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The Validation of adoption model for vehicle tracking and monitoring systems in the Kenya police service

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Abstract

Purpose: The purpose of this study was to validate the adoption model for vehicle tracking and monitoring systems in the Kenya police service.

Methodology: This research used explanatory research design. The population of this research consisted of all the 110 police stations and police posts in Nairobi County. A sample of 57 police stations and police posts was selected. The research used primary data that was collected by use of questionnaires. The research used both descriptive statistics and inferential statistics in the analysis. The study further conducted structural modeling analysis using the partial least square to validate the proposed model. SPSS-Amos was used for data analysis.

Results: Validity tests proved that the variables in the model were significant in explaining the behavioral perceived usefulness and perceived ease of use of police towards vehicle tracking and monitoring systems use. Perceived Usefulness and Perceived Ease of Use were also significant in explaining the behavioral intention to use of police towards vehicle tracking and monitoring systems use. The final model accounted for a significant variance of behavioral intention towards vehicle tracking and monitoring systems use.

Unique contribution to theory, practice and policy: Based on the study findings, the study recommends that the Kenya police service should consider adopting the proposed model in implementing vehicle tracking and monitoring systems. The research sets a baseline from a demand side point of view to enable supply side (developers) can use this information to see how best to develop tracking systems that would appeal to users and be highly adopted.

Keywords: *validation adoption of model, vehicle tracking, monitoring systems*

1.0 INTRODUCTION

Many companies are starting to realise the benefits of vehicle tracking systems. The benefits cross all industries and both the commercial and public sector. Tracking makes it easier to eliminate fleet inefficiencies such as journey duplication/overlap and unscheduled journeys. It also encourages a safer, more economic driving style among mobile employees and more efficient call placing. Other benefits include reduced vehicle wear and tear and reduced administration time associated with meeting health and safety policies (Marchet, Perego & Perotti, 2009).

The potential benefits of a vehicle tracking system can be immediate, with enhanced fleet reactivity and productivity making it possible to generate a fast return on investment and increase business capacity. It can also assist with meeting the needs of government legislation and security for mobile employees (Ting, Wang &Ip, 2012).

Vehicle tracking is a way to improve company efficiency and in effect, increase profitability, especially in the business of large vehicle fleets (Hsieh, Yu, Chen & Hu, 2006). The tracking system is the enabling technology, and is the key to release the value trapped in asset management. By its non-contact, scan-based data reading characteristics, it automates the asset tracking and data acquisition that enables an enterprise to locate vehicles (cars, trucks, etc.) and even uses location information to optimize services. With the help of tracking information, the manager is able to access one or more driver locations and gets their status information on a real-time basis (for instance, checking if the drivers execute the order; if they follow the driving routes; if there is any traffic congestion (Roh, Kunnathur &Tarafdar, 2009).

Numerous studies suggest that Radio Frequency Identification (RFID) technology can provide improved container handling efficiency; however, there is a relative lack of research concerning adoption of tracking and monitoring systems of police vehicle movement in the security operations. This study therefore aims to formulate a model for the adoption of tracking and monitoring systems for police vehicles in the Kenyan police service.

The vehicle tracking systems that is applied to security and safety is rapidly being tested and piloted and it has remained a matter of several government reports and legislative responsibility (Bharath, 2013;Ripplinger & Brand-Sargent, 2010; Rahul, 2014).The vehicle industry has been adopting the use of vehicle tracking for a several reasons, particularly the efficiency achieved by better fleet management of both drivers and assets such as trucks or tractors)(Elshafee, EIMenshawi & Saeed, 2013).

Keeping track of all vehicle movements has been made possible and easier by vehicle tracking and monitoring systems. The motor tracking systems makes use of techniques such as the Geographical Positioning Software (GPS) and radio navigation system which function through satellites and ground based stations (Bharath, 2013; Ripplinger & Brand-Sargent, 2010; Rahul, 2014). There is widespread use of the motor tracking system in commercial operations such as fleet management (Elshafee, EIMenshawi & Saeed, 2013). Non commercial activities such as monitoring employee driving behavior and vehicle theft prevention also make use of the tracking system. This is made possible by following the signal emitted by the motor tracking system to locate the vehicle.

