Accelerating Application of Science in Solving Crime: An Analysis of Individual and Institutional Predictors of the Adoption of Forensic Science in Kenya.

1.Dennis Miano: Lecturer, Institute of Criminology Forensic and Security Studies, Dedan Kimathi University of Technology, Kenya. P.O. Box Private Bag, 10143, Nyeri, Kenya, Email: jomiano@gmail.com

2. Dr. Kathleen Ayako Anangwe: Lecturer, Department of Sociology and Social Work, The University of Nairobi, Kenya.

3 Dr. Kiemo Karatu: Lecturer, Department of Sociology and Social Work, The University of Nairobi, Kenya.

Abstract

The application of forensic science (FS) in the criminal investigation remains a global issue. Scholarly literature indicates that factors accelerating the adoption of forensic technology vary from individual to institutional factors, however, scanty research investigating individual or institutional factors accelerating the adoption of FS. This paper examined predictors of the adoption of forensic science and analyzed their significance in accelerating the application of science in solving crime. The study was a cross-sectional descriptive study grounded the on social-technical system (STS) theory. Data collected from 146 respondents from the Directorate of Criminal Investigation, Kenya were analyzed quantitatively using binary logistic regression. The results show that the decomposed predictor variables, knowledge, attitude, and organizational structure were statistically significant ($p<0.05$) in predicting the adoption of forensic science, however, organizational culture was not statistically significant ($p=.686$). The composite individual and institutional factors were found to be statistically significant ($p<0.05$) in predicting the adoption of forensic science.

The study concludes that criminal investigation agencies need to focus on building individual capabilities (knowledge and attitude) and strengthening institutional factors (organizational structure) in order to accelerate the application of forensic science in crime investigation. The study recommends, to forensic practitioners, that there is need to develop strategic policy designed to build a strong forensic department founded on people subsystem (knowledge & attitude), work environment sub-system (organization structure) and availability of modern forensic technology to achieve optimal application of forensic science in solving crime.

Key Words: Forensic Science, Adoption, Individual, Institutional, Social-technical Theory.

Introduction

Forensic science (FS) is considered a self-evaluating and constantly improving phenomena making it hard to adopt in the justice process. However, its exact value is anchored on steadfast methods of scientific inquiry borrowed from natural science disciplines, that are considered truthful, consistent and dependable, making it a valuable inclusion in the criminal justice system (James & Norbdy, 2005; Budowle et al., 2009). FS is believed to offer criminal justice process more probative evidence, with a reasonable degree of efficacy and a high measure of assurance

and dependability (Julian, et al., 2011; McEwen, 2010; Murphy, 2007; Snow, 2005). In fact, it has been established that FS increases crime solvability by over 40% and yields five times more convictions (Asplen, 2014).

While FS offers enormous prospects in criminal investigation, its full potential remains unrealized, due to poor and/or slow adoption processes (Anderson, Matheis, Greathouse & Chari, 2018). Despite the huge investments in modern forensic science in most criminal justice systems, the scale of adoption is unbelievably slow and laggard. Indeed, extant literature demonstrates that there is a concerted effort toward improving application of FS in crime investigation but its laggard diffusion and outright resistance remain an inescapable impediment toward higher and faster rates of crime solvability (Anderson et al., 2018; Burch et al., 2012; National Academy of Science, 2009).

Unfortunately, even with the struggles to establish and maintain modern forensic crime investigation units, crime remains high, unresolved and a persistent source of socio-economic disenfranchisement in most countries (National Council on Administration of Justice, 2019; Sowmyya, 2014; McNutt, 2010). Indeed, in the developing countries such as Somalia, South Africa, Nigeria, and Kenya, crime rates (both violent and non-violent) remain high (Numbeo, 2020). For instance, in Kenya (Nairobi) crime index rose to a high of 61.87 in 2020 compared to 59.94 in 2018 (Numbeo, 2020) and also reported a 1.3% rise in the total number of crimes reported in 2017 (Kenya National Bureau of Statistics, 2018). In addition, Kenyans self-reported to the police over 88,268 victimization incidents in 2018, an increase of 10,276 (13%) compared to 2017 cases (NPS, 2018). These statistics paint a grim picture of the trend of crime and implore the urgent need to understand the circumstance surrounding the adoption of FS for crime solvability (Mbaya, 2016).

