted that the lack of human and other resources, such as ammunition, printers, and vehicles, is a major concern in ballistics. Human resources

specifically refers to the ballistics experts tasked with analysing forensic firearm identification evidence. The main issue with insufficient ballistics experts is that their capacity cannot keep pace with the influx of ballistics cases. Despite other methods that can be adopted to ensure the flow of cases, such as overtime, it is important to have enough ballistics experts to ensure the number of cases assigned to them is proportional to the number of incoming cases. In the analysis of forensic firearm identification evidence, ammunition is needed to test-fire the suspect firearm. The test-fired bullets and cartridge cases will be compared with the ones recovered from the crime scene to determine whether they were or were not fired from the same firearm.

As indicated in section 3.9, the intention of the firearm experts in forensic firearm identification is to match the fired cartridge case and bullets recovered from the crime scene with the test-fired ones from the suspect firearm or to exclude such suspect firearm (Mutsavi & Meintjies van der Walt, 2020:4). Lack of resources, such as ammunition delays the process of forensic firearm identification. In such instances, the ballistics experts will have to pause the analysis until ammunition is available. The IOs, as indicated in section 5.3.4.1, noted a lack of vehicles, cellphones, and tracking devices at the DPCI Serious Organised Crime unit in Krugersdorp.

6.2.4.2 Poor consultation of the ballistics experts as witnesses with the prosecutors before presenting evidence in court

As discussed in section 5.3.4.2, poor consultation with the ballistics experts as witnesses by the prosecutors before presenting evidence in court was identified as a challenge. Proper consultation grants the witnesses an opportunity to determine what is in dispute and provide any clarity on the ballistics reports, as part of court preparation. Although ballistics experts are specialists in their field, court preparation through consultations plays a major role.

6.2.4.3 Poor ballistics case management

Based on the findings in section 5.3.4.3, the allocation of ballistics cases to the ballistics experts is poor because they are allocated to them after they have been in the Ballistics Case Administration safe for a long time. Once they are assigned to the ballistics experts, these cases are rushed, resulting in unnecessary pressure to finalise them. This indicates that there is a shift of responsibility from Ballistics Case

Management to the ballistics experts because the cases stay for a longer period in the Ballistics Case Administration safe, but once they are allocated to the ballistics expert, it becomes their responsibility to complete them, reminding them of how the reports are urgently needed in court. At that stage, the expedition of the cases is emphasised. The need to expedite ballistics cases should be emphasised immediately when they are submitted to the FSL for ballistics analysis. It will never be a solution to inform the court or investigating officers that the ballistics reports are not ready because the ballistics experts are still busy with cases they were allocated, for example, a year after they were submitted to FSL.

6.2.4.4 Inability to maintain the chain of custody

The findings revealed that the court questions the chain of custody of forensic firearm identification evidence, especially in CIT armed robberies, as discussed in section 5.3.4.4. It becomes challenging because some of the ballistics experts are no longer available for various reasons. Ballistics cases are registered in entries every time new evidence related to a specific laboratory number or case is sent to the FSL. As a result, the chain of custody breaks when the person who analysed the first and second entries is no longer available, and when the court requires ballistics expert testimony, you find that only the one who worked on the third entry, for example, is available. During the presentation of forensic firearm identification evidence in court, the chain of custody must cover all entries.

6.2.4.5 Lack of support from the judges, magistrates, and prosecutors when presenting evidence in court

As discussed in section 3.13, although every criminal case is unique, one commonality among them is the use of expert witnesses (Pumphrey, 2022). The author further indicated that expert testimony is based on scientific, technical, and other specialised knowledge to solve crimes and assist the court in prosecuting criminal cases. As indicated in section 5.3.4.5, ballistics experts are not supported when presenting evidence in court by the judges, magistrates, and prosecutors. The same section highlighted that intimidation tactics are always used; however, the ballistics experts indicated they can deal with them. It is important to be ready to testify because the questions asked remain unpredictable. Confidence in the forensic firearm identification

evidence analysis and preparedness to testify are important elements of a successful presentation of expert testimony.

6.2.4.6 *Incompetent ballistics experts*

In section 5.3.4.6, incompetent ballistics experts were identified as a challenge. In forensic firearm identification, incompetent ballistics experts contribute to the wrong or unnecessary inconclusive findings. In section 3.12, it was mentioned that errors in tests reflect a specific ballistics expert and his or her failure of that expert's criteria for firearm identification (Lacalamita, 2022:2). Dorfman and Villiant (2022) argued that when ballistics experts declare the fired cartridge cases or bullets inconclusive, it is regarded as a failure to determine whether they are of common origin. The authors further highlighted that inconclusive findings fail to contribute to the prosecution of the suspect if it cannot be determined whether the bullets or cartridge cases were fired from the same firearm or were fired from different firearms. Forensic firearm identification evidence relies on the competency of a ballistics expert. Although there are contributing factors to the incompetence of ballistics experts, such as the training they have received, their qualifications, experience, and proper compliance with competency tests, the competency of ballistics experts remains a priority. While there is a need for sufficient ballistics experts at FSL, their competency must never be compromised, as this will continue to affect the quality of forensic firearm identification analysis.

6.2.4.7 *Delayed ballistics reports*

As discussed in section 1.1, forensic firearm identification evidence should not just form part of case dockets compilation for court purposes but should also assist in the investigation process to strengthen the case. In section 5.3.4.7, it was noted that although ballistics experts attend court when needed, delayed ballistics reports remain a concern. It was further mentioned that ballistics reports used to take six to eight weeks to be issued. According to the participants, currently, it takes 12 months to be issued. As discussed in section 3.12.9 and 5.3.2.12, a system called ICDMS was introduced to make ballistics reports easily accessible to IOs. The researcher argues that the accessibility of the ballistics reports is important; however, priority should be given to the report's readiness. In that case, all means of collection of ballistics reports, such as personal collection from FSL, can be utilised. The researcher maintains that

ballistics reports must serve their purpose and contribute to the investigation and prosecution of crime. It does not help to issue a ballistics report while the case has been withdrawn from court. The next theme focuses on suggestions to enhance the investigative value of forensic firearm identification evidence.

6.2.5 Theme 5: Suggestions on how to enhance the investigative value of forensic firearm identification evidence

In section 5.3.5, the suggested measures to enhance the investigative value of forensic firearm identification evidence are: forensic firearm identification awareness; proper consultation of ballistics experts with the prosecutors before the presentation of testimony in court; enough time allocation for analysis of forensic firearm identification evidence; sufficient ballistics experts, collection of all possible evidence at the crime scene; and the establishment of a database for test-fired bullets and cartridge cases for every new licensed firearm; as measures to improve the use of forensic firearm identification evidence in all crime types that involve firearms, including CIT armed robberies. These suggested measures are discussed as follows.

6.2.5.1 *Forensic firearm identification awareness*

As discussed in section 5.3.5.1, there are instances in which ballistics experts, when presenting evidence in court, are asked to read their ballistics reports without being questioned and then excused. Ballistic terminology, such as bullets and cartridges, is incorrectly used in court. This might change the meaning of their 212 statements, known as the ballistics report. For example, a cartridge is called a bullet. These two concepts are different and can make a statement lose its meaning if used interchangeably. To address this challenge, forensic firearm identification evidence awareness among criminal justice system role players, such as IOs, police officials, prosecutors, magistrates, judges, and lawyers, is necessary. Forensic firearm identification awareness will make it easier for IOs and prosecutors to interpret ballistic reports.