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Transmissions from orbiting satellites are picked up by GPS which is then used by on-vehicle technology to calculate location (Ripplinger & Brand-Sargent, 2010). Other vehicle tracking and monitoring technologies include the Automatic Vehicle Location (AVL) and the Radio Frequency Identification (RFID).The origins of use of RFID technology date back to World War II, when it was used to detect friendly aircraft (Hasan, Rahman, Haque & Rasheed, 2009).

Vehicle tracking holds the promise of reducing risks created by unsafe driving practices and by terrorist attacks. Insurance companies that are looking at available methods and technologies as well as commercial best practices no doubt will increasingly factor vehicle tracking into their appraisal of each company's overall posture, which will in turn influence insurance rates (Rahul, 2014).Vehicle tracking results in higher efficiency and productivity (Rahul, 2014). There are various reasons for low adoption of these vehicle tracking and monitoring softwares in Kenya including criticisms of invasion of privacy by GPS and that the cost of implementing RFID is high and this poses a hindrance to its implementation (Lai, Ngai & Cheng, 2005).

In the past decade, the service has come under scrutiny over rampant corruption, high crime rates and abuse of office by senior officers (Auerbach, 2003; Cheng, 2005; Rahul, 2014). In an effort to improve accountability in the force, this study discusses the factors influencing adoption of vehicle tracking and monitoring system in the Kenyan police service.

1.2 Statement of the Problem

In the past decade, the Kenyan Police service has come under scrutiny over rampant corruption, high crime rates and abuse of office by senior officers (Auerbach, 2003; Cheng, 2005; Rahul, 2014).Recently, the Police service issued a warning on the Police vehicle stolen during Lamu terror attack. The Police Inspector General warned the public to be vigilant, cautioning that the police vehicle stolen with registration number GKB 595J could be used by criminals or terrorists to commit crime in any part of the country (Ombati, 2015). This is an indicator of the poor vehicle tracking and monitoring measures by the police service.

A spot-check on the Kenya police revealed that presence of patrol cars in the streets has not increased as was expected, in the wake of the leasing of hundreds of emergency response vehicles to the police in 2014. Juniors on routine easily drive away from areas they are supposed to patrol and move to other zones dotted with bars and night clubs, as well as matatu termini with the aim of collecting bribes. Rogue officers also ensure the fuel consumed while the cars are used for personal errands is paid for by the taxpayer. The cars are fuelled at stations authorized by the service on the pretext the car is on official duty (Ombati, 2015).

Effective use of the existing resources is likely to better service delivery. It is therefore imperative to validate the adoption model for tracking and monitoring systems in the Kenyan police service.

1.3 Objectives of the Study

i. To validate the adoption model for vehicle tracking and monitoring systems in the Kenya police service

2.0 LITERATURE REVIEW

2.1 Radio Frequency Identification Model

Abad *et al.* (2009) developed an RFID-based system for traceability and cold chain monitoring of food. Wang et al. (2009) proposed a RFID-based decision support system to monitor, trace and track products in containers. Chao and Lin (2009) analyzed critical factors affecting the adoption of a container security service, which is composed of auto-detection and RFID technologies, from the shippers' perspective.

Cao and Xiao (2011) analyzed a propagation prediction model and the performance of a container vehicle tracking systems under metallic container production circumstances. These applications encourage study of RFID to realize vehicle tracking in container terminals. However, although numerous studies involving the installation of RFID have demonstrated the benefits of better container handling efficiency, a relative lack of research concerning tracking and monitoring vehicle movement in the container terminal environment is appearance.

There is another technique based on cellular infrastructure. Network Overlay Systems use cell phone infrastructure for locating vehicles (Kane, Vermaa & Jaina, 2008). The cell centers with additional hardware and software assess the time of arrival (TOA) and angle of arrival (AOA) of radio signals from vehicles to compute the position of the vehicles. This information is sent to the tracking center through the cell link or a conventional link. Another technique used for locating vehicles computes the time difference for signals from two cell centers to reach the vehicle. This computation is made in a public platform and the position information is sent to the tracking center through the cell phone link. Unfortunately this approach cannot get the vehicle locations fairly accurately.