It is against this backdrop, that most criminal investigation agencies, even those in developing economies, continue to make huge investments in the acquisition of modern forensic science equipment and technology but the outcome in the justice process is still unsatisfactory. For instance, the United States of America spent over USD 1.5 billion annually in 2006 on modern forensic science, but the national clearance rate for homicide remained low with only about 61% success rate (National Institute of Justice Research Solicitation, 2006). In Kenya, there has been a steady and gradual investment in a modern physical forensic crime laboratory but there are

numerous backlogged cases (DCI, 2022). The Kenyan courts have reported high pending cases overtime: 530,000 (2010), 426,508 (2014), 617,582 (2020) and 649,112 (2021) while in 2017, there were over 50,000 inmates against est. 20,000 prison capacity in Kenya (over 200% occupancy) of whom 85% were pretrial detainees, meaning they had not gone through the court trial process due to lack of sufficient evidence (Judiciary of Kenya, 2021).

Nambati et al. (2020) assert that there is need for prompt adoption of FS in order to increase the rate of case clearance & crime solvability and achieve optimal value of science in criminal justice. However, a growing number of studies continue to find a disconnect between theoretical potential and huge investments directed towards forensic science versus its practice and actual value to improve case clearance and crime solvability (Shako & Kalsi, 2019; Anderson et al., 2018; West & Meterko, 2015; National Academy of Science, 2009). This disconnect can be traced back to poor and slow adoption of forensic science among criminal investigators. This research work contends that definitive value of FS, in any criminal justice system, can only be realized if the adoption of FS is prompt and yielding. Hence, the need to canvass for factors that accelerate prompt adoption of FS among investigators.

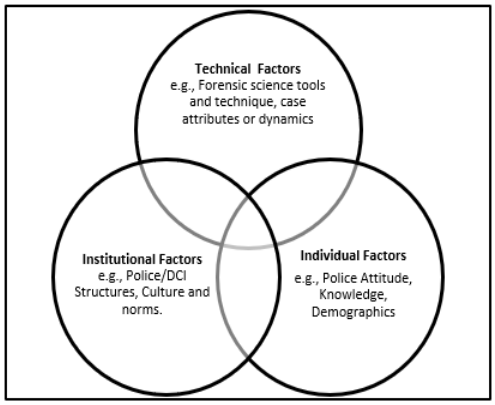
The paper present ways in which the current criminal investigation departments, particularly in the developing economies, can accelerate the adoption of FS in crime investigation. To achieve this goal, this research examines individual and institutional factors that predict the adoption of FS among investigation officers in the Kenya directorate of criminal investigation (DCI). The paper shows the significance of individual and institutional factors positively predict the adoption of FS.

Theoretical Framework

Adoption of new technology in most institutions is still challenging. In bid to find a solution, several models have been designed to explain different approaches of integrating new technology in the society or institutions. Social-technical system (STS) is one of the models. STS has an extensive conceptual and empirical contribution to the applied designs that explain and improve the adoption and performance of new technology in an organization (Applebaum, 1997; Trist, Higgin, Murray, & Pollack, 1963). STS proponents hold the view that an organization will reach its optimal status in the adoption of new technology, only if all its subsystems (technical, social and environment subsystems) work together to process input and synthesize outputs.

According to STS, a criminal justice system would achieve its optimal adoption of forensic science if all the investigation subsystems worked together. In such case, the model postulates that the technical subsystem (i.e., forensic tools and techniques) the social/individual subsystem (i.e., individual investigators skills, attitudes, values and knowledge and the environment subsystem (i.e., police institutional systems and authority structures) ought to work together if criminal justice system is to promptly and optimally adopt new forensic science technology

Figure 1.



Transformation of Institutional, Technical and Individual factors as they interact to accelerate Adoption of Forensics Science in Crime Investigation.

(Applebaum, 1997).

