E-Journal of Humanities, Arts and Social Sciences (EHASS)
ISSN – Online 2720-7722 | Print 2821-8949
Volume 6 Issue 14 2025 pp 3698 - 3714
Available online at: https://noyam.org/journals/ehass/
DOI: https://doi.org/10.38159/ehass.202561422

Police Methods and Challenges in the Utilisation of Technology to Combat Carjacking in Selected Police Precincts in the Gauteng Province of South Africa

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ABSTRACT
The pervasive influence of technology is evident across various facets of contemporary life. Within the realm of criminology, its impact is particularly notable in law enforcement and investigative procedures. Nevertheless, the effectiveness of technological interventions in addressing carjacking in South Africa remains uncertain, as evidenced by the persistent upward trend in carjacking incidents. This study thus explored police methods and the challenges associated with the utilisation of technology in combating carjacking in selected policing precincts in the Gauteng province of South Africa. The research methodology employed a qualitative approach and utilised semi-structured interviews for data collection. Research participants were drawn from selected police precincts throughout Gauteng, namely Johannesburg Central, Hillbrow, and Alexandra. The sampling strategy adhered to a non-probability framework, with participants chosen through purposive selection. The study found that various types of technological methods, systems, and devices were utilised by the police; nevertheless, several challenges exist that affect their effective utilisation. The study recommends the establishment of a crime prevention information, communication, and technology division in the South African Police Service (SAPS), among other suggestions. State the contribution of this study to scholarship.

Keywords: Carjacking, Technology, Crime, Gauteng

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Publication History
Received: 8th July, 2025
Accepted: 23rd October, 2025
Published online: 30th December, 2025

To Cite this Article:
Chauke, Rescar Nyiko, and Hendrick Puleng Motlalekgosi."Police Methods and Challenges in the Utilisation of Technology to Combat Carjacking in Selected Police Precincts in the Gauteng Province of South Africa." *E-Journal of Humanities, Arts and Social Sciences* 6, no. 14 (2025): 3698 - 3714, https://doi.org/10.38159/ehass.202561422.

INTRODUCTION
The World Population Review reports that South Africa ranks as the fifth most crime-ridden country globally.[1] This aligns with the assertions of Van Dijk, Nieuwbeerta, Larsen[2] and Theron et al.[3] that South Africa grapples with unacceptable levels of crime. This situation is a cause for concern for the South African government, given its responsibility to ensure that its citizens are safe and free from crime. South Africans are faced with a high rate of assault, rape, homicide, and other violent crimes.[4] The latter includes categories such as robbery with aggravating circumstances, of which carjacking is a part.

[1] World Population Review, "Crime Rate by Country 2025," 2025, accessed June 6, 2025, https://worldpopulationreview.com/country-rankings/crime-rate-by-country.
[2] J. van Dijk, P. Nieuwbeerta and J.J. Larsen, "Global Crime Patterns: An Analysis of Survey Data from 166 Countries Around the World, 2006–2019," *Journal of Quantitative Criminology* 38 (2021): 793-827.
[3] K. Theron et al., "A Street Segment Analysis of Crime in a Township: Evidence from South Africa," *Police Practice and Research* 24, no. 5 (2022): 539-557.
[4] World Population Review, "Crime Rate by Country 2025."

South Africa is one of the countries with the highest rates of motor vehicle crimes in the world, particularly carjacking.[5] This negatively impacts the safety and security of the citizens, as well as the economy.[6] Carjacking is often accompanied by other violent crimes, such as assault, rape, and murder. Victims are frequently left with scars and trauma that can last for years; for some, it is for a lifetime.[7]

A decline of 15.1% in carjacking during the first quarter of 2025, as compared to the same period in 2024, is a step in the right direction.[8] However, the level at which this crime occurs is concerning. A comparative analysis of the rate of carjacking during the first quarters of the last three years paints a bleak picture. The year 2024 saw an increase in carjacking from 5,119 to 5,338 in 2023.[9] In 2022, a surge in carjacking was experienced, where it was estimated that a motor vehicle was hijacked every 22 minutes,[10] with Gauteng accounting for more than half of these incidents.[11] Furthermore, Statistics South Africa reported a significant increase in hijacking between 2020/2021 and 2021/2022, with approximately 330,000 persons experiencing hijacking.[12] This represents an increase of 179,000 over the year.

Several studies focusing on the use of technology to combat crime in general have been conducted. However, there is relatively little empirical research that has explored the use of technology to combat carjacking in particular. This is despite the pervasive nature of carjacking, not only in South Africa but in many other countries around the world. For instance, Ivliev et al. analysed topical issues related to improving information technology and the technical means necessary for an effective fight against crime.[13] Achim, Borlea and Văidean analysed the influence of technology on the level of economic and financial crime.[14] Sayed and Khalefa examined crime and the synergistic effect of technology in combating crimes, utilising the digital skills of security agencies.[15] Nuth explored how criminals and crime fighters take advantage of new technologies, with considerable emphasis on information and communication technologies (ICTs).[16]

This study, therefore, aimed to explore police methods and challenges in the utilisation of technology to combat carjacking in selected policing precincts in the Gauteng province of South Africa. To achieve this goal, it was necessary to characterise the current technologies used by the SAPS to combat carjacking, assess their effectiveness, and identify the key challenges associated with the use of technology in the fight against carjacking in these selected precincts. The findings are presented subsequently.

LITERATURE REVIEW

This section aims to enhance understanding of the use of technology in combating crime by providing a summary of literature on topics related to carjacking and identifying connections among previous and related studies.[17] To achieve this goal, this section addresses topics including the prevalence of carjacking in South Africa, the use of technology to counteract crime, and the challenges associated with using technology to combat carjacking.

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[5] P. Monyeki, "Data Mining to Analyse Recurrent Crime in South Africa" (Master's, Durban University of Technology, 2021).

[6] F. Burgers, G. Wright and L. Nel, "National Initiatives to Prevent and Combat Vehicle Crime", 2007, accessed May 25, 2025, https://repository.up.ac.za/handle/2263/5983.

[7] H. Copes, A. Hochstetler and M. Cherbonneau, "Getting the Upper Hand," *Journal of Research in Crime and Delinquency* 49 (2012): 249-268.