6.2.5.2 *Proper consultation of ballistics experts with the prosecutors before the presentation of testimony in court*

Consulting ballistics experts as witnesses by the prosecutors before presenting evidence in court is important. As discussed in section 5.3.5.2, there is a lack of

consultation with ballistics experts as witnessed by the prosecutors before their testimony is presented in court. According to the participants, such consultations allow them to clarify any issues before the court presentation. The participants suggested proper consultation with ballistics experts by the prosecutors.

6.2.5.3 Enough time allocation for analysis of forensic firearm identification evidence

Forensic firearm identification evidence requires enough time for analysis. In section 5.3.5.3, it was emphasised that time is of the essence when analysing forensic firearm identification evidence. In the same section, it was mentioned that ballistics experts in the USA are given sufficient time for ballistics evidence analysis, compared to those in South Africa. The participants mentioned that the ballistics experts at Pretoria FSL are under pressure to expedite their cases within a limited timeframe. As a result, they have developed an 'inconclusive syndrome'. This syndrome was described as a tendency to conclude that forensic firearm identification analysis is inconclusive, meaning it cannot be determined whether the fired cartridge cases and bullets, under microscopic comparison, were or were not fired from the same firearm, due to time constraints.

6.2.5.4 Sufficient ballistics experts

As indicated in section 5.3.5.4, human resources refer to the ballistics experts tasked with analysing forensic firearm identification evidence. In the same section, it was noted that a lack of human resources is a challenge in ballistics. This serves as a contributing factor to the delayed ballistics reports. Due to insufficient ballistics experts, cases are stored in the main ballistics safe for about two years before they can be allocated to the experts for analysis. Participants in the same section indicated a need for sufficient manpower at ballistics to address the backlog, which is the reason most cases are withdrawn due to delayed ballistics reports. Although sufficient ballistics experts will impact in addressing the issue of delayed ballistics reports, their competency plays an important role.

6.2.5.5 Collection of all possible evidence

In section 5.3.2.7, it was noted that to secure convictions, it is necessary to collect all available evidence from the crime scene. This will help the court to link the suspect to

the committed crime. Since forensic firearm identification evidence links the firearm only to a crime scene, not to a suspect, other forensic evidence, such as DNA or fingerprints, with forensic firearm identification evidence, will help the court to link the firearm to the suspect.

6.2.5.6 *Database for test-fired bullets and cartridge cases of every new licensed firearm*

As discussed in section 5.3.5.6, participants expressed different views on establishing a database of test-fired bullets and cartridge cases for every licensed firearm. Some participants support the establishment of this database, but others do not. Again, some participants believe it is a 50/50 situation. Those who support this database indicated that it will serve as a source of information, especially regarding the firearms that end up in the hands of criminals. The owner of such firearms can be traced, as their details are in the database.

Those who do not support this database noted that firearms' characteristics change over time due to factors such as use, rust, or damage. The database will rely on continuous retesting of these firearms and on the acquisition of fired cartridge cases and bullets on IBIS. It was indicated that every five years, such retesting of firearms will be required. The participants highlighted that, given the number of firearms we have in South Africa, the practicality of this idea is highly difficult to achieve, if not impossible. Based on participants' views, the suggested database can contribute to using forensic firearm evidence by serving as a source of information for future reference. However, it comes with challenges, such as changes in firearms' characteristics over time, which will need to be considered.

6.3 SUMMARY

This chapter presented the interpretation of the data collected from the participants. The researcher explored the investigative value of forensic firearm identification in CIT armed robberies in the West Rand District Municipality. The research findings revealed that forensic firearm identification plays an important role in investigating and prosecuting CIT armed robberies and all crime types that involve firearms through shootings. The next chapter presents the study's summary, recommendations, and conclusion.

CHAPTER 7: SUMMARY, RECOMMENDATIONS, AND CONCLUSION

7.1 INTRODUCTION

The summary, recommendations, and conclusion of this study are the main focus of this chapter. The summary covers all the chapters of the study. The recommendations are made based on the research findings. The conclusion is made considering the research aim and findings. The next section presents the study's summary.

7.2 SUMMARY

This study consists of seven chapters as presented below.

7.2.1 Chapter 1: General orientation

This chapter introduced the study and problem statement. The delimitation of the study, the aim of the research, the research objectives, the research questions, the conceptual clarification, the philosophical worldview offered in the study, and the overall layout of the chapters were also discussed.

7.2.2 Chapter 2: An overview of CIT armed robberies in South Africa

This chapter summarises the literature on CIT armed robberies in South Africa. The focus was on the background of CIT armed robberies, CIT armed robbery in the Global North and South, contributing factors to CIT armed robberies, the profile of CIT armed robbers and their modus operandi, the investigation of CIT armed robberies, and the new trends and developments in CIT armed robberies.

7.2.3 Chapter 3: The science of forensic firearm identification

The science of forensic firearm identification was covered in this chapter. Forensic firearm identification and its history, the types of firearms, ammunition construction and terminology, the firing process of a firearm, forensic firearm identification marks on fired cartridge cases and bullets, characteristics of firearms' marks, the theory behind forensic firearm identification, the process of forensic firearm identification evidence analysis, IBIS, an estimation of forensic firearm identification error rate, the training of ballistics experts, the role of forensic firearm identification evidence in the

investigation and prosecution of CIT armed robberies, and the reliability of forensic firearm identification evidence were discussed.

7.2.4 Chapter 4: Research methodology

This chapter presented the research methods and designs used in this study. Data collection and analysis techniques, target population, and sampling are also discussed in this chapter. Ethical considerations and methods to ensure trustworthiness form part of this chapter.

7.2.5 Chapter 5: Presentation and discussion of the findings

The research findings, based on participants' experiences and viewpoints on the investigative value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality, were presented verbatim in this chapter. The findings were presented thematically. Each theme and sub-theme was explained by the researcher, followed by participants' responses. The findings were also discussed as the conclusion for each theme and sub-theme. The participants' responses to the questions posed during data collection formed the basis of this chapter.

7.2.6 Chapter 6: Interpretation of the findings

This chapter entailed the interpretation of the findings. The researcher interpreted the findings based on the themes and sub-themes presented in chapter 5. Each theme and sub-theme was mentioned, explained, and supported by the literature presented in chapters 2 and 3 of this study. The researcher wrapped up each theme and sub-theme by synthesising the discussion.

7.2.7 Chapter 7: Summary, recommendations, and conclusion

The summary, recommendations, and conclusion of this study are provided in this chapter. The following section presents the recommendations.

7.3 RECOMMENDATIONS

The findings revealed that forensic firearm identification evidence plays an important role in investigating and prosecuting CIT armed robberies, and all other crime types involving firearms, as discussed in sections 5.2.3 and 6.2.3. The findings further highlighted that forensic firearm identification evidence links the firearms with crime scenes and cannot link the suspect. This limitation relies on corroborative evidence, such as DNA or fingerprints, to link firearms to suspects. Although forensic firearm identification evidence is crucial in investigating and prosecuting CIT armed robberies, it is associated with challenges as identified in section 5.3.4 of the study. The participants in section 5.3.4 of the study pointed out a lack of resources, delayed ballistics reports, poor consultation of the ballistics experts and IOs, with the prosecutors before the presentation of evidence in court, poor Ballistics Case Management, inability to maintain chain of custody, and insufficient and incompetent ballistics experts as the challenges associated with the investigative value of forensic firearm identification evidence. To address these challenges, the following recommendations were made to enhance the investigative value of forensic firearm identification evidence in CIT armed robberies.