From the past forensic studies there is evidence of STS framework demonstrating that different factors in an organization ought to work together to facilitate the adoption of new technology. Although forensic science makes invaluable contribution to the criminal justice in different ways (Peterson et al., 2013; Baskin & Somers, 2012; Broidy, 2004), several studies contend that the contribution of FS in crime solvability is sometimes constrained by multiple factors thereby limiting its swift and seamless application (Shako & Kalsi, 2019; Anderson et al., 2018; West & Meterko, 2015; National Academy of Science, 2009). For example, past studies have readily shown that organizational management characteristics, individual attributes, technology characteristics and environmental conditions may influence the adoption and implementation of new technology (Ahuja et al., 2009; Peansupap & Walker, 2005). Indeed, organizational characteristics and individual top management background have been found to play a significant

role in the adoption of forensic accounting technique (Umar & Aliyu, 2017; Muthusamy, 2011; Bierstaker et al., 2006). In this study, it is postulated that individual and institutional sub systems play a critical role in the adoption of forensic science (technical subsystem) in criminal investigation.

Individual Factors

Individual factors are key elements in the social subsystem and describes the affective and cognitive attributes of a person (Trist, Higgin, Murray, & Pollack, 1963). The importance of individual factors in adoption studies is underscored in multiple studies. For example, in a narrative synthesis study design, individual factors such as, attitudes and knowledge were found to be key constructs in at least half of the 20 theories on adoption and diffusion of technology sampled, validating their selection for this study (Wisdom, Chor, Hoagwood & Horwitz, 2014). Their study demonstrates that individual factors, i.e., attitude and knowledge, are valid metrics of measure in designing adoption models. Although, there is strong evidence that individual factors are strong predictors of actual usage of technology (Davis, 1989; Venkatesh et al., 2003), the area remains understudied in adoption and innovation studies, especially the predictive role played by individual factors in the adoption of new technology (Serigar, Ahman & Senen, 2019; Dillon & Watson, 1996). For instance, through a structured literature review, individual factors were found to influence the adoption of safety technology in an organization, but their role in accelerating the adoption was not elaborate (Nnaji, Karakhan & Eseonu, 2019). As such, this study identifies and postulates that attitude and knowledge are the key individual factors that predict the adoption of FS.

Attitude on the Adoption of Forensic Science

Variant technology acceptance models (TAM) are premised on the claim that attitude influences any reasoned behavior (Davis, 1989; Venkatesh & Davis, 2000; Venkatesh & Bala, 2008). Although divergent views exist on the role of attitude in the adoption of forensic science, attitude remains a key cog in the formation of reasoned behavior (Park & Blenkinsopp, 2009; Altamimi, 2017). Several empirical studies have found attitude to be an important element in studying human behavior, particularly in the use of new technology (Yanga & Yoo, 2004; Oskamp & Schulz, 2005; Yalcinkaya, 2007). For instance, attitude was found to be a strong predictor of police intention to use the POLNET system (Yalcinkaya, 2007), police officer's issuance of

traffic citations (Johnson, 2011) and utilization of eService by police (Hossan & Ryan, 2018). Yet, in other forensic studies, attitude has been found to be a significant factor in the development of professional behavior in forensic accounting (Poopola, Ahmad & Samsudin, 2014) and a key foundation in forensic decision-making (Dror, 2017). Although no past study has researched the predictive role of attitude on forensic science, it is on this context that, the present study proposes that attitude is an important individual factor in predicting the adoption of forensic science in a criminal investigation.

Knowledge on the Adoption of Forensic Science

Knowledge is the second individual factor and an essential determinant in the successful execution of tasks in any profession, and lack of it can lead to incomplete and/or incorrect completions (James & Gladyshev, 2013). Although too much knowledge increases the risk of over-emphasizing and over-evaluating information and even changing decision criteria (Dror, Charlton & Peron, 2006), it is argued that a considerable amount of knowledge is required to complete tasks (Tanner and Dampier, 2010; Poopola, Ahmad & Samsudin, 2014). For instance, police forensic work, which involves collecting, preserving, analyzing and presenting scientific evidence in court, is knowledge intensive (Holgersson, Gottschalk & Dean, 2008; Chen et al., 2010). Indeed, knowledge was found to be an important contributor in reduction of vulnerabilities in fingerprints forensic science investigations (Dror, Charlton & Peron, 2006). In a different study, Edmond et al., (2016) found that knowledge in cognitive science and experimental psychology is likely to enhance capabilities and procedures in forensic science. Yet, in another study, technical knowledge and awareness was found to be important in Malaysia forensic investigation department (Rajagopal et al., 2014).

In sum, most studies, find knowledge and skills in any professional discipline important in the execution and successful completion of tasks. Aligned with these studies and TAM, this study suggests that knowledge plays an important part in the completion of forensic tasks, hence, is a key factor in predicting the adoption of FS.