[8] South African Police Service (SAPS), "Police Recorded Crime Statistics: Fourth Quarter of 2024-2025 Financial Year (January 2025 to March 2025)," 2025, accessed June 11, 2025, https://www.saps.gov.za/services/downloads/2024/2024-2025_Q4_crime_stats.pdf.

[9] South African Police Service (SAPS), "Police Recorded Crime Statistics: Fourth Quarter of 2024-2025 Financial Year (January 2025 to March 2025)," 2025.

[10] South African Police Service (SAPS), *Quarterly Statistics* (Pretoria: SAPS, 2022).

[11] M. Libera, "New Carjacking Trend Hitting South Africa," 2024, accessed January 8, 2025, https://businesstech.co.za/news/lifestyle/798248/new-carjacking-trend-hitting-south-africa/.

[12] Statistics South Africa, "Governance, Public Safety and Justice Survey (GPSJS): Victims of Crime 2021/22," 2022, accessed June 7, 2025, https://www.statssa.gov.za/publications/P0341/GPSJS%202021_22%20%20Final_29_08_22.pdf.

[13] P. Ivliev et al., "The Use of IT Technologies in the Prevention of Crimes," *BIO Web of Conferences* 65 (2023): 1-9.

[14] M.W. Achim, S.N. Borlea and V.L. Văidean, "Does Technology Matter for Combating Economic and Financial Crime? A Panel Data Study," *Technological and Economic Development of Economy* 27, no. 1 (2021): 223-261.

[15] M.H. Sayed and A.A. Khalefa, "Synergistic Effect of Technology in Combating Crime," 2018, accessed 15 April, 2025, https://www.researchgate.net/publication/362859710_Synergistic_Effect_of_Technology_in_Combating_Crime.

[16] M.S. Nuth,"Taking Advantage of New Technologies: For and Against Crime,"*Computer Law & Security Report* 24, no.5(2008):437-446.

[17] J. Paul and A.R. Criado, "The Art of Writing Literature Review: What Do We Know and What Do We Need to Know?", *International Business Review* 29, no. 4 (2020): 101717.

The Prevalence of Carjacking

While the history of carjacking in South Africa is not extensively documented, it can be traced back to the 1980s. Before 1987, the incidence of motor vehicle carjacking in South Africa rose significantly, which made it one of the countries with the highest carjacking rates worldwide.[18] Rory indicates that there were 16,000 reported carjackings in 1998, which decreased to 12,434 by 2005, and continued to decline until the 2011/2012 financial year.[19] Despite this, South Africa was still considered the country with the highest carjacking rates at that time, which negatively impacted the safety and well-being of its residents, as well as the economy.[20] A reduction in crime statistics is always a positive sign and offers hope to the citizens. However, the increase in vehicle carjackings, along with a general rise in violent organised crime in South Africa, with 17,900 carjacking incidents reported to the SAPS in 2016/2017,[21] quickly dashed the citizens' hopes as this issue continues to plague them.

In the recent past, this crime has escalated uncontrollably. Crime figures published by the SAPS for the period from 1 October 2020 to 31 December 2020 indicated a yearly rise in carjackings in South Africa.[22] In 2020, approximately 4,794 carjackings were reported, reflecting a 7.4% increase compared to the 4,462 instances reported in 2019. An escalation of this crime was documented in all provinces of the country, except for the Free State, which had no variation, and the Eastern Cape, which reported a decline of 2.1%. The preponderance of these occurrences was documented in the most densely populated regions.

The highest number of reported cases occurred in Gauteng, with 2,346 incidents, followed by KwaZulu-Natal, with 791, and the Western Cape, with 708. It appears that sedans and hatchbacks are the most frequently targeted vehicles, followed by trucks and sport utility vehicles. Nyanga in the Western Cape recorded the highest incidence of carjackings with 133 cases, followed by Umlazi in KwaZulu-Natal with 73. Additionally, Motroka in Gauteng had the highest number of reported cases at 48. The majority of these carjackings occurred in townships, followed by adjacent residential areas.[23]

Nevertheless, figures released by the vehicle tracking company Tracker in January 2020 indicate that carjacking is more prevalent than vehicle theft in the country, with an average distribution of 53% to 47% in comparison to common theft.[24] This crime is characterised as opportunistic, with most cars being targeted for their cargo, particularly fast-moving consumable commodities. Furthermore, drivers who transport substantial sums of cash are often targeted. Other vehicles, however, are not exempt; they are intended to be dismantled at "chop shops" or sold on the illegal market. Tracker's data reveal that the majority of automobiles are hijacked or stolen at the end of the week, with most carjackings occurring from Wednesday to Friday, predominantly between 16:00 and 20:00.[25]

Furthermore, Tracker's data indicate that Gauteng continues to record the highest incidence of vehicle carjackings, with Johannesburg and Pretoria identified as the primary hotspots, followed by KwaZulu-Natal, where Durban is the focal point for carjackings. Carjacking predominantly occurs in Mitchells Plain and various regions of Cape Town.[26] In 2024, the SAPS's statistics indicated that South Africa experienced a year-on-year increase in carjackings, with certain regions witnessing a more significant rise in incidents than others.[27] The SAPS reported that three provinces observed a significant year-on-year increase in carjackings of over 10%: Gauteng (14.4%), the Western Cape (14%), and North West (11%). KwaZulu-Natal experienced a 17.6% reduction in carjackings, while the Eastern Cape recorded a decline of 5.2%. During the final quarter of 2023, Gauteng documented 3,010 carjackings, representing 50.4% of all carjackings in the third quarter of 2023/2024. The Western Cape recorded 856