7.3.1 Forensic firearm identification awareness

The participants highlighted that, sometimes, when testifying in court, they are simply asked to read their ballistics reports without being asked questions or being excused. They alluded to the fact that some ballistics terminology is erroneously used in court, thus altering the meaning of their testimonies. For example, a cartridge will be referred to as a bullet. These two concepts are distinct and can render the statement meaningless when used incorrectly or interchangeably. According to the participants, this indicates a limited knowledge of forensic firearm identification. Forensic firearm identification awareness was recommended to equip the criminal justice system's role players with what this concept entails.

7.3.2 Prioritisation of the expedition of ballistics cases within the turnaround period

One participant recommended prioritising the expedited processing of ballistics cases within the turnaround period. This person notes that instead of spending time on forensic firearm identification awareness, the emphasis should be on completing ballistics cases and issuing ballistics reports on time. The researcher found that forensic firearm identification awareness and the need to prioritise the expeditious processing of ballistics cases within the turnaround period were relevant to this study. This is because, as urgent as ballistic reports are for investigative and prosecutorial purposes, it is also necessary for those who receive them to be able to interpret them accurately and correctly. This can be achieved through forensic firearm identification awareness and prioritising the completion of ballistics cases within the turnaround period.

7.3.3 Proper consultation of ballistics experts and investigating officers as witnesses, with the prosecutors, before presenting evidence in court

The participants further recommended proper consultation with ballistics experts and IOs, as witnesses, with the prosecutors, before the presentation of evidence or testimony in court. This will serve as an opportunity for court preparation. This recommendation is based on the challenge raised by the participants of the lack of proper consultation. The witnesses will have the opportunity to clarify anything in their 212 statements during these consultations. They will also be informed of the disputed matters during consultations.

7.3.4 Allocation of sufficient ballistics resources

The participants highlighted that the lack of essential ballistics resources, such as ammunition and chemicals used to recover obliterated serial numbers on firearms through etching, is a major concern. Forensic firearm identification without these resources delays the completion of ballistics cases. The ballistics experts need enough resources to perform their analysis. Ammunition and etching chemicals are essential for forensic firearm identification. Microscopic comparison of fired cartridge cases and bullets for forensic firearm identification can be done only after the suspect

firearm has been test-fired. A lack of ammunition delays the forensic firearm identification analysis.

Some firearms that are submitted to FSL for forensic firearm identification have had their serial numbers filed off by the criminals. To retrieve the obliterated serial numbers, the ballistics experts need etching chemicals. The lack of such chemicals also affects the finalisation of ballistics cases. To address insufficient essential resources, the Ballistics section needs sufficient resources to avoid unnecessary delays in completing ballistics cases. This assists in issuing the ballistics reports within the turnaround period, so they can serve their role in investigating and prosecuting crime.

7.3.5 Sufficient and competent ballistics experts

Participants noted that a shortage of competent ballistics experts is a challenge. This affects the flow of cases, as the influx requires sufficient ballistics experts for analysis. Incompetent ballistics experts were also highlighted as a challenge. Forensic firearm identification relies heavily on the competency of the ballistics experts. Although dynamics surround the competency of experts, such as training and regular competency tests, it was recommended that the development of ballistics experts' competency be prioritised. Sufficient ballistics experts need to be competent to ensure the quality of ballistic analysis.

7.3.6 Sufficient time allocation for analysis of forensic firearm identification evidence

The participants indicated that forensic firearm identification analysis requires enough time to ensure accurate findings. Enough time allocation for the analysis of forensic firearm identification evidence will address the developing inconclusive syndrome due to time constraints. Given enough time to analyse forensic firearm identification evidence, the ballistics experts' confidence in their findings further increases, as thorough analysis allows them to do so. The findings will guide the IOs and ensure that the prosecution is based on accurate facts.

7.3.7 Collection of all possible evidence from the crime scene

The collection of all possible evidence from the crime scene, as noted by the participants, will assist in linking the suspect to the crime, since forensic firearm identification links the firearm to the crime scene, not the suspect. Other forensic evidence, such as DNA, fingerprints, and any other physical evidence found on the crime scene, with the forensic firearm identification evidence. This will play an important role in investigating and prosecuting CIT armed robberies and other crime types that involve shootings and linking the suspects with the crime.

7.3.8 Establishment of a database for test-fired bullets and cartridge cases of every new licensed firearm

The establishment of a database for fired cartridge cases and bullets as part of the new firearms licensing process for future reference was supported by other participants, indicating that this database will serve as a source of information, especially when a firearm is suspected of involvement in crime-related shootings. However, the participants who partially supported and those who did not highlighted that the challenge with this database is that the firearms characteristics are subject to change. The establishment of this database will require continuous testing of firearms and acquisition of fired cartridge cases and bullets on IBIS, every five years.

7.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Based on the findings of this study, the following areas for future research are recommended.

7.4.1 Practicality of the recommended database for test-fired bullets and cartridge cases of every new licensed firearm

Future direction requires a viability study of the recommended database mentioned in section 7.3.8. It should focus on the implementation process, its effectiveness, legal implications, storage of forensic firearm identification evidence, the availability of ballistics experts, resources, and other related dynamics. The impact of illegal firearms on the efficiency of this database should also be considered.

7.4.2 Focussing on case study based research

Further research is required to examine the differences in the frequency, techniques, and social contexts of CIT armed robbery across these regions. In addition, research could also examine the differences in the frequency, techniques, and social contexts of CIT armed robbery across these regions. By incorporating detailed case studies or real-world examples that demonstrate the successful application of these forensic techniques in cash-in-transit robbery scenarios would greatly enhance future research.

7.4.3 Integration of advanced technologies

Although IBIS is one of the adopted technological systems in forensic firearm identification evidence analysis, the focal point of the future research should be the integration of other innovative technologies such as algorithms, 3D topographical surface imaging systems, artificial intelligence and machine learning.

7.4.4 Assessment of the influx of ballistics cases with the work study capacity at FSL, Ballistics Section in Pretoria

Following the research findings, delayed ballistics reports, insufficient human resources, and time allocated to the ballistics experts to expedite the cases, and a lack of resources such as laptops, personal computers, and ammunition are part of the identified challenges. The researcher finds these challenges to be interlinked and contribute to the production of ballistics reports within the turnaround period. For the ballistics reports to be ready, human and physical resources are required. The ballistics cases submitted for analysis rely on the strength of the Ballistics section. To understand the dynamics around delayed ballistics reports, future research to assess the influx of Ballistics cases cooperatively with the work study capacity has been recommended. The findings will reveal the gaps, necessitate backlog assessment, and direct a way forward.

7.5 CONCLUSION

The research aimed to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT-armed robberies in the West Rand District

Municipality. In section 6.2.3, the research findings revealed the evidential value of forensic firearm identification, suggesting that it plays an important role in investigating and prosecuting CIT armed robberies and other crime types involving shootings. Regarding crime investigation, participants in the same section indicated that forensic firearm identification links the suspect firearm to the crime scene. It was further emphasised that forensic firearm identification does not link the suspect firearm with the suspect; instead, it places the suspect firearm at the crime scene as a tool of crime.

The findings revealed that after the suspect firearm has been linked with the crime scene through forensic firearm identification, trace evidence plays a significant role in linking the suspect with the crime scene. Forensic firearm identification also confirms whether the device sent for ballistic analysis complies with the Firearm Control Act 60 of 2000 and is regarded as a firearm. Forensic firearm identification evidence was found to be essential, as it guides the investigation processes. For example, if forensic firearm identification evidence analysis reveals that the suspect firearm was linked to various crime scenes, it can assist the IOs with further investigations.