Ayers, Wu, and Anderson (2004) evaluated the use of the GPS35-HVS GPS for vehicle tracking and found that GPS was able to monitor a vehicle position and dynamic properties. However there are still some limitations with GPS. On average, a satellite navigation receiver is accurate to within 15 m. A number of positioning errors can occur, limiting accuracy to within 15–25 m. The positioning errors are supposed to intensify when a fast moving vehicle is to be tracked and immediate longitude and latitude calculations are to be carried out (Kane et al., 2008). Additionally, GPS focuses on location tracking not objective tracking.

The use barcodes is also a common technology for vehicle tracking. For easy identifying and tracing of products and containers, barcode technology had been used in products and containers management for several years. Nowadays, RFID is beginning to replace barcode techniques because of the limitations of the old technology, especially in logistics. Compared with barcodes, RFID enables the capturing of real-time information in fast moving and bulky product flows with the aim of achieving a high degree of efficiency and assuring high quality (Marchet, Perego and Perotti, 2009).

2.2 Empirical Review

Karake (2014) investigated the factors affecting the adoption of electronic policing in the police service. The study found that the police service had adopted electronic identification, police-public interface, centralized information storehouse, radio frequency identification (RFID) and electronic transport (E-Transport) systems. Further, the service had adopted online verification and fingerprints reader, real-time Information access, closed circuit television (CCTV) and intelligent sensors systems in crime control in Nairobi County. The study concluded that the adoption of e policing had significantly increased efficiency in crime control. The study mentioned that difficulties of integrating existing systems with electronic policing systems and perceived loss of control are some of the challenges in the adoption of e policing.

Wang and Potter (2007) assessed the introduction of tracking system in the shipping industry in the UK. Findings revealed that tracking system was still not well adopted but with possibility of higher levels of adoption in days to come. There exists a contextual gap as the study focused on the shipping industry and not the police service. The geographical scope also differs from the current study as it was not carried out in Kenya but in the UK.

Bett (2012) examined the adoption and impact of GPS technology on motor vehicle insurance in Kenya's insurance industry. The study revealed that the adoption of GPS tracking systems by insurance firms was low. This is because it focused on Lorries and trucks only. The study failed to address the factors that influence adoption of vehicle tracking systems by the police service in Kenya. This is a research gap that the current study wishes to address by focusing on factors of adoption such as ease of use, perceived usefulness, and availability of resources and awareness of vehicle tracking systems.

Ngugi, Were and Titany (2012) explored the determinants of service delivery in the Kenya Police Service. ICT adoption was found to be a significant determinant of service delivery. Despite the population of this study being the same as that of the current study, it ignored the issue of adoption of vehicle tracking and monitoring systems in the Kenya police service. Investment cost is one of the significant factors affecting the implementation of RFID systems (Ngai, et al., 2010). In Ngai, et al., (2010) study, the total setup cost (including the readers, tags, software, etc.) was around HK$ 6.5 million to track and trace 600 vehicles (with 100% tag readability).

3.0 RESEARCH METHODOLOGY

This study used explanatory research design. The population of this study consisted of all police stations and police posts in Nairobi County either having or not having a vehicle monitoring and tracking system. The number of police stations and police posts in Nairobi County is 110. A sample size of 57 police posts and police stations was used. This study utilized primary data in order to answer the stated research questions. Pilot test was carried on of 10 police posts in Nairobi. Validity of research instrument was checked by subjecting the questionnaire to experts. Structural modeling analysis was done using the partial least square to validate the proposed model. SPSS-Amos was used for data analysis.

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4.0 RESEARCH FINDINGS AND DISCUSSION

4.1 Response Rate

The total number of questionnaires distributed for this study was 114. The study sampled 2 policemen/women for each 57 police stations sampled. Out of the total of 114, 105 were properly filled and returned which represents a response rate of 92.1%. According to Mugenda and Mugenda (2003) a response rate of above 50% is adequate for a descriptive study.

4.2 Demographic Characteristics

4.2.1 Gender of the Respondents

The findings indicate that majority of the respondents who participated in this study were male. This was represented by 78% of the respondents. The female respondents were 22% of the total respondents. The gender of respondents may have influenced the level of adoption of vehicle tracking and monitoring software.