[18] R. Zinn, "Victims of Motor Vehicle Hijacking," in *Victimology in South Africa*, ed. R. Peacock (Pretoria: Van Schaik, 2013), 183-195.
[19] C. Rory, "Carjacking: The Everyday Ordeal Testing South Africa," *The Guardian*, March 2, 2006, accessed March 11, 2024, https://www.theguardian.com/world/2006/mar/02/film.oscars2006.
[20] Burgers, Wright and Nel, "National Initiatives to Prevent and Combat Vehicle Crime."
[21] C. James, "Carjacking in South Africa: Exploring Its Consequences for Victims," *Acta Criminologica: African Journal of Criminology & Victimology* 30, no. 2 (2017): 147-161.
[22] BusinessTech, "Hijackings on the Rise in South Africa – Here Are the Hotspot Areas," 2021, accessed May 25, 2025, https://businesstech.co.za/news/lifestyle/539516/hijackings-on-the-rise-in-south-africa-here-are-the-hotspot-areas/.
[23] BusinessTech, "Hijackings on the Rise in South Africa – Here Are the Hotspot Areas."
[24] Tracker, "Tracker Profile: Carjacking," 2020, accessed June 6, 2025, https://www.tracker.co.za.
[25] Tracker, "Tracker Profile: Carjacking."
[26] BusinessTech, "Hijackings on the Rise in South Africa – Here Are the Hotspot Areas."
[27] BusinessTech, "New Carjacking Trend Hitting South Africa," 2024, accessed June 9, 2025, https://businesstech.co.za/news/lifestyle/798248/new-carjacking-trend-hitting-south-africa/.

carjackings, whereas KwaZulu-Natal reported 834. Upon examining more granular station data, Gauteng exhibited the highest incidence of hijackings per region, with Ivory Park in Ekurhuleni recording the most occurrences.[28]

The Use of Technology to Counteract Crime

Recent technological advances have transformed societal living conditions and work practices. Previously deemed unattainable, these advancements are now considered feasible due to the emergence of new technologies. Technology is integral to society and a fundamental aspect of our lives.[29] Conversely, criminal behaviours and habitual practices have evolved in tandem with these technological advancements. Criminals also employ technological tools in the commission of offences.[30] By utilising sophisticated software, hardware, and various technological tools, individuals can easily perpetrate crimes, which have transitioned from more readily identifiable means to the digital domain. This indicates that those who understand the significance of information technology and possess adequate knowledge of its current advancements can exert greater control over situations today than in previous times.

Numerous recent advancements and modifications have taken place in both the hard and soft technology employed by law enforcement agencies across various contexts. The following paragraphs outline the recent advancements and applications that enhance the efficiency and efficacy of policing, including network analysis, Geographic Information System (GIS), crime mapping, biometrics, fingerprinting, deoxyribonucleic acid (DNA) analysis, facial recognition, speech recognition, and closed-circuit television (CCTV).

Studies have shown that social networks not only help to detect criminal behaviour but are also a useful tool in counteracting crime.[31;32;33] Network analysis serves as a crucial instrument for law enforcement, which enables the demonstration of the dynamics of growing relationships between individuals. Understanding the connections among individuals on social networking platforms such as Facebook may assist law enforcement in elucidating a particular criminal investigation. Conversely, traffic data from mobile phones and emails may provide significant leads in resolving criminal activities.[34]

GIS and crime mapping are innovative technologies that have been effectively utilised in law enforcement. GIS is a spatial decision support system that emphasises decision-making and problem-solving procedures.[35] It is not merely an additional data-visualisation tool but an extensive array of instruments for the collection, storage, retrieval, analysis, and presentation of spatially referenced data.[36] In GIS, automated computerised pin mapping and hotspot analysis are the predominant applications used by law enforcement agencies. Crime mapping produces informative outputs and mental representations that enhance the precision of decision-making processes. Consequently, the system reduces effort and augments the decision maker's (law enforcement) current capabilities.[37] Moreover, crime-mapping applications allow law enforcement organisations to evaluate crime incidents and influencing factors in any geographic region.

Biometrics refers to technology that utilises an individual's distinctive traits, such as fingerprints, DNA composition, and vocal patterns.[38] Biometrics have been used for many years by law enforcement

[28] South African Police Service (SAPS), "Crime Statistics," 2024, accessed September 3, 2024, https://www.saps.gov.za/services/crimestats.php.
[29] T. Fatih and C. Bekir, "Police Use of Technology to Fight Against Crime," *European Scientific Journal,* 11, no. 10 (2015): 286-296.
[30] Fatih and Bekir, "Police Use of Technology to Fight Against Crime."
[31] Y Cai, "The Role of Social Media in Influencing Juvenile Delinquent Behavior," *Communications in Humanities Research* 52 (2024): 1-8.
[32] M.J. Leote de Carvalho, "Social Media in Juvenile Delinquency Practices: Uses and Unlawful Acts Recorded in Youth Justice in Portugal," *Comunicação* 42 (2022): 1-19.
[33] D. Bright, R. Brewer and C. Morselli, "Using Social Network Analysis to Study Crime: Navigating the Challenges of Criminal Justice Records," *Social Networks* 66 (2021): 50-64.
[34] T. Podzolkova, I. Shynkarenko and P. Sergii, *Integrated Computer Technologies in Mechanical Engineering – Synergetic Engineering* (Cham: Springer, 2022).
[35] G.E. Baraka, "An Evidence-Based Theoretical Underpinning of Technological Transformation in Policing: From Manual Crime Mapping to Geographic Information Systems in Kenya," 2023, accessed May 25, 2025, https://shorturl.at/hukjj.
[36] Baraka, "An Evidence-Based Theoretical Underpinning of Technological Transformation in Policing."
[37] Baraka, "An Evidence-Based Theoretical Underpinning of Technological Transformation in Policing."
[38] Podzolkova, Shynkarenko and Sergii, *Integrated Computer Technologies in Mechanical Engineering.*

and intelligence agencies worldwide. They are employed to identify suspects or perpetrators responsible for committing a crime, such as locating individuals whose fingerprints were found on a firearm.[39] Biometric technology is used in law enforcement to match sensitive information by comparing it with various regional and national databases, which provides enhanced authentication capabilities.