Based on the findings, the role of forensic firearm identification evidence in prosecution determines specific minimum sentences. During the prosecution, the type of firearm used in the commission of any crime determines the suitable sentence. This information assists the court in determining relevant convictions based on the type of firearm used. It will also ensure that the court is dealing with a firearm, not a similar device. It was also emphasised that without forensic firearm identification evidence, it is impossible to prosecute, as the court is obliged to prove that the firearm is linked to the crime scene. Failure to do so will result in the withdrawal of cases. Considering the findings, forensic firearm identification is important for investigating and prosecuting CIT armed robberies and other crime types that involve shootings.

The research findings conclude that forensic firearm identification evidence is indispensable in forensic science. Its role in the criminal Justice System justifies empowering role players, investing in state-of-the-art equipment, and developing retention strategies to secure experienced professionals. This will ensure that the evolving needs of the Criminal Justice System are realised, and justice is served.

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ANNEXURES

ANNEXURE A: ETHICAL CLEARANCE CERTIFICATE



College of Law_RERC

Date: 31/07/2023

Dear: Mrs MAUREEN MAADINTSI MDAWO

Name: Mrs MAUREEN MAADINTSI MDAWO
Student #: 45069247

**Decision: Ethics Approval from
31/07/2023 to 31/07/2026**

Researcher: Mrs MAUREEN MAADINTSI MDAWO

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45069247@mylife.unisa.ac.za 079 046 9235

Supervisor: Professor Bernadine Benson bensobc@unisa.ac.za

**AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION
EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT
MUNICIPALITY**

Qualification: PHD CRIMINAL JUSTICE

Thank you for the application for research ethics clearance by the College of Law_RERC for the above mentioned research study Ethics approval is granted for three years.

The **medium risk application** was **reviewed** by College of Law_RERC on **31/07/2023** 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(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College of Law_RERC.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research 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.

5. 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.
6. Only de-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.
7. No field work activities may continue after the expiry date 31/07/2026. Submission of a completed research ethics progress report will constitute an application for renewal, for Ethics Research Committee approval.

Additional Conditions

1. Disclosure of data to third parties is prohibited without explicit consent from Unisa.
2. De-identified data must be safely stored on password protected PCs.
3. Care should be taken by the researcher when publishing the results to protect the confidentiality and privacy of the university.
4. Adherence to the National Statement on Ethical Research and Publication practices, principle 7 referring to Social awareness, must be ensured: "Researchers and institutions must be sensitive to the potential impact of their research on society, marginal groups or individuals, and must consider these when weighing the benefits of the research against any harmful effects, with a view to minimising or avoiding the latter where possible." Unisa will not be liable for any failure to comply with this principle.

Note

The reference number 0862 should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.

Kind regards,



Prof Lincoln Fitz
Chair of College of Law_RERC
E-mail: fitzlg@unisa.ac.za



Executive Dean / By delegation from the Executive Dean of College of Law_RERC
E-mail: koleoj@unisa.ac.za

**ANNEXURE B1: PERMISSION LETTER FROM SAPS DIRECTORATE FOR
PRIORITY CRIME INVESTIGATION**



Privaatsak Private Bag X94	Pretoria 0001	Faks No. Fax No.	(012) 432 7866
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Your reference/U verwysing:

My reference/My verwysing: 3/34/2

THE HEAD: RESEARCH
SOUTH AFRICAN POLICE SERVICE
PRETORIA
0001

Enquiries/Navrae: Col (Dr) Smit
W/O Thenga
Tel: (012) 432 7866
Email: ThengaS@saps.gov.za

APPROVED

MM Mdawo
UNIVERSITY OF SOUTH AFRICA

**RE: PERMISSION TO CONDUCT RESEARCH IN THE SOUTH AFRICAN POLICE SERVICE:
UNIVERSITY OF SOUTH AFRICA: DOCTORATE DEGREE: AN EXPLORATION OF THE
INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-
IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY:
RESEARCHER: MM MDAWO**

1. The above subject matter refers.
2. You are hereby granted approval for your research study on the above-mentioned topic in terms of National Instruction 4 of 2022.
3. Further arrangements regarding the research study may be made with the following office:

The National Head: Directorate for Priority Crime Investigation:

- **Contact Person:** Brigadier RM Matthews
 - **Contact Details:** (012) 846 4325/082 563 5762
 - **Email Address:** MatthewsR@saps.gov.za
4. Divisional Commissioner: Detective and Forensic Services, has disapprove your study due to the fact that material within the Forensic Laboratory is under sub judiare.
 5. Kindly adhere to paragraph 8 of our attached letter signed on **2023-08-23** with the same abovementioned reference number.


MAJOR GENERAL
THE HEAD: RESEARCH
DR PR VUMA

Date: 2023-10-17

INFORMATION NOTE

To: National Head
Directorate for Priority Crime Investigation

PERMISSION TO CONDUCT RESEARCH IN THE DIRECTORATE FOR PRIORITY CRIME INVESTIGATION: UNIVERSITY OF SOUTH AFRICA: DOCTORATE: AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY: RESEARCHER: MM MDAWO

1. Purpose

- 1.1. The purpose of the information note is to seek the approval of the National Head for research to be conducted by Researcher: MM Mdawo within the Directorate for Priority Crime Investigation (DPCI).

2. Background

- 2.1. The Researcher: MM Mdawo is conducting a study titled: "An exploration of the investigative value of forensic firearm identification evidence in Cash-In-Transit (CIT) armed robberies in the West Rand District Municipality".
- 2.2. The researcher is requesting permission to interview fourteen (14) members from the National Head Office of the Directorate.

3. Attachments

- 3.1. Application letter from Division: Research with ref. number 3/34/2 dated 2023-08-23
- 3.2. Research proposal (Detail of studies) which contains the following:
 - Aim of the research
 - Research objectives
 - Research questions
- 3.3. The research application has been perused and recommended for permission by the Division: Research and found to be compliant with the National Instruction 1 of 2006: Research in the South African Police Service.

PERMISSION TO CONDUCT RESEARCH IN THE DIRECTORATE FOR PRIORITY CRIME INVESTIGATION: UNIVERSITY OF SOUTH AFRICA: DOCTORATE: AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY: RESEARCHER: MM MDAWO



COLONEL
BRIGADIER

f/ SECTION HEAD: STRATEGIC MANAGEMENT: GOVERNANCE AND CORPORATE SERVICES
DIRECTORATE FOR PRIORITY CRIME INVESTIGATION
RM-MATTHEWS M.J. MATHEWS

Date: 2023/08/30

Application recommended/ ~~not recommended~~

Comments:

100



MAJOR GENERAL
COMPONENT HEAD: GOVERNANCE AND CORPORATE SERVICES
DIRECTORATE FOR PRIORITY CRIME INVESTIGATION
DM MOLATJANA

BRIGADIER
SECTION HEAD: HRM & D
DPC: HEAD OFFICE

Date: 2023-08-30

Application recommended/ ~~not recommended~~



LIEUTENANT GENERAL
DEPUTY NATIONAL HEAD: DIRECTORATE FOR PRIORITY CRIME INVESTIGATION
ST NKOSI

Date: 2023/08/31

PERMISSION TO CONDUCT RESEARCH IN THE DIRECTORATE FOR PRIORITY CRIME
INVESTIGATION: UNIVERSITY OF SOUTH AFRICA: DOCTORATE: AN EXPLORATION OF
THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN
CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY:
RESEARCHER: MM MDAWO