Institutional Factors

Institutional predictors of technology adoption are anchored on institutional philosophy, that argues social structures are established and sustained on processes such as schemas, rules, norms, and routines which in turn become legitimate guidelines for behavior formation (Hodgson, 2006; Wells, 1970). In addition, most institutions depend upon rational individuals to take shape and form, which in turn act as agents with the ability to change individuals by shaping their decision-making process and behavior. While previous studies have found evidence that either institutional factors or organizational context influence the adoption of new technology, it still remains understudied and unclear how institutional factors can accelerate the adoption of FS (Kamal, Ibrahim & Nilashi, 2019; Alenezi, Atlam & Wills, 2019; Trojanowicz & Bucqueroux, 1990). Principally, institutional factors are studied as either organizational structures or organizational culture (Morabito, 2008). This study looks into the independent role played by either of the two elements.

Organizational Structure on the Adoption of Forensic Science

Organizational structure is the formal arrangement of an organization, represented by different characteristics in the form of rules and regulations, authority flow and duty specialization (Robbin & Coulter, 2007; Jewczyn, 2010). Most police organizations follow a Weberian model of structure that has classic bureaucratic characteristics (O'hara, 2005).

Extant literature find that police organizational structures and other institutional micro characteristics may influence police work outcome (Lee, Lim, Moore & Kim, 2013; Prenzler, 2009). For instance, police organizational characteristics such as vertical height command, specialized functional units & formal procedures and policies affect the adoption of crime analysis technology (Randol, 2014). In a different study, Power and Sanders (2013) found that organizational factors such as, organizational complexity and control of domain are linked to the adoption of new innovation. While, Kang, Nalla and Chun, (2014) found that South Korean police organizational characteristics influenced police officers' attitudes toward the adoption of technology. However, not all organizational structural characteristics positively influence adoption, some such as, governance structures, negatively inhibit the adoption and usability of a new technology (Ernest, Veen & Kop, 2021). Although different studies continue to present different facets of the role of organizational structure characteristics in the adoption of new technology, the present study undertakes that organizational structures significantly predict the adoption of FS in crime investigation.

Organizational Culture on the Adoption of Forensic Science

Organizational culture embodies norms and beliefs in an organization (Schein, 1990). Several studies come to a consensus that organizational culture has a positive association with the adoption of innovations (Aarons et al., 2011; Solomons & Spross, 2011; Gallivan 2001). For example, organizational culture was found to be a significant variable that influences a person's behavior formation, stimulate performance and corporate success and anchor the relationship between technology adoption and organizational growth (O'Hara, 2005; Chatman & Jehn, 1994). In British police studies, police culture is considered an extremely powerful variable during organizational change (Kiely and Peek, 2002). In context, forensic culture (older police officers normalizing the use of forensics) has been found to be an important factor for readiness in the adoption of forensics in a criminal investigation department (Alenezi, Atlam & Wills, 2019; Elyas, Maynard, Ahmad & Lonie, 2014). From the foregoing, culture is presumed to play a significant role in the adoption of forensic science.

In summary, this study postulates that individual and institutional factors predict the adoption of forensic science in crime investigation. More specifically, it assumes that knowledge and attitude are key attributes within individual factors that predict adoption, while organizational structure and culture are the important elements in predicting the adoption of forensic science.

Method

The paper adopted a descriptive study design. The study analyzed data collected from 146 criminal investigation officers from 14 different forensic departments at the Kenya Directorate of Criminal Investigation (DCI), a police department in Kenya mandated to conduct criminal investigations. Chi-square and logistic regression were done to show the association and predictive role of the independent variables on the dependent variable (the adoption of FS).

The dependent or outcome variable of the study is the adoption of FS. The measurement scale was coded as either 'No' [0] indicating that forensic investigators do not use forensic science procedures or equipment at all times, while 'Yes' [1] indicates the use of forensic science technology, procedures and equipment at all times, at their disposal. The study had two main independent variables, individual factors (decomposed to knowledge measured by training on forensic science, and attitude measured as several items on a Likert scale) and institutional

factors (decomposed to organizational structure and culture measured as several items on a Likert scale).