Fingerprint technology is a crucial biometric modality employed by law enforcement authorities globally. Fingerprints are distinctive to individuals and do not change over time. Consequently, fingerprint analysis serves as an invaluable tool for law enforcement in identifying suspects and providing pertinent evidence to corroborate their involvement in criminal activities.[40] In addition to using fingerprints, law enforcement agencies have gained numerous advantages from the application of DNA research. DNA analysis offers guidance during the investigative process.[41] DNA analysis can resolve many challenging situations, particularly those that have been unsuccessful with alternative methods. Furthermore, even in the absence of witnesses, DNA analysis can yield significant investigative insights.[42]

Facial recognition is a technological tool that assists law enforcement organisations in acquiring and analysing individual profiles from various databases. Speech recognition technology is also beneficial for law enforcement, as it enables the detection of audio samples from criminals and allows for comparison with established criminal profiles.[43] In response to heightened crime rates, increased terrorist incidents, and occurrences of shootings in educational and professional environments, law enforcement agencies have implemented CCTV security monitoring systems in several areas to enhance societal safety.[44] Some video cameras are affixed within police vehicles to oversee traffic stops and vehicle movements. The advancement of technology has led to a reduction in the cost of CCTV equipment. Consequently, numerous security managers have initiated the installation and implementation of security monitoring systems in their designated areas. Furthermore, wireless technology has enabled law enforcement authorities to monitor security cameras via their laptops and mobile devices. Critical evidence recorded by CCTV frequently aids in elucidating a criminal case and supplying proof to the court.[45]

Several studies have found that new technological applications and gadgets help police departments to make better use of their limited resources to combat crime.[46;47;48] Innovative technology has assisted the Brazilian police in effectively combating border crimes.[49] They implemented the Integrated Border Monitoring System (SISFRON), which resulted in a significant number of illegal migrants being apprehended and a notable decrease in border crimes. Gkougkoudis et al. discovered that the use of novel technologies such as facial recognition, drones, and CCTV assisted the police in gathering evidence for the majority of crimes committed in the European Union.[50] As a result, although technological gadgets and systems place a substantial strain on police agencies' finances, they are viewed as successful and efficient methods of policing in modern society.[51]

[39] Podzolkova, Shynkarenko and Sergii, *Integrated Computer Technologies in Mechanical Engineering.*
[40] T. Murthy, "Fingerprint Image Recognition for Crime Detection," *Turkish Journal of Computer and Mathematics Education (TURCOMAT)* 12, no. 12 (2021): 2230-2237.
[41] N.F. de Groot, B.C. van Beers and G. Meynen, "Commercial DNA Tests and Police Investigations: A Broad Bioethical Perspective," *Journal of Medical Ethics* 47, no. 12 (2021): 788-795.
[42] De Groot, Van Beers and Meynen, "Commercial DNA Tests and Police Investigations."
[43] F. Jansen, J. Sánchez-Monedero and L. Dencik, "Biometric Identity Systems in Law Enforcement and the Politics of (Voice) Recognition: The Case of SiiP," *Big Data & Society* 8, no. 2 (2021): 20539517211063604.
[44] P. Matczak et al., "Cost-Effectiveness of CCTV Surveillance Systems: Evidence from a Polish City," *European Journal on Criminal Policy and Research* 29 (2022): 555-577.
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[47] G. Gkougkoudis, D. Pissanidis and K. Demertzis, "Intelligence-Led Policing and the New Technologies Adopted by the Hellenic Police," *Digital* 2, no. 2 (2022): 143-163.
[48] T.J. Aransiola and V. Ceccato, "The Role of Modern Technology in Rural Situational Crime Prevention: A Review of the Literature," in *Rural Crime Prevention*, ed. A. Harkness (London: Routledge, 2020), 58-72.
[49] Mlambo, Adetiba and Thusi, "Using Technology to Address Cross Border Crime and Illegal Migration."
[50] Gkougkoudis, Pissanidis and Demertzis, "Intelligence-Led Policing and the New Technologies Adopted by the Hellenic Police."
[51] Aransiola and Ceccato, "The Role of Modern Technology in Rural Situational Crime Prevention."

Challenges in the Use of Technologies to Combat Carjacking

While innovative technological systems and devices have made significant contributions to combating crime in general, statistics indicate a notably high occurrence of carjacking in South Africa. This can be attributed to the challenges that come with using technology to tackle carjacking. Despite the availability of a number of vehicle security systems on the market today, the carjacking rate remains relatively high.[52] Various studies have concluded that, despite advancements in crime prevention technology, such as the face recognition system, much work remains to be done to reduce the escalating crime of carjacking.[53;54;55]

While innovative vehicle technology plays an important role in combating carjacking, it is not without flaws. Vehicle technological applications rely on an accurate, secure, and reliable positioning system, which current systems based on Global Navigation Satellite System (GNSS), vehicle sensors, radar, cameras, and laser scanners cannot guarantee in all use cases and operating conditions.[56] Although GNSS receivers have seen significant performance advancements, they still struggle to provide precise position information in certain environments, such as dense interiors, tunnels, urban canyons, busy cities, or when passing near buildings or trees.

One of the current issues with vehicles equipped with the latest innovative technology designed to safeguard drivers from carjacking is their high cost. With a high unemployment rate, expensive living costs, and a declining economy in South Africa[57;58;59], not many individuals can afford them. This means that the majority of South African drivers are unable to benefit from the new technology offered by modern vehicles due to their prohibitive cost[60], which leaves them more vulnerable to carjacking. For these vehicle technology systems and gadgets to be effective in combating carjacking, they must be accessible to a large number of drivers, not only a select few.[61]

Existing vehicle safety mechanisms have their own set of obstacles and flaws that carjackers who are familiar with modern vehicle technology exploit. Some vehicles' panic buttons and safety systems are easily accessible. Carjackers often find it easy to discover and take measures that compromise these systems, thus rendering them ineffective.[62;63] This indicates that, regardless of advancements made in vehicle safety technology, carjackers continually find ways to penetrate and compromise these systems. Once a vehicle safety technology is compromised, it no longer serves its purpose. For example, a motor vehicle tracking device that has been compromised may no longer be able to send the location of the carjacked vehicle to the controller or authorities, and if it does, the location may be incorrect.[64]

Fingerprint analysis is one of the common methods used by the police to identify crime suspects. Prints are lifted from crime scenes and then compared with existing entries in the database to determine the true identity of those involved. Although fingerprint analysis plays a crucial role in combating crime, the system itself has limitations and risks. The risks associated with employing biometric fingerprints are significant. Once breached, they are no longer recoverable. Because the data are not renewable, they