Application approved/~~not approved~~

Comments:


LIEUTENANT GENERAL
NATIONAL HEAD: DIRECTORATE FOR PRIORITY CRIME INVESTIGATION
(DR/ADV) SG LEBEYA (SOEG)

Date: 2023-09-01

**ANNEXURE B2: DENIAL OF REQUEST TO CONDUCT RESEARCH: SAPS
FORENSIC SCIENCE LABORATORY**

SAP 21

SUID-AFRIKAANSE POLISIEDIENS  **SOUTH AFRICAN POLICE SERVICE**

Private Bag X322, **ARCADIA**, 0001

Verwysing Reference	3/1/5
Navrae Enquiries	Col NM Rababalela Lt Col DN Rikhotso
Telefoon	012 421 0413
Telephone	012 421 0409
Epos	
E-mail	RababalelaM@saps.gov.za

**DIVISIONAL COMMISSIONER
DETECTIVE AND FORENSIC
SERVICES
HEAD OFFICE**

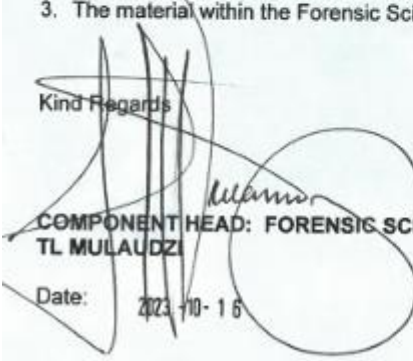
The Divisional Commissioner
RESEARCH

For attention: Lt Col (Dr) Smit

PERMISSION TO CONDUCT RESEARCH IN THE SOUTH AFRICAN POLICE SERVICE: UNIVERSITY OF SOUTH AFRICA: DOCTORATE DEGREE: AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY: RESEARCHER: MM MDAWO

1. Your letter with reference 3/34/2 dated 2023/08/23 bears reference.
2. Permission is herewith **Not granted** to the request for research by researcher: MM Mdawo.
3. The material within the Forensic Science Laboratory is under sub judicare.

Kind Regards


**MAJOR GENERAL
COMPONENT HEAD: FORENSIC SCIENCE LABORATORY
TL MULAUDZI**

Date: 2023-10-16

ANNEXURE B3: PERMISSION LETTER FROM THE NATIONAL PROSECUTING AUTHORITY

STRATEGY, OPERATIONS & COMPLIANCE

Strategy Management Office

Tel: +27 12 845 6000 | Fax: +27 12 845 7356
Victoria & Griffiths, Mxenge Building, 123 Westlake Avenue
Weavind Park, Silverton, Pretoria | P/Bag X752, Pretoria,
0001, South Africa



National Prosecuting Authority
South Africa

Enquiry: Mr. Mandla Msiza

Email: mamsiza@npa.gov.za

Phone: 012 845 6342

Date: 02/10/2023

Ms. Maureen Mdawo

733/13 Block VV

Soshanguve

Pretoria

0152

RE: Approval of request to conduct interviews with Krugersdorp Regional Court Prosecutors with regards to an exploration of the investigative value of forensic firearm identification evidence in Cash-in-Transit armed robberies in the West Rand District Municipality

Dear Ms. Mdawo

Thank you for showing interest in conducting research in the National Prosecuting Authority. The purpose of this letter is to inform you that your request to conduct interviews with Krugersdorp Regional Court Prosecutors with regards to an exploration of the investigative value of forensic firearm identification evidence in Cash-in-Transit armed robberies in the West Rand District Municipality has been approved.

The NPA appreciates that the University of South Africa's Research Ethics Committee has approved your research. Please consider and/or observe (whichever is applicable) the under-mentioned in support of your research:

Independence · Professionalism · Accountability · Credibility

1. The research request focuses on "an exploration of the investigative value of forensic firearm identification evidence in Cash-in-Transit armed robberies in the West Rand District Municipality".
2. Permission to conduct research is limited to conducting interviews with Prosecutors at the Krugersdorp Regional Court and is subject to their availability and personal willingness to contribute to your research.
3. Permission is specifically subject to the stated research questions as stated in your research proposal and interview schedule.
4. You are not permitted to conduct interviews with NPA officials pertaining to cases that are still sub judice.
5. Research with NPA officials should adhere to COVID-19 related Regulations.
6. It is requested that a copy of the thesis be sent to the NPA for perusal upon completion of the research project.
7. It is also requested that in the event of publishing an article on research which contains NPA information, such an article should be shared with the NPA.
8. This approval letter is valid for 2 years from the date of approval by the Acting Deputy Director-General: Corporate Services. In case your research exceeds the above-mentioned timeframe, you will be required to re-apply.

Kindly keep the NPA informed about further developments on this research and please direct your correspondence to Dr. Kefentse Mojaki-Moremogolo on the following details:

Telephone number: 012 845 6506 / 073 079 8444
E-mail address: KMojaki-Moremogolo@npa.gov.za

Yours sincerely



Ms. Bulelwa Makeke

Acting Deputy Director-General: Corporate Services

Date: 23/10/2023

ANNEXURE C1: INTERVIEW GUIDE FOR SAMPLE A

SOUTH AFRICAN POLICE SERVICE: DPCI INVESTIGATING OFFICERS INTERVIEW GUIDE

PhD RESEARCH PROJECT

INTERVIEW GUIDE FORM:

UNISA

**RESEARCH TITLE: AN EXPLORATION OF THE INVESTIGATIVE VALUE OF
FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT
ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY**

SECTION A

INTRODUCTION

This study is conducted as part of the researcher's PhD studies at the University of South Africa. The interview guide forms part of my research thesis to explore the investigative value of forensic firearm identification evidence in CIT armed robberies in the West Rand District Municipality. This research aims to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the above mentioned area.

The study will add to the body of knowledge in the Criminal Justice System, SAPS, Law enforcement agencies, SABRIC, CIT companies and to other researchers by establishing the investigative value of forensic firearm identification evidence in CIT armed robberies in the West Rand District Municipality. The existing gaps with regards to the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality will be identified. The abovementioned departments will benefit from this study through the recommendations that will be made.

METHODOLOGY TO OBTAIN INFORMATION

This interview guide forms part of the data collection techniques used by the researcher to obtain answers to address the research questions. The questions in this interview guide were prepared in advance and relate to the research question.

During the interview, the researcher will:

- Record your answers by taking notes
- Record this interview on a digital audio recording device

Afterwards, your interview with the researcher will be transcribed verbatim, and the transcription analysed to interpret the results.

PURPOSE OF RESEARCH

The purpose of this study is to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality. The researcher expects the study to contribute to the body of knowledge as follows:

- To explore what may be considered as ballistics evidence found at CIT armed robbery crime scenes.
- To explain what CIT armed robbery is and how it manifests in SA as opposed to other countries in the Global South and North.
- To explain what forensic firearm identification entails.
- To explore the role of forensic firearm identification in investigating and prosecuting CIT armed robberies.
- To determine any challenges associated with forensic firearm identification in investigating and prosecuting CIT armed robberies.