Bivariate analysis and logistic regression are used to assess the correlation and determine the significance of the association between each predictor and the adoption of forensic science in crime investigation. Data analysis was done with the help JASP 0.16.3, a social science statistical software.

Ethics

Prior to data collection, permission was granted by the National Commission for Science, Technology and Innovation (NACOSTI) after confirmation of the study's ethical adherence to the research protocol.

Test of Collinearity

The dependent variable data was normally distributed, presenting ranges not exceeding (-3 and +3), a mean of 1.53 and a standard deviation of 0.943. Tests of collinearity were done and results show tolerance levels were greater than one (>1) and the VIF was less than ten (<10) signifying that the dependent variable data does not violate the collinearity rule. Moreover, the correlation coefficient was (<.70) signifying that there is no multicollinearity.

Results

A total of 146 DCI officers responded to the study questionnaire. The majority (78.8%) were males while 21.2% were females. 47.3% of the officers had worked at the DCI for over 6-10 years, while 50% had worked in their current forensic department for less than five years, and another 36.3% had worked at their current department for less than 10 years. In regards to knowledge (formal training on FS) 47.9% of the respondents said they have received some form of formal training on FS compared to 52.1% who said they have not received any form of formal training. More specifically, out of the 70 who had received some formal training, 3.4% rated their level of training as proficient, 22.6% advanced, 12.3% intermediate, 9.6% as basic. The findings are consistent and support the literature on the ongoing efforts in training and capacity building of the DCI in the adoption of FS, but also show the gaps in the capabilities of the DCI to handle forensic-based cases.

In regards to the slow adoption of FS in crime investigation, a majority 57.5% of the respondents did not use forensic science at all the times (during the cases they investigated) compared to only 42.5% that used forensic science in all the case, always. These results are as expected and consistent with the current literature at both local and international levels that the adoption of forensic science is not at an optimal level (Nambati et al., 2020; Anderson et al., 2018; Burch et al., 2012; National Academy of Science, 2009). From the data, majority 64.5% of the total (31) female officers indicated they do not use forensic science at all times in crime investigation compared to males 57.7% of the total (115) males. This is a clear indication that more males readily use forensic science than females. Further, 80.8% of officers with only a KCSE certificate said they do not use forensic science regularly, while 53.5% of bachelor's degree holders said they use forensic science at all times. The results are as expected that officers with higher levels of education, degree and above readily adopt forensics science in crime investigation. Bivariate analysis shows that, current level of education (X^2=11.355, p<.05), level of education before joining the service (X^2=13.733, p<.05) and years of service at the DCI (X^2=10.41, p<.05) had a significant relationship with the adoption of FS. All the other variables did not present a strong association. Table 1 below presents association of demographic characteristics and the adoption of FS.

Table 1: Bivariate analysis of demographic characteristics and adoption of forensic science

Variable		**Descriptive**	**Adoption of FS**		**(X^2)**	**2-Tailed**
Demographic	**Category**	**Frequency (%)**	**No (%)**	**Yes (%)**	**Value**	**Sig (p)**
Gender	Male	115 (78.8)	64(57.7)	51(44.3)	0.785	0.376
	Female	31(21.2)	20(64.5)	11(35.5)		
Level of Education	Certificate	26(17.8)	21(80.8)	5(19.2)	11.355	**0.023**
	Diploma	39(26.7)	25(64.1)	14(35.9)		
	Bachelor	71(48.6)	33(46.5)	38(53.5)		
	Masters	9(6.2)	5(55.6)	4(44.4)		
	Doctorate	1(.7)		1(100)		
Level of Education before service	Certificate	79(54.1)	56(70.9)	23(29.1)	13.733	**0.001**
	Diploma	26(17.8)	13(50)	13(50)		
	Bachelor	41(28.1)	15(36.6)	26(63.4)		
YoSDCI	Less than 5 Years	29(19.9)	22(75.9)	7(24.1)	10.41	**0.064**
	6-10 Years	69(47.3)	33(47.8)	36(52.2)		
	11-15 Years	20(13.7)	10(50)	10(50)		
	16-20 Years	15(10.3)	9(60)	6(40)		
	21-25 Years	4(2.7)	4(100)			
	26 Years and Above	9(6.2)	6(66.7)	3(33.3)		
YoSCS	Less than 5 Years	73(50)	47(64.4)	26(35.6)	3.832	0.429
	6-10 Years	53(36.3)	26(49.1)	27(50.9)		
	11-15 Years	12(8.2)	6(50)	6(50)		