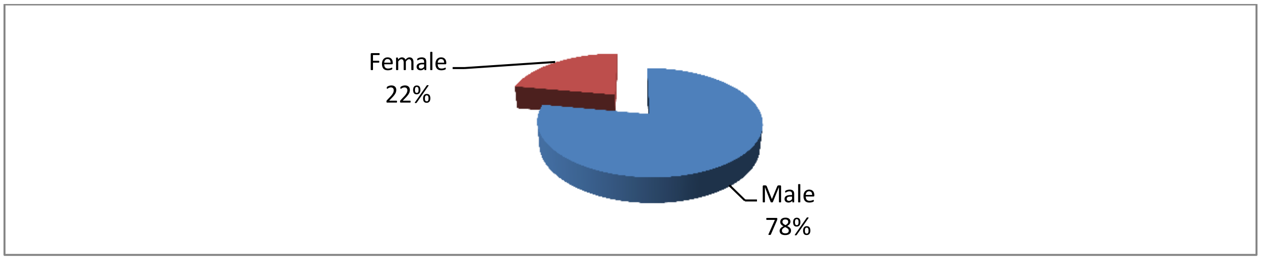

Figure 1 Gender of the Respondents

4.2.2 Rank of the Respondents

The study also sought to find out the rank of the respondents.

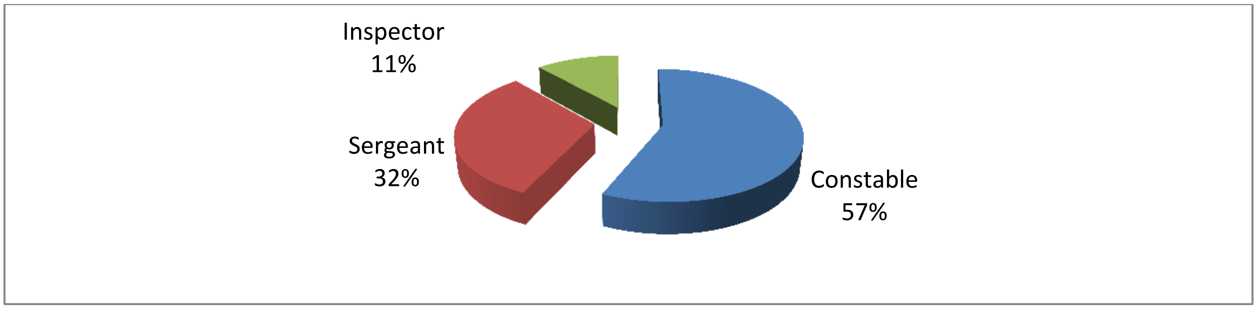

Figure 2 Rank of the Respondents

The results indicate that majority (57%) were at constable level. Those at sergeant and inspector level were 32% and 11% respectively. The rank of respondents may have influenced the level of adoption of vehicle tracking and monitoring software.

4.2.3 Work Experience of the Respondents

The study sought to find out the number of years the respondents had worked with the Kenya police service.

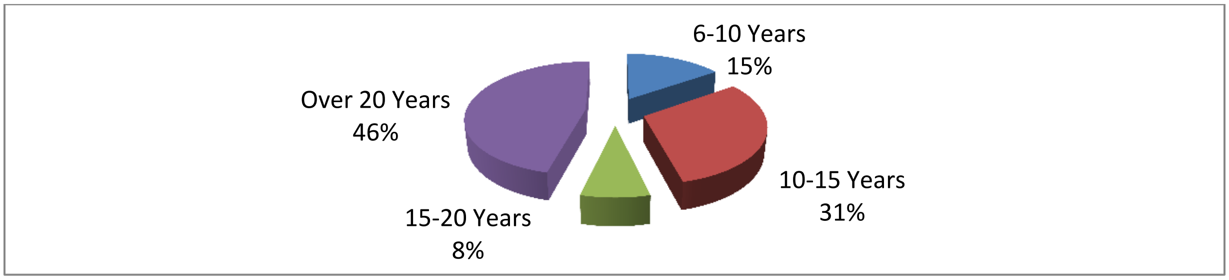

Figure 3 Work Experience of the Respondents

The findings indicate that majority (46%) of the respondents had worked with the Kenya police service for over 20 years. those that had worked for between 10-15 years were 31% while 15% indicated to have worked for between 6-10 years. Those who had between 15-20 years work experience were the least at 8%.The work experience of respondents may have have influenced the level of adoption of vehicle tracking and monitoring software.