RESEARCH QUESTION

The following research question is formulated for this study:

- What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

CONFIDENTIALITY AND ANONYMITY

Your participation in this study is voluntary and can be terminated at any time. The information you provide will be used to answer the research questions and will be treated with the utmost confidentiality by the researcher, where all participants will remain anonymous. The names of the organisations participating in this study may be

included. All participants will be allocated a number, and completed interview guide will be captured on an electronic database. All computerised notes will be stored on a secure, password-protected computer. Transcribed interviews will be kept in a secure place for a period of five years as required by the university rules. The transcribed interviews will thereafter be destroyed. Only the results of the research will be made available to the University of South Africa (UNISA). Your identity will in no way be detectable from the research results.

INTERVIEW GUIDE

FOR OFFICE USE ONLY

PARTICIPANT NUMBER: _____

SECTION B: BACKGROUND

1. Which unit are you attached to within the DPCI?

2. What is your area of jurisdiction?

3. Gender

A	B
MALE	FEMALE

4. What is your current rank?

5. How many years of service do you have in the SAPS?

A 1 – 5 years	B 5 – 10 years	C 10 - 15 years	D More than 15 years

6. What is your current position?

7. How long have you served in this position?

A 1 – 5 years	B 5 – 10 years	C 10 - 15 years	D More than 15 years

PRIMARY QUESTION

8. What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

The subsequent probing and follow up questions will be asked from the participants that are important for this research. The discussion will be guided by an interview guide rather than dictated by it. To ensure that a broad coverage of issues is achieved during the semi-structured interview, the researcher will ask focusing, but not leading questions, and listen carefully to gain the perspective of the participants.

9. Please describe your level of experience in investigating CIT armed robberies.
10. Do you have any formal qualifications?
11. Have you undergone any training related to the use of forensic firearm identification in the investigation of CIT armed robberies?

12. In your opinion, do you believe that the training you received is sufficient to enable you to investigate CIT armed robberies?

SECTION C1: THE ROLE OF FORENSIC SCIENCE IN THE INVESTIGATION OF CRIME

13. How do you define forensic science?
14. In your opinion, what are the objectives of forensic science?
15. What is the meaning of criminal investigation?
16. What are the objectives of criminal investigation?
17. What is the role of forensic science in the investigation of crime?
18. How do you describe physical evidence?
19. What do you understand about Locard's Exchange Principle?
20. What is the difference between identification and individualisation in forensic science?
21. How do you understand continuity of possession?
22. In your opinion, what is contamination of evidence?
23. What is a crime scene?

SECTION C2: EVIDENTIAL VALUE OF FORENSIC FIREARM IDENTIFICATION IN INVESTIGATING CIT ARMED ROBBERIES

24. What is a firearm in terms of Firearm Control Act 60 of 2000?
25. What do you understand by forensic firearm identification evidence?
26. What kind forensic firearm identification evidence do you usually recover from the CIT armed robberies crime scenes?
27. Apart from the crime scenes where else do you recover the forensic firearm identification evidence?
28. What is the procedure of collecting forensic firearm identification evidence in the CIT armed robberies crime scenes?
29. Do you always submit forensic firearm identification evidence to the forensic Science Laboratory for analysis? Please elaborate.
30. Based on your experience, how does forensic firearm identification evidence contribute to the investigation of CIT armed robberies?
31. How does the absence of forensic firearm identification evidence affect the investigation of CIT armed robberies?

32. What is the value of crime scene reconstruction by the ballistics experts in the CIT armed robbery cases?
33. What are the requirements for the admissibility of forensic firearm identification evidence in court?

SECTION D: MODUS OPERANDI OF CIT ARMED ROBBERIES

35. What do you understand by CIT armed robbery?
36. What are the two main forms of CIT armed robberies?
37. Which firearms are mostly used in the CIT armed robberies?
38. In your opinion, what could be the root causes of CIT armed robberies?
39. Which CIT companies are mostly targeted by the CIT armed robbers? Please elaborate.
40. What are the various modus operandi of CIT armed robbers in the West Rand District Municipality?
41. Which modus operandi of the CIT armed robbers is common in the West Rand District Municipality?
42. Which CIT companies are mostly targeted by the CIT armed robbers? Please elaborate.
43. How can the modus operandi of the CIT armed robbers positively enhance investigation of CIT armed robberies?

SECTION E: BEST PRACTICES

44. In your understanding, what are the current best practices of the SAPS in investigating CIT armed robberies in the West Rand District Municipality?
45. What measures can SAPS put in place to proactively deal with the CIT armed robberies in the West Rand District Municipality?
46. In your experience, how does your unit gather information and intelligence on CIT armed robberies?
47. What strategies are currently in place to curb CIT armed robberies?
48. What are the organizational challenges do you face in investigating CIT armed robberies?

49. Is there any collaboration between SAPS, other Law enforcement agencies, SABRIC and CIT companies to curb the CIT armed robberies? Please elaborate.
50. In your opinion what be done to promote and improve the use of forensic firearm identification evidence in the investigation of CIT armed robberies?

ANNEXURE C2: INTERVIEW GUIDE FOR SAMPLE B

INTERVIEW GUIDE FOR SAMPLE B

SOUTH AFRICAN POLICE SERVICE: FSL FORMER BALLISTICS EXPERTS

INTERVIEW GUIDE

PhD RESEARCH PROJECT

INTERVIEW GUIDE FORM:

UNISA

RESEARCH TITLE: AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY

SECTION A

INTRODUCTION

This study is conducted as part of the researcher's PhD studies at the University of South Africa. The interview guide forms part of my research thesis to explore the investigative value of forensic firearm identification evidence in CIT armed robberies in the West Rand District Municipality. This research aims to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality.

This study will add to the body of knowledge in the Criminal Justice System, SAPS, Law enforcement agencies, CIT companies and other researchers by establishing the investigative value of forensic firearm identification evidence in CIT armed robberies in the West Rand District Municipality. The existing gaps with regards to the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality will be identified. The abovementioned departments will benefit from this study through the recommendations that will be made.

METHODOLOGY TO OBTAIN INFORMATION

This interview guide forms part of the data collection techniques used by the researcher to obtain answers to address the research questions. The questions in this interview guide were prepared in advance and relate to the research question.

During the interview, the researcher will:

- Record your answers on paper
- Record this interview on a digital audio recording device

Afterwards, your interview with the researcher will be transcribed verbatim, and the transcription analysed to interpret the results.

PURPOSE OF RESEARCH

The purpose of this study is to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality. The researcher expects the study to contribute to the body of knowledge as follows:

- To explore what may be considered as ballistics evidence found at CIT armed robbery crime scenes.
- To explain what CIT armed robbery is and how it manifests in SA as opposed to other countries in the Global South and North.
- To explain what forensic firearm identification entails.
- To explore the role of forensic firearm identification in investigating and prosecuting CIT armed robberies.
- To determine any challenges associated with forensic firearm identification in investigating and prosecuting CIT armed robberies.

RESEARCH QUESTION

The following research question is formulated for this study:

- What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

CONFIDENTIALITY AND ANONYMITY

Your participation in this study is voluntary and can be terminated at any time. The information you provide will be used to answer the research questions and will be treated with the utmost confidentiality by the researcher, where all participants will remain anonymous. The names of the organisations participating in this study may be included. All participants will be allocated a number and completed interview guide will be captured on an electronic database. All computerised notes will be stored on a secure, password-protected computer. Transcribed interviews will be kept in a secure place for a period of five years as required by the university rules. The transcribed interviews will thereafter be destroyed. Only the results of the research will be made available to the University of South Africa (UNISA). Your identity will in no way be detectable from the research results.