[52] A. Poornima et al., "Raspberry PI-Based Vehicle Anti-Theft System by Face Recognition," *International Journal of Research and Analytical Reviews* 9, no. 2 (2022): 117-121.
[53] S. Lin and J. Wu, "Face Recognition Unlocking Uses Principal Component Analysis to Control the Vehicle Door System," *Journal of Physics: Conference Series* 2020 (2021): 012028.
[54] A. Atmaja et al., "Face Recognition System Using Micro Unmanned Aerial Vehicle," *Journal of Physics: Conference Series* 1845, no. 1 (2021): 012043.
[55] C. Shi, C. Wu and Y. Gao, "Vehicle Face Recognition Algorithm Based on Fusion of Siamese Neural Network," *Journal of Physics: Conference Series* 2027 (2021): 012044.
[56] R. Halili, "Joint Communication and Localization for Connected Vehicles" (Ph.D., University of Antwerp, 2022).
[57] D. Sekwati and M.A. Dagume, "Effect of Unemployment and Inflation on Economic Growth in South Africa," *International Journal of Economics and Financial Issues* 13, no. 1 (2023): 35-45.
[58] K. Naidoo et al., "Firm Innovation and Employment in South Africa: Examining the Role of Export Participation and Innovation Novelty," *Emerging Markets Finance and Trade* 59, no. 2 (2023): 589-604.
[59] E.M. Buthelezi, "Impact of Inflation in Different States of Unemployment: Evidence with the Phillips Curve in South Africa from 2008 to 2022," *Economies* 11, no. 1 (2023): 29.
[60] M. Bharathidasan et al., "A Review on Electric Vehicle: Technologies, Energy Trading, and Cyber Security," *Energy Reports* 8 (2022): 9662-9685.
[61] I.W. Damaj, J.K. Yousafzai and H.T. Mouftah, "Future Trends in Connected and Autonomous Vehicles: Enabling Communications and Processing Technologies," *IEEE Access* 10 (2022): 42334-42345.
[62] R.R. Brooks et al., "Automobile Security Concerns," *IEEE Vehicular Technology Magazine* 4 no. 2 (2009): 52-64.
[63] C. Andrews, "Cyber Car Crime: Thieves Turn to High Tech," *Engineering & Technology* 12, no. 2 (2017): 32-35.
[64] M. Ramesh et al., "Implementation of Vehicle Security System Using GPS, GSM and Biometric," in *Proceedings of the 2019 Women Institute of Technology Conference on Electrical and Computer Engineering (WITCON ECE)* (New Jersey: IEEE, 2019), 71-75.

cannot be used once stolen.[65] Additionally, if proper procedures are not followed when collecting fingerprints, negative outcomes are more likely to occur. Inadequately gathered fingerprints may fail to match the carjacking suspect to the fingerprints in the database.

METHODOLOGY

The objective of this study was to explore police methods and challenges in the utilisation of technology in combating carjacking in selected police precincts in the Gauteng province, South Africa. This is a relatively unknown research area. To gain a broader understanding of this phenomenon, a phenomenological qualitative research design was deemed appropriate for this study. Phenomenology is an approach to qualitative research that focuses on the commonality of lived experiences in a particular group.[66] The fundamental goal of this approach is to arrive at a description of the nature of the specific phenomenon. Against this background, interviews were conducted to acquire information based on the participants' perceptions, experiences, and understanding of the phenomenon regarding the use of innovative technologies, as well as the effectiveness and challenges in combating carjacking.

This study utilised non-probability sampling procedures, specifically purposive sampling. This method allows for the selection of research participants based on the researcher's judgement.[67] In this study, this judgement was informed by two factors: years of work experience, which ranged between five and eleven years, and the nature of the work the participants were doing. Consequently, only police officers involved in combating carjacking and related crimes, operating in detective units at the police station level, and those working in the forensics branch of the SAPS, were sampled. Table 1 presents the demographic information of the sampled participants.

Table 1: Participant Demographics

Police Station	**Number**	**Years of Experience**
Johannesburg Central SAPS	4	13 to 33 years
Hillbrow SAPS	3	28 to 33 years
Alexandra SAPS	3	05 to 31 years
Gender of Participants		
Male	6	
Female	4	
Race of Participants		
African	7	
White	2	
Coloured	1	
Total Number of Participants	**10**	

In order to ensure consistency in the line of questioning, an interview guide containing a set of questions was prepared as the research instrument. Follow-up questions, which were not formulated beforehand, were also asked to allow the participants to provide more information regarding police methods and challenges in the utilisation of innovative technologies. The participants were interviewed one-on-one and permitted their interviews to be recorded without identification. Only those who gave their willing consent were interviewed. No one was forced to participate, and the freedom to withdraw at any stage of the research was always available for the participants. Pseudonyms were used, which, in essence, meant respecting their right to privacy and ensuring their anonymity. Field notes were also taken, which were later transcribed, analysed, and recorded. This qualitative study utilised thematic analysis to

[65] J.H. Park et al., "A Comprehensive Survey on Core Technologies and Services for 5G Security: Taxonomies, Issues, and Solutions," *Human-Centric Computing and Information Sciences* 11, no. 3 (2021): 22.

[66] J.W. Creswell, "Steps in Conducting a Scholarly Mixed Methods Study," 2013, accessed June 28, 2025, https://digitalcommons.unl.edu/cgi/viewcontent.cgi?params=/context/dberspeakers/article/1047/&path_info=2013_11_14_ALL_Steps_in_Conducting_Mixed_Methods_Research_Creswell.pdf.