4.3 Confirmatory factor analysis of proposed model assessment and validation

4.3.1 Regression Weights-Default Model

The results from the structural model conducted are shown in Table 1.

Table 1 Regression Weights: (Group number 1 - Default model)

Relationship			Hypotheses	Estimate	P-value	Decision
PU	<---	Tech Awareness	*HO_2*	.290	.004	Null Rejected
PU	<---	Environmental	*HO_5*	.385	***	Null Rejected
PU	<---	Financial	*HO_8*	.098	.329	Accepted
PEOU	<---	Financial	*HO_7*	.266	.007	Null Rejected
PEOU	<---	Technology complexity	*HO_{10}*	.051	.589	Accepted
PU	<---	Technology complexity	*HO_{11}*	-.165	.085	Accepted
PEOU	<---	Environmental	*HO_4*	.167	.058	Accepted
PEOU	<---	Awareness	*HO_1*	.231	.021	Null Rejected
Intention	<---	PU	*HO_{14}*	.129	.077	Accepted
Intention	<---	PEOU	*HO_{13}*	.392	***	Null Rejected
Adoption	<---	Intention	*HO_{15}*	.172	.023	Null Rejected

The p-value of below 0.05 implies that the null hypothesis was rejected meaning that the relationship was statistically significant. The result shows that the relationship between technology awareness, environmental context and technology complexity was statistically significant to Perceived Usefulness. Whereas financial resources and technology awareness was statistically significant to Perceived ease of use implying the two factor influenced Perceived ease of use. Perceived ease of use also had statistically significant relationship with intention to use. The results further imply that the intention to use significantly influenced adoption of the vehicle tracking systems. The relationship whose p-value was greater than 0.05 (Null hypothesis was accepted) imply insignificant relationship.

4.3.2 Covariance -Default model

The covariance analysis was conducted to measure of how much two random variables change together. The results show that the covariance of the study variables was significant implying that variables change together. The positive covariance indicates the variables increased together.

Table 2 Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Awareness Mean	<-->	Environmental Mean	.017	.019	.879	.379	
Environmental Mean	<-->	Financial Mean	.104	.024	4.262	***	
Financial Mean	<-->	Technology complexity	.068	.021	3.251	.001	
Environmental Mean	<-->	Technology complexity	.061	.022	2.782	.005	
Awareness Mean	<-->	Financial Mean	.057	.019	3.001	.003	
Awareness Mean	<-->	Technology Mean	.043	.018	2.404	.016	

4.3.3 Model Fitness Summary

To assess the model fitness the study used confirmatory factor analysis. The results for CMIN/DF, RMR, GFI and RMSEA that were used to test the goodness of fit of the model are given in table 3.

Table 3 CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	25	121.804	11	.000	11.073
Saturated model	36	.000	0		
Independence model	8	277.951	28	.000	9.927

CMIN is a Chi-square statistic comparing the tested model and the independence model to the saturated model. CMIN/DF, the relative chi-square, is an index of how much the fit of data to model has been reduced by dropping one or more paths. The value of CMIN/DF is above the threshold of 5 meaning the model has good fitness. The P-value of less than 0.05 indicates poor fit.

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Table 4 RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.024	.826	.431	.252
Saturated model	.000	1.000		
Independence model	.058	.532	.398	.414

GFI, the goodness of fit index, tells you what proportion of the variance in the sample variance covariance matrix were accounted for by the model. This should exceed .9 for a good model. The GFI was .826 which is close to .9 implying the model was okay. AGFI (adjusted GFI) is an alternate GFI index in which the value of the index is adjusted for the number of parameters in the model. The fewer the number of parameters in the model relative to the number of data points (variances and covariances in the sample variance-covariance matrix), the closer the AGFI will be to the GFI.