INTERVIEW GUIDE

FOR OFFICE USE ONLY

PARTICIPANT NUMBER: _____

SECTION B: BACKGROUND

1. Which section are you attached to within the FSL?

2. What is your area of jurisdiction?

3. Gender

A	B
MALE	FEMALE

4. What is your current rank?

5. How many years of service do you have in the SAPS?

A	B	C	D
1 – 5 years	5 –10 years	10 - 15 years	More than 15 Years

6. What is your current position?

7. How long have you served in this position?

A	B	C	D
1 – 5 years	5 –10 years	10 - 15 years	More than 15 Years

PRIMARY QUESTION

8. What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

The subsequent probing and follow up questions will be asked from the participants' that are important for this research. The discussion will be guided by an interview guide rather than dictated by it. To ensure that a broad coverage of issues is achieved during the semi-structured interview, the researcher will ask focusing, but not leading questions, and listen carefully to gain the perspective of the participants.

9. Please describe your level of experience in analysing forensic firearm identification evidence?
10. Do you have any formal qualifications?
11. Have you undergone any training relevant to the analysis of forensic firearm identification evidence?
12. In your opinion, do you believe that the training you received is sufficient to enable you to analyse forensic firearm identification evidence? Please elaborate.

SECTION C: THE SCIENCE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE

13. How do you interpret the Theory of Identification?
14. Are there any standard operating procedures that regulate the analysis of forensic firearm identification evidence in the FSL? If so, how do you understand such SOPs.
15. What is a firearm in terms of Firearms Control Act 60 of 2000?
16. What is an ammunition?
17. What are the various components of ammunition?
18. What are the types of firearms and their working mechanisms?
19. What are the safety measures for handling firearms related evidence?
20. What is the sequence of action in the firing process of a firearm?
21. What does the forensic firearm identification entails?
22. What is forensic firearm identification evidence?
23. What kind forensic firearm identification evidence do you usually receive for analysis in CIT armed robbery cases?
24. Which tool does the ballistics experts need to analyse forensic firearm identification evidence?
25. What is the process of analysing forensic firearm identification evidence?
26. What are the formal categories of the findings for forensic firearm identification evidence?
27. After the analysis of forensic firearm identification evidence, what is the process of disposing the exhibits?

28. In which manner does the investigating officers receive the ballistics experts' 212 statements in terms of the Criminal Procedure Act 51 of 1977 (known as ballistics reports) with regards to the results of the analysis?

SECTION D: EVIDENTIAL VALUE OF FORENSIC FIREARM IDENTIFICATION IN THE INVESTIGATION AND PROSECUTION OF CIT ARMED ROBBERIES

29. What is a CIT armed robbery?
30. What are the requirements for the admissibility of forensic firearm identification evidence in court?
31. How do you maintain the chain of custody of the exhibits that you receive for analysis?
32. Why is it important to maintain the chain of custody?
33. What is the role of forensic firearm identification evidence in the investigation of CIT armed robberies?
34. What is the impact of forensic firearm identification evidence in the prosecution of CIT armed robberies?
35. What challenges do you face when presenting expert testimony in court on forensic firearm identification evidence?

SECTION E: BEST PRACTICES

36. What is the turnaround time for analysis of forensic firearm identification evidence?
37. What are the organizational challenges do you encounter when analysing forensic firearm identification evidence?
38. Do you think the law enforcement agencies and CIT companies need forensic firearm identification awareness? Please elaborate.
39. In your opinion what be done to improve the use of forensic firearm identification evidence in the investigation and prosecution of CIT armed robberies?

ANNEXURE C3: INTERVIEW GUIDE FOR SAMPLE C

**NATIONAL PROSECUTING AUTHORITY: KRUGERSDORP: KAGISO REGIONAL
COURT PROSECUTORS**

INTERVIEW GUIDE

PhD RESEARCH PROJECT

INTERVIEW GUIDE FORM:

UNISA

**RESEARCH TITLE: AN EXPLORATION OF THE INVESTIGATIVE VALUE OF
FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT
ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY**

SECTION A

INTRODUCTION

This study is conducted as part of the researcher's PhD studies at the University of South Africa. The interview guide forms part of my research thesis to explore the investigative value of forensic firearm identification evidence in CIT armed robberies in the West Rand District Municipality. This research aims to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality.

This study will add to the body of knowledge in the Criminal Justice System, SAPS, Law enforcement agencies, CIT companies and other researchers by establishing the investigative value of forensic firearm identification evidence in CIT armed robberies in the West Rand District Municipality. The existing gaps with regards to the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality will be identified. The abovementioned departments will benefit from this study through the recommendations that will be made.

METHODOLOGY TO OBTAIN INFORMATION

This interview guide forms part of the data collection techniques used by the researcher to obtain answers to address the research questions. The questions in this interview guide were prepared in advance and relate to the research question.

During the interview, the researcher will:

- Record your answers by taking notes
- Record this interview on a digital audio recording device

Afterwards, your interview with the researcher will be transcribed verbatim, and the transcription analysed to interpret the results.

PURPOSE OF RESEARCH

The purpose of this study is to establish the evidential value of forensic firearm identification in investigating and prosecuting CIT armed robberies in the West Rand District Municipality. The researcher expects the study to contribute to the body of knowledge as follows:

- To explore what may be considered as ballistics evidence found at CIT armed robbery crime scenes.
- To explain what CIT armed robbery is and how it manifests in SA as opposed to other countries in the Global South and North.
- To explain what forensic firearm identification entails.
- To explore the role of forensic firearm identification in investigating and prosecuting CIT armed robberies.
- To determine any challenges associated with forensic firearm identification in investigating and prosecuting CIT armed robberies.

RESEARCH QUESTION

The following research question is formulated for this study:

- What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

CONFIDENTIALITY AND ANONYMITY

Your participation in this study is voluntary and can be terminated at any time. The information you provide will be used to answer the research questions and will be treated with the utmost confidentiality by the researcher, where all participants will remain anonymous. The names of the organisations participating in this study may be included. All participants will be allocated a number and completed interview guide will be captured on an electronic database. All computerised notes will be stored on a secure, password-protected computer. Transcribed interviews will be kept in a secure place for a period of five years as required by the university rules. The transcribed interviews will thereafter be destroyed. Only the results of the research will be made available to the University of South Africa (UNISA). Your identity will in no way be detectable from the research results.

INTERVIEW GUIDE

FOR OFFICE USE ONLY

PARTICIPANT NUMBER: _____

SECTION B: BACKGROUND

1. Which section are you attached to within the NPA?

2. What is your area of jurisdiction?

3. Gender

A	B
MALE	FEMALE

4. How many years of service do you have in the NPA?

A	B	C	D
1 - 5 years	5 - 10 years	10 - 15 years	More than 15 Years

5. What is your current position?

6. How long have you served in this position?

A	B	C	D
1 - 5 years	5 - 10 years	10 - 15 years	More than 15 Years

PRIMARY QUESTION

7. What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?

The subsequent probing and follow up questions will be asked from the participants that are important for this research. The discussion will be guided by an interview guide rather than dictated by it. To ensure that a broad coverage of issues is achieved during the semi-structured interview, the researcher will ask focusing, but not leading questions, and listen carefully to gain the perspective of the participants.

8. Please describe your level of experience in prosecuting CIT armed robberies.
9. Do you have any formal qualifications?
10. Have you undergone any training related to forensic firearm identification evidence?
11. In your opinion, do you believe that the training you received is sufficient to enable you to use forensic firearm identification in the prosecution of CIT armed robberies?

SECTION C: EVIDENTIAL VALUE OF FORENSIC FIREARM IDENTIFICATION IN THE PROSECUTION OF CIT ARMED ROBBERIES.