[67] F.B. Thomas, "The Role of Purposive Sampling Technique as a Tool for Informal Choices in Social Sciences Research Methods," *Just Agriculture* 2, no. 5 (2022): 1-8.

analyse the collected data.The data analysis of this study was guided by Creswell's six-step data-analysis process:

- **Step 1:** The Data was organised and prepared for analysis. The data obtained from the interviews were transcribed during this step.
- **Step 2:** The transcribed data were read through. This was done to gain a general sense of the data and to secure the opportunity to reflect on its overall meaning.
- **Step 3:** At this stage, a detailed analysis of the coding process began. The collected data were organised by categorising the text and then labelling the categories with specific terms.
- **Step 4:** The coding process was used to develop a description of the people, setting, or categories/themes for analysis.
- **Step 5:** The descriptions of the themes were presented in a qualitative narrative. During this step, the researchers merged the themes into narrative passages so that the findings could emerge logically from the participants' responses.
- **Step 6:** At this stage, the research findings, as well as the information gleaned from personal experiences, history, and/or the literature, were provided under the results and discussion sections of this study.[68]

PRESENTATION OF FINDINGS

The participants in this study comprised members from Johannesburg Central SAPS, Hillbrow SAPS, and Alexandra SAPS. All the SAPS members worked in units that investigate vehicle-related crimes and were therefore included in this study. The participants were as follows:

Table 2: Number of Participants and Police Stations

Johannesburg Central Saps	Hillbrow Saps	Alexandra Saps
• Participant 1 • Participant 2 • Participant 3 • Participant 4	• Participant 5 • Participant 6 • Participant 7	• Participant 8 • Participant 9 • Participant 10

Fieldnotes taken by the researchers during the interviews also facilitated data analysis. These notes provided direction during the data-analysis process and aided in the categorisation of the data into themes. The analysis of this group's responses yielded two themes: (1) innovative technologies utilised by the SAPS to combat carjacking and their effectiveness, and (2) challenges encountered in the utilisation of innovative technologies to combat carjacking.

Theme 1: Innovative Technologies Utilised by the South African Police Service (SAPS) and the Effectiveness Thereof

The participants were asked to identify innovative technological devices and systems they were aware of that were utilised by the SAPS, as well as their effectiveness in combating carjacking. Their responses varied. Some participants indicated that the Circulation System was the technology currently used to address carjacking and other vehicle-related crimes. Others mentioned devices such as cameras, tracking devices, radios, tracking apps, vehicle sensors, the Crime Scene Management System, the Automated Fingerprint Management System, CCTV, the Vehicle Identification System, and mobile phones. The following are some of the participants' responses:

> *"Currently, we utilise street cameras, which are being monitored, to combat carjacking. But we also use the fingerprint identification system to process fingerprints collected from carjacking scenes"* (Participant 1).

> *"We are working with car tracking companies who fit our state vehicles with equipment to locate carjacked vehicles"* (Participant 2).

[68] J.W. Creswell, *Mapping the Field of Mixed Methods Research* (Los Angeles: Sage Publications, 2009).

"CCTV cameras and drones" (Participant 3).

"Tracking devices, CCTVs and drones" (Participant 4).

"Private tracking devices" (Participant 5).

"MCD phone system" (Participant 6).

"Municipal cameras and licence plate recognition system" (Participant 7).

"Circulation and radios" (Participant 8).

"Car tracking devices" (Participant 9).

"Tracking devices" (Participant 10).

The above discussions demonstrate that different units in the SAPS utilise various devices and systems in the execution of their duties. For instance, detective units at police stations rely heavily on the Circulation System and radios. These systems are commonly used by detectives to circulate information about reported carjacking crimes. Other external systems and devices that the participants identified as useful to the police included CCTV, municipal cameras, and drones. These systems are often operated by local governments and private security companies, which share crime information along with digital evidence with the police, to aid them in apprehending and prosecuting carjackers. When asked about the effectiveness of the technological systems and devices currently utilised by the police to combat carjacking, the participants' replies were as follows:

"They are effective in a way that once the information given is accurate, it is easy to find the car, because all the police vehicles will be alerted so that they may pursue. Police choppers are mobilised to search carjacked vehicles from above" (Participant 1).

"We recovered lots of stolen and carjacked vehicles" (Participant 2).

"It is effective if utilised correctly" (Participant 3).

"It serves as crime deterrence. It helps us to arrest criminals, and assist in crime prevention efforts" (Participant 4).

"Tracking devices are very effective. They help us to recover carjacked vehicles and to arrest carjackers" (Participant 5).

"This system works effectively on roadblocks" (Participant 6).

"They are very effective. When crime is reported, we circulate it, our members are on the lookout. When the vehicle is captured by cameras, we are able to locate it and follow it up" (Participant 7).

"They are very effective because all SAPS members receiving the message are immediately on the lookout, and can easily discover the carjacked vehicle" (Participant 8).

"The technology is effective" (Participant 9).

"Very effective" (Participant 10).

In the discussion above, most participants claimed that the technologies currently at their disposal were effective in combating the crime of carjacking. They argued that most stolen vehicles are recovered with the assistance of these innovative technologies. However, a few participants pointed out instances where the operation of their technologies was not effective. They stated that their systems sometimes failed due to a loss of network, especially during load shedding. Some also noted that modern carjackers are clever and can interfere with and manipulate these technologies to evade arrest.

Theme 2: Challenges Encountered in the Utilisation of Innovative Technologies to Combat Carjacking

In respect of this theme, the participants were asked to describe the challenges associated with the functioning of innovative technologies currently utilised to combat carjacking. The responses varied according to their line of work and the innovative technologies employed at their stations. Some participants highlighted the challenges posed by the telecommunications network, stating that during load shedding, their crime prevention technological systems and devices do not operate due to loss of network connectivity. Load shedding refers to the rolling blackouts implemented by the electricity-generating entity, Eskom, in South Africa, due to constant strain on the grid. It involves regular planned power outages, which are deliberate shutdowns of parts of the electricity distribution network to avoid damage to the grid and to safeguard against the risk of a national blackout.[69] Furthermore, other participants noted that carjackers often use jammers to compromise vehicle tracking systems, which makes it very difficult for them to trace carjacked vehicles. Below are their responses:

> *"Firstly, there is load shedding; without electricity, the cameras don't work, street lights are off. Secondly, delays in fingerprint processing can compromise the evidence"* (Participant 1).
>
> *"Not all SAPS vehicles are fitted with tracking systems"* (Participant 2).
>
> *"Untrained and unmotivated police investigators"* (Participant 3).
>
> *"Load shedding and network problems"* (Participant 4).
>
> *"Sometimes these trackers are easily located and deactivated by carjackers, even before we find them"* (Participant 5).
>
> *"When there is no network or during load shedding"* (Participant 6).
>
> *"Once clever criminals plug fake number plates, the number plate recognition system is unable to pick them"* (Participant 7).
>
> *"Not any that I am aware of"* (Participant 8).
>
> *"Some carjackers are able to remove tracking devices"* (Participant 9).
>
> *"Jamming devices and network issues caused by load shedding"* (Participant 10).