	16-20 Years	4(2.7)	2(50)	2(50)		
	21-25 Years	4(2.7)	3(75)	1(25)		
Police Ranks	Senior Assistant Inspector General	1(0.7)		1(100)	7.486	0.679
	Senior Superintendent	2(1.4)	2(100)			
	Superintendent	2(1.4)		2(100)		
	Assistant Superintendent	1(0.7)		1(100)		
	Chief Inspector	19(13)	12(63.2)	7(36.8)		
	Police Inspector	27(18.5)	15(55.6)	12(44.6)		
	Senior Sergeant	2(1.4)	1(50)	1(50)		
	Police Sergeant	15(10.3)	9(60)	6(40)		
	Police Corporal	22(15.1)	12(54.5)	10(45.5)		
	Police Constable	50(34.2)	30(60)	20(40)		
	Not Applicable	5(3.4)	3(60)	2(40)		
Service Formation	National Police Service	126(86.3)	74(58.7)	52(41.3)	7.486	0.679
	Kenya Defense Forces	7(4.8)	3(42.9)	4(57.1)		
	Any Other	13(8.9)	7(53.8)	6(46.2)		
Dichotomized Variables						
Favorite Subject in School	Non-Science	45(30.8)	31(68.9)	14(31.1)	3.433	**0.064**
	Science	101(62.9)	53(52.5)	48(47.5)		
Police Ranks	Gazetted Officer	52(35.6)	29(55.8)	23(44.2)	0.108	0.948
	Non-Gazetted officer	89(61)	52(58.4)	37(41.6)		
	Others	5(3.4)	3(60)	2(40)		

YoSDCI – Years of Service at the DCI; YoSCS – Years of Service at the Current Service.
Source Data: Author 2022

In regards to factors predicting the adoption of FS, the two composite variables individual and institutional factors were statistically significant to the model. The logistic regression summary model for the two composite factors was statistically significant $X^2(2) = 100.12$, $p<0.001$, suggesting that the model could distinguish between those who could and could not adopt FS upon interventions of the two factors. The model explained between 50.3% (McFadden's R^2) to 66.7% (Nagelkerke R^2) of the variance in the dependent variable and correctly classified 82.2% of the cases. From the data, the individual factor model was statistically significant ($X^2(1) = 62.796$, $p<0.001$), and was able to explain 31.5% (McFadden R^2) to 47% (Nagelkerke R^2) of the variance. The individual factor was statistically significant ($p<0.001$) with an odds ratio (OR) of 84.178, suggesting that an increase by one unit of individual factors would increase the likelihood adopting FS by 84.178 units. The institutional factor model was statistically significant ($X^2(1) = 74.701$, $p<0.001$) with an (OR, 13.082; $p<0.001$; 95% CI, 1.2:3.9). This suggests that there was a strong and positive relationship. The results mean that one unit increase in institutional factors would increase the likelihood of adopting forensic science by 13.082 units. The results are presented in table 2 below.

Table 2: Logistic Regression of Individual and Institutional factors and the Adoption of FS.

					Wald Test			95% CI	
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**	**Lower bound**	**Upper bound**
1. Individual Factors	4.433	1.082	84.178	-5.668	32.128	1	**< .001*** **	2.313	3.065
a). Attitude	1.835	0.628	6.267	2.925	8.555	1	**< .003***	0.605	3.487
b). Knowledge	2.490	0.934	12.065	2.688	7.116	1	**< .008***	0.661	4.320
2. Institutional Factors	2.571	0.683	13.082	3.767	14.191	1	**< .001*** **	1.233	3.909
a). Org' Structure	1.083	0.533	2.953	2.033	4.133	1	**< .042***	0.039	2.127
b). Org' Culture	0.167	0.414	1.182	0.404	0.163	1	0.686	-0.644	0.979

Note. Adoption FS level 'Yes' coded as class 1; Predicted probability is of membership for Yes
*p<.05; **p<0.01; ***p<0.001