12. What do you understand by forensic firearm identification?
13. What is forensic firearm identification evidence?
14. What is CIT armed robbery?
15. What kind forensic firearm identification evidence is usually presented in court for the prosecution CIT armed robberies?
16. What is the importance of forensic firearm identification evidence's chain of custody in the prosecution of CIT armed robbery cases?
17. What is the role of forensic firearm identification evidence in the prosecution of CIT armed robberies?
18. How does the absence of forensic firearm identification evidence affect the prosecution of CIT armed robberies?
19. What are the requirements for admissibility of forensic firearm identification evidence in court?

SECTION D: BEST PRACTICES

20. What are current best practices of the NPA for the prosecution of CIT armed robberies?
21. What are the organizational challenges that you encounter with regards to the use of forensic firearm identification evidence in the prosecution of CIT armed robbery cases?
22. Is there any collaboration between the NPA, SAPS, other Law enforcement agencies, SABRIC and CIT companies in dealing with the CIT armed robberies?
23. Based on your experience, what can be done to improve the use of forensic firearm identification evidence in the prosecution of CIT armed robbery cases?

ANNEXURE D: LANGUAGE EDITING AND FORMATTING CERTIFICATE

University Editor (CC)	
Certificate of comprehensive English editing	
This document certifies that we have edited the manuscript indicated below for English language, grammar, spelling, clarity, scholarly writing style, and formatting.	
Manuscript Title:	
AN EXPLORATION OF THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN CASH-IN-TRANSIT ARMED ROBBERIES IN THE WEST RAND DISTRICT MUNICIPALITY	
Author:	
MAUREEN MAADINTSI MDAWO	
Date Issued: 22 February 2026	
The author's subject matter contents and intentions were unaltered during the editing process . Manuscripts with this certification should be grammatically ready for publication; however, the author/s have the final choice to accept or reject our suggestions and changes. If you have any questions regarding the edited document, kindly contact info@uedit.org or visit us at https://uedit.org	
Singed by the editor	 in Pretoria
Address: 111 Bronkhorst Street, Groenkloof, Pretoria Email: info@uedit.org https://uedit.org Chief Executive Officer: A Apostolides BA (UNISA), MPhil, MA (<i>cum laude</i>), PhD (University of Pretoria)	

APPENDIX E: TURNITIN CERTIFICATE

Similarity Report	
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Summary	

APPENDIX F: THEMATIC REPRESENTATION FROM INTERVIEW GUIDES

	SAMPLE A n - 2	SAMPLE B n - 4	SAMPLE C n - 2
THEME 1: AN OVERVIEW OF THE CIT ARMED ROBBERY IN THE WEST RAND DISTRICT MUNICIPALITY			
Sub-theme 1: General understanding of CIT armed robbery	D 34, D 35		C 14
Sub-theme 2: The root causes of CIT armed robberies	D 37		
Sub-theme 3: The most targeted CIT companies and the reasons thereof	D 38		
Sub-theme 4: Modus Operandi of the CIT armed robbers			
Sub-category: The meaning of Modus Operandi	D 33		
Sub-category: The use of Modus Operandi	D 41		
Sub-category: Various Modus Operandi of the CIT armed robberies in the West Rand District Municipality	D 39		
Sub-category: The Common Modus Operandi in the West Rand District Municipality	D 40		
THEME 2: THE SCIENTIFIC ANALYSIS OF FORENSIC FIREARM IDENTIFICATION EVIDENCE			
Sub-theme 1: Types of firearms		C 15	
Sub-category 1: The firearm parts that contribute to the development of marks on fired cartridge cases and bullets		C 15	
Sub-theme 2: Ammunition components		C 15	
Sub-theme 3: General understanding of forensic firearm identification	C 24	C 16	C 12, C 13
Sub-theme 4: Theory behind Forensic Firearm Identification		C 13	
Sub-theme 5: The types of forensic firearm identification evidence		C 17	

	SAMPLE A n - 2	SAMPLE B n - 4	SAMPLE C n - 2
Sub-category 5.1: The process of collecting forensic firearm identification evidence	C 27		
Sub-category 5.2: The process of analysing forensic firearm identification evidence		C 14, C 19	
Sub-category 5.3: The analysis of forensic firearm identification evidence		C 14	
Sub-category 5.4: The tools needed to analyse forensic firearm identification evidence		C 18	
Sub-category 5.5: Turnaround period for analysis of forensic firearm identification evidence		C 14, E 29	
Sub-category 5.6: Formal findings of the analysis of forensic firearm identification evidence analysis		C 20	
Sub-category 5.7: Issuing of Ballistics reports		C 22	
Sub-theme 6: Admissibility requirements for forensic firearm identification evidence in court	C 32	D 23	C 19
THEME 3: THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN INVESTIGATING AND PROSECUTING CIT ARMED ROBBERIES AND OTHER CRIME TYPES THAT INVOLVE SHOOTINGS			
Sub-theme 1: What is the evidential value of forensic firearm identification in the investigation and prosecution of CIT armed robbery suspects?	C 8	C 8	C 7
Sub-theme 2: The role of forensic evidence in criminal investigations	C 13, C 14, C 16, C 17, C 29, C 30	D 26	C 17, C 18
Sub-theme 3: Locard's Principle of Exchange	C 20		
Sub-theme 4: The importance of the Chain of Custody	C 22, C 23	D 24, 25	C 16
Sub-theme 5: CIT armed robbery scene as a source of evidence	C 18, C 19, C 26, C 28		
Sub-category 5.1: General understanding of a crime scene	C 15, C 31		

	SAMPLE A n - 2	SAMPLE B n - 4	SAMPLE C n - 2
Sub-category 5.2: The kinds of forensic firearm identification evidence that can be found at the CIT armed robberies scenes	C 25, D 36	C 17	C 15
THEME 4: CHALLENGES ASSOCIATED WITH THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE IN INVESTIGATING AND PROSECUTING CIT ARMED ROBBERIES AND OTHER CRIME TYPES THAT INVOLVE SHOOTINGS			
	E 45	D 30	D 21
Sub-theme 1: Lack of resources			
Sub-theme 2: Poor consultation of Ballistics experts and investigating officers as witnesses prior to the presentation of evidence in court.			
Sub-theme 3: Poor Ballistics Case Management			
Sub-category 3.1: Incompetent Ballistics Experts			
Sub-category 3.2: Delayed Ballistics reports			
Sub-theme 4: Inability to maintain Chain of Custody			
Sub-theme 5: Lack of support from the judges, magistrates, and prosecutors when presenting evidence in court			
THEME 5: SUGGESTIONS TO ENHANCE THE INVESTIGATIVE VALUE OF FORENSIC FIREARM IDENTIFICATION EVIDENCE			
	E 42, E 44	E 31, E 32, E 33	D 20, D 22, D 23
Sub-theme 1: Forensic firearm identification awareness			
Sub-theme 2: Ballistic experts			
Sub-category 2.1: Sufficient human resources			
Sub-category 2.2: Enough time allocation to the Ballistics experts for analysis of forensic firearm identification evidence			
Sub-category 2.3: Proper consultation of the Ballistics experts and the investigating officers as witnesses, prior to the			

	SAMPLE A n - 2	SAMPLE B n - 4	SAMPLE C n - 2
presentation of the Ballistics expert testimony in court			
Sub-theme 3: Collection of all possible evidence			
Sub-theme 4: An establishment of a database for test-fired cartridge cases and bullets of every licensed firearm			