The participants pointed out various challenges associated with the operation of innovative technologies used to combat carjacking. They mentioned that sometimes their systems, such as street cameras and CCTV, shut down due to vandalism or poor maintenance, and during these periods, they are unable to work effectively to combat carjacking. Some participants noted that their vehicle tracking systems cannot track carjacked vehicles if the tracking devices have been removed by carjackers.

Additionally, some participants claimed that certain carjackers collaborate with vehicle tracking technicians, who assist them in removing and deactivating tracking devices immediately after committing

[69] K. Walsh, R. Theron and C. Reeders, "Estimating the Economic Cost of Load Shedding in South Africa," Paper Submission to the Biennial Conference of the Economic Society of South Africa (ESSA), 2021.

carjackings. Other participants highlighted the issue of network connectivity, stating that when there is no network, they cannot use their technological systems or devices. One major cause of network shutdown mentioned by the participants was load shedding. Furthermore, the use of fake number plates on carjacked vehicles by carjackers to evade capture presents a unique challenge for the police. Number plate recognition systems are unable to identify a vehicle owner's true identity when it has fake plates.

DISCUSSION

This study explored police methods and challenges in the utilisation of technology to combat carjacking in selected policing precincts of Gauteng, South Africa. It found that various devices and systems are employed by the SAPS in its efforts to combat carjacking; however, these technologies are less sophisticated and have made little impact on the prevalence of carjacking incidents, which contributes to the continuous increase in such crimes. Most participants in this study indicated that the SAPS at the station level relied heavily on the Circulation System to address carjacking. Although the Circulation System is intended for communicating carjacking incidents, it has no direct role in or impact on the investigation of the crime. This heavy reliance on the Circulation System highlights the weaknesses in efforts to counteract carjacking. It is therefore critical for law enforcement to utilise intelligent, dependable, effective, and technological systems to combat vehicle crimes.[70] These sentiments are supported by Gkougkoudis et al., who believe that police efforts to tackle crime and conduct successful investigations should be significantly assisted by developments in innovative technology.[71]

When the participants were asked to describe how the Circulation System worked, they explained that whenever a carjacking is reported, and a docket is opened, SAPS officers record this information in the Circulation System. This allows other police stations to receive the details and pass them on to officers in the field, who will then be on the lookout for the reported vehicle. Although this system is essential for disseminating information about carjacking cases to various police stations, officers on the street are not equipped with the technology needed to locate these vehicles in real time, which renders this method ineffective.

They often use vehicle registration numbers, communicated to them by the radio controller, to look for a match as they drive around. This is why very few carjackers are apprehended. Consequently, there are low prosecution and conviction rates for carjacking in South Africa. More than 16,000 carjacking incidents were reported to the police in the last calendar year, but very few of these incidents resulted in a criminal conviction.[72] A report indicates that only 2.3% of all hijackers, around one in 40, are actually arrested and charged for their crimes.[73] One factor that contributes to the low conviction rate for carjackers in South Africa is the lack of modern, sophisticated crime prevention technologies in the police service.[74]

Another device that SAPS members frequently utilise in combating carjacking is the police radio. The participants explained that every SAPS vehicle is equipped with a radio, which their police stations use to transmit messages to patrol members. When a carjacking is committed or reported, members on the ground often receive messages through these radios. They use them to communicate with their stations, as well as among themselves on the ground. Police officers also use social media platforms, with the most common being WhatsApp. Officers unofficially use WhatsApp groups to communicate work-related matters. In cases of carjacking incidents, detailed information, images, and videos are shared with fellow SAPS members and, at times, also with other crime prevention stakeholders, such as private security companies. WhatsApp is one of the most commonly used communication platforms in the world. It is not only used by the police but also by neighbourhood watch groups and community police forums. Neighbours use it to exchange warnings, concerns, and information about incidents, emergencies, and suspicious situations. These exchanges often lead to neighbours actively protecting and monitoring their streets, sharing messages about suspicious activities, and using the camera on their mobile phones to

[70] Ramesh et al., "Implementation of Vehicle Security System Using GPS, GSM and Biometric."
[71] Gkougkoudis, Pissanidis and Demertzis, "Intelligence-Led Policing and the New Technologies Adopted by the Hellenic Police."
[72] T. Head, "Fortune Favours the Criminal: Low Conviction Rate for Hijackers Is a Shocker," 2020, accessed June 29, 2025, https://www.thesouthafrican.com/news/hijackers-conviction-rate-south-africa-low/.
[73] J.M. Versluis and J. de Lange, "Just 2 out of 100 Hijackers Sentenced," *Netwerk24*, October 20, 2019, accessed June, 29, 2025, https://www.netwerk24.com/Netwerk24/net-2-uit-100-kapers-gevonnis-20191020.
[74] B. Cele, "SAPS Budget Vote," 2022, accessed June 2, 2025, https://www.saps.gov.za/newsroom/msspeechdetail.php?nid =39973.

record criminal events. The recorded incidents are frequently sent to the police for further investigation. However, the effectiveness and impact of WhatsApp in combating carjacking are not yet clear, given the high rate of carjacking in South Africa. Despite these efforts, scholars argue that to enhance the effectiveness of the currently utilised technology in combating carjacking, much more needs to be done to improve their capabilities and efficiency.[75;76;77;78]

It was further found that numerous challenges exist in the utilisation of innovative technologies currently employed by the police. The participants indicated that although various innovative technological systems and devices exist to aid them in combating carjacking, the technology is not without its challenges. The participants pointed out various loopholes in the functioning of these innovative technologies. Vehicle tracking devices were reported to be easily compromised. Over the past few decades, Global Positioning System (GPS) technology has transformed vehicle tracking and security, and offers unparalleled convenience and peace of mind. However, with technological advancements come new challenges. One such challenge is the emergence of devices like vehicle tracking jammers, which can disrupt GPS signals and compromise vehicle security systems.[79]

Jamming was also one of the challenges mentioned by the participants. They indicated that carjackers today utilise jamming systems to compromise police tracking systems, thus evading capture. The participants complained that once carjackers activate their jamming devices, it becomes almost impossible to locate and recover carjacked vehicles. These findings are supported by Halili, who stated that criminals use jamming to block GPS-enabled tracking and/or to disorient navigation and positioning systems.[80] Furthermore, the participants claimed that highly experienced carjackers always find ways to deactivate tracking devices after committing a carjacking. Some participants even asserted that carjackers often collaborate with vehicle tracking technicians, who assist them in locating and removing tracking devices.