Source Data: Author 2022

In regards to the decomposed variables (knowledge, attitude, organizational structure and culture) and the adoption of FS. The logistic regression summary model was statistically significant ($X^2(1) = 73.959$, $p<0.001$). The decomposed variables regression model was able to classify 80.1% of the cases and explain about 37.2% (McFadden R^2) to 53.4% (Nagelkerke R^2) of the variance in the model. This means that independent predictor variables, knowledge, attitude, organizational structure and culture affected the likelihood of adoption. Separately, attitude (OR, 6.267; p<.003; 95% CI, 0.6:3.5), knowledge (OR, 12.065; p<.008; 95% CI, 0.7:4.3) and organizational structure (OR, 2.953; p<.042; 95% CI, 0.03:2.1), were all statistically significant in predicting the adoption of FS. However, organizational culture was not statistically significant in predicting the adoption of forensic science. In summary, the results suggest that a unit increase in attitude, knowledge and organizational structure would respectively see a 6, 12 and 3 times increase in likelihood of adoption. The results are presented in table 2 above.

Discussion

Social-technical system (STS) theory claims that there is a need to maintain a symbiotic relationship between technology, people and work environment sub-systems for optimal utilization of new technology in an organization (Applebaum, 1997; Trist, Higgin, Murray, & Pollack, 1963). In this study on forensic science and technology, police officers working as criminal investigators and the directorate of criminal investigation working environment are theorized to interrelate for optimal, efficient and effective adoption of FS in criminal investigations. To this end, the study investigated the role of the individual (social sub-system) and institutional (environmental sub-system) in predicting adoption of FS (Technical sub-system) in crime investigation. By so doing, the study simulated individual and institutional

factors that would accelerate the adoption of new forensic science technology in a criminal investigation department.

As presented in the STS, the results show that individual factors and institutional factors are important variables in the adoption of FS. In fact, both variables were found to be statistically significant ($p<.001$) in predicting the adoption of FS. Although the study was done in a developing country the results are consistent with previous global studies on the two broad variables, i.e., individual factors (Davis, 1975; Venkatash et al., 2003; Wisdom, Chor, Hoagwood & Horwitz, 2014) and institutional factors (Kamal, Ibrahim & Nilashi, 2019; Alenezi, Atlam & Wills, 2019; Trojanowicz & Bucqueroux, 1990; Bingham, 1978). These results confirm that individual and institutional factors, whether studied in different contexts, play a significant role in predicting adoption and thereby vital accelerants in the adoption of new technology.

In the decomposed variables case, the study found that independently: attitude, knowledge and organizational structure were statistically significant ($p<.05$) in predicting the adoption of FS in crime investigation. However, organizational culture was not statistically significant. The findings show that attitude was an important predictor of adoption is consistent with previous studies that support positive attitude toward technology can influence it's use (Yalcinkaya, 2007; Johnson, 2011; Poopola, Ahmad & Samsudin, 2014; Hossan, 2016; Dror, 2017). Similarly, knowledge was found to be statistically significant ($p<.05$) in predicting adoption, consistent with previous studies in different disciplines like management and police studies (Dror, Charlton & Peron, 2006; Rajagopal et al., 2014; Edmond, et al., 2016). Further, knowledge which is represented by training in forensics science is consistent with the strong positive association in the bivariate analysis on levels of education and regression on the adoption of FS. Generally, higher education was associated with higher chances in the adoption of FS compared to lower levels of education. Finally, organizational structures are statistically significant ($p<.05$) in predicting application of FS. In police studies, police structures are strictly upheld and that could give an explanation for the results, consistent with previous studies (Power & Sanders, 2013; Randol, 2014; Kang, Nalla & Chun, 2014). Although organizational culture was found to be significant in the previous studies (Alenezi, Atlam & Wills, 2019; Elyas, Maynard, Ahmad & Lonie, 2014), this study did not find it statistically significant ($p=0.686$) in contributing to the prediction model.

While past studies have found conflicting results in the attributes under study, the study findings provide a baseline foundational requirement on which the adoption of forensic science in Kenya and other developing nation can thrive. The study findings imply that education and experience stand out as key elements in the selection of adoption of forensic science. However, it is important to follow through with more focused studies with different models to confirm the role of culture in the adoption of forensic science.

Conclusion

In conclusion, individual factors and institutional factors contribute significantly to the application of FS in crime investigation. More specifically, attitude, knowledge, and organizational structures play a significant role in predicting the adoption of FS. The contributions of attitude, knowledge and organizational structure in the prediction of the