Table 5 RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.313	.264	.364	.000
Independence model	.294	.263	.326	.000

The Root Mean Square Error of Approximation (RMSEA) estimates lack of fit compared to the saturated model. RMSEA of .05 or less indicates good fit, and .08 or less adequate fit. LO 90 and HI 90 are the lower and upper ends of a 90% confidence interval on this estimate. PCLOSE is the *p* value testing the null that RMSEA is no greater than .05. The χ_2 statistic for model fit is significant, meaning that the null hypothesis of a good fit to the data can be rejected. The RMSEA likewise suggests that the fit of the model is questionable. The value of .313 exceeds the .05 suggested as a cut-off for accepting the model fit.

4.3.4 Validated Model

The overall model fit appears quite good. The χ_2 test yields a value of 121.804 which, evaluated with 11 degrees of freedom, has a corresponding p-value of .143. This p-value is too high to reject the null of a good fit.

Table 6Model Notes

Result (Default model)
Chi-square = 121.804
Degrees of freedom = 11
Probability level = .143

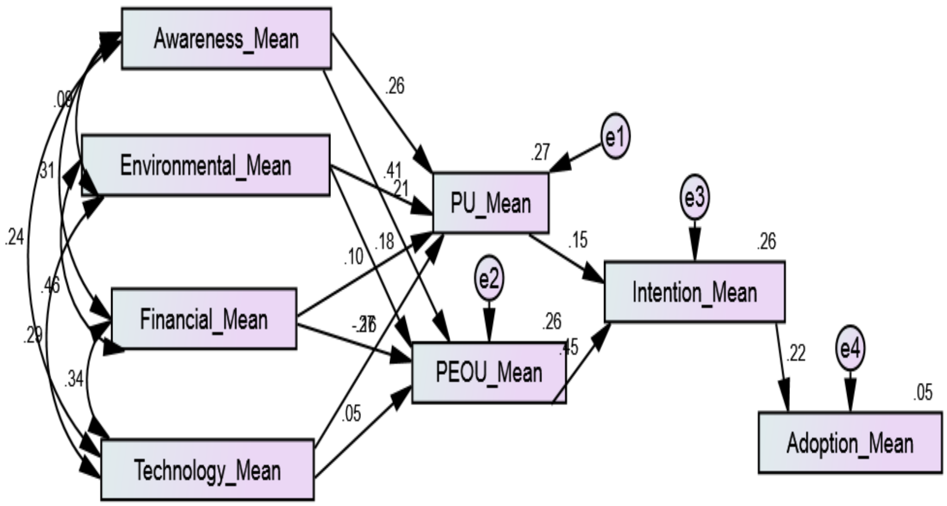

Figure 4 Validated Model

The result in the validated model indicates that technological awareness, environmental context, financial resources and technological complexity account for 27% for the variation in PU. The same variables account for 26% for the variation in PEOU. The results also show that PU and PEOU account for 26% of the variation in Intention to use.

5.0 DISCUSSION CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussions

The findings of this study indicate that technology awareness, environmental context and technology complexity was statistically significant to Perceived Usefulness. These findings concur with those of Nzomoi *et al.* (2007) who sought to establish the factors influencing technology adoption in the horticultural sector in Kenya.

The study also established that the relationship between technology awareness, environmental context and technology complexity was statistically significant to Perceived Usefulness. Whereas financial resources and technology awareness was statistically significant to Perceived ease of use implying the two factor influenced Perceived ease of use. Perceived ease of use also had statistically significant relationship with intention to use. The results further imply that the intention to use significantly influenced adoption of the vehicle tracking systems.

5.2 Conclusions

This study aimed to propose a vehicle tracking and monitoring systems adoption model from the perspective of Kenya police service. Validity tests have proved that the following variables and their corresponding dimension of the model were significant in explaining the behavioral perceived usefulness and perceived ease of use of police towards vehicle tracking and monitoring systems use.

5.2 Recommendations

Based on the study findings, the study recommends that the Kenya police service should consider adopting the proposed model in implementing vehicle tracking and monitoring systems. The study also recommends that the Kenya police service should train their officers on the vehicle tracking and monitoring systems. Kenya police service should also allocate funds in their budget to implement the installation and training on tracking and monitoring systems.

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