This study also found that network issues were a contributing factor to the failure of some modern innovative technologies, such as the Circulation System and SAPS radios, which are designed to assist in combating carjacking. The participants lamented that whenever there is load shedding, their technological systems and devices do not work well, and in some instances do not work at all, due to a lack of network connectivity. Load shedding presents various challenges for South Africa, including crime. Some studies have found that criminal activities rise sharply during load shedding.[81;82;83] This is supported by the social disorganisation theory, which affirms that criminal activities thrive in environments that are not well organised. Once crime prevention technologies are rendered ineffective due to poor network connectivity caused by load shedding, criminals find opportunities to commit crimes in general, and carjacking in particular. During load shedding, monitoring cameras are essentially rendered ineffective at night due to darkness. These findings are supported by Jacobs and Cherbonneau, who argued that carjacking crimes often occur at night in solitary, dark areas with improper lighting. Clearly, there is a link between load shedding and an increase in carjacking crimes.[84]

RECOMMENDATIONS

In line with the findings of this study, the following recommendations are made:

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[75] Gkougkoudis, Pissanidis and Demertzis, "Intelligence-Led Policing and the New Technologies Adopted by the Hellenic Police."
[76] Aransiola and Ceccato, "The Role of Modern Technology in Rural Situational Crime Prevention."
[77] V. Ruggiero, "The Degrowth Movement and Crime Prevention," *Crime, Law and Social Change* 77, no. 5 (2022): 463-478.
[78] M.H. Ho, R. Ko and L. Mazerolle, "Situational Crime Prevention (SCP) Techniques to Prevent and Control Cybercrimes: A Focused Systematic Review," *Computers & Security* 115, no. 120 (2022): 102611.
[79] K. Makodi, "Car Trackers: Understanding the Challenges and Potential Implications of GPS Tracking Issues," 2025, accessed July 7, 2025, https://gauteng.news/2025/03/24/car-trackers-understanding-the-challenges/.
[80] Halili, "Joint Communication and Localization for Connected Vehicles."
[81] Z. Banda, *The Social Environmental Effects of Load Shedding in Lusaka's Kalingalinga Township* (Zambia: Cavendish University, 2020).
[82] M. Lambongang, "Criminal Behavior During Electricity Blackouts: Evidence from Load Shedding in Cape Town, South Africa" (Master's, North Dakota State University, 2023).
[83] V.H. Mlambo, "Living in the Dark: Load Shedding and South Africa's Quest for Inclusive Development," *International Journal of Social Sciences Review* 11, no. 2 (2023): 153-160.
[84] B.A. Jacobs and M. Cherbonneau, "Carjacking and the Management of Natural Surveillance," *Journal of Criminal Justice* 61 (2019): 40-47.

Installation of SAPS-Owned Network Satellites

The study found that challenges exist in the functioning of the technologies currently utilised by the SAPS due to power cuts (load shedding), which cause poor network connections. It is therefore recommended that SAPS-owned network satellites be established to provide an uninterrupted network connection for the SAPS's crime prevention technologies.

Installation of Tracking Systems in SAPS Vehicles

The study found that the police rely on common technological devices and systems, such as radios and the Circulation System, which are less effective in combating carjacking. This study, therefore, recommends the use of tracking systems by the SAPS. These tracking systems should be installed in all police vehicles that deal with carjacking and other vehicle crimes to aid in the identification, location, and recovery of carjacked vehicles.

Establishment of a Crime Prevention Information and Communications Technology (ICT) Division in the SAPS

The findings of this study highlighted that the SAPS, particularly at the station level, has no technological systems or devices specifically designed to address carjacking. The study therefore recommends the establishment of a crime prevention ICT division in the SAPS. This division will be responsible for upgrading and modernising the technological infrastructure of the SAPS. It should consider the installation of number plate recognition systems to assist in identifying carjacked vehicles. Lastly, the division should also explore establishing surveillance capabilities, such as street monitoring cameras and drones, to monitor vehicle movements and illegal activities, including carjacking and vehicle theft.

CONCLUSION

The purpose of this study was to explore the methods employed by police and the challenges faced in utilising technology to combat carjacking in selected policing precincts within Gauteng province, South Africa. It outlined the various types of innovative technologies available to law enforcement and assessed how these tools are currently used to address crime, with a specific focus on carjacking. In highlighting the scope of the issue, the study reviewed the prevalence of carjacking in South Africa and analysed the effectiveness of technological systems implemented by the South African Police Service (SAPS) — the country's primary crime prevention agency.

Findings revealed that the technologies used at the station level by SAPS are often basic and not specifically designed to address carjacking. The true effectiveness of these systems remains unclear, yet the persistence of carjacking as a serious crime underscores a pressing need for more targeted and advanced solutions. The study also identified key operational challenges in the use of current technologies, including infrastructure limitations and disruptions caused by load shedding.

In response, several recommendations were made: the establishment of SAPS-owned network satellites to ensure uninterrupted connectivity; the installation of tracking systems in SAPS vehicles to strengthen response capabilities; and the creation of a dedicated ICT crime prevention division within SAPS. This specialised unit would be tasked with the continuous upgrading and modernisation of the organisation's technological infrastructure—ensuring SAPS is better equipped to meet the demands of contemporary crime prevention.

A future study building on these conclusions could be expanded by incorporating a comparative analysis between precincts that use advanced crime prevention technologies and those reliant on basic systems, to more clearly measure the impact of technology on reducing carjacking. The research could also benefit from engaging with multiple stakeholders, including private security companies, technology providers, and community policing forums, to capture a broader picture of collaborative approaches to combating vehicle-related crime. Additionally, longitudinal data collection would help track the effectiveness of newly implemented technologies over time, offering insights into both short-term and long-term outcomes. Finally, expanding the scope beyond Gauteng to include other provinces would provide a national perspective, allowing policymakers to develop more comprehensive and evidence-based strategies for strengthening SAPS's technological capacity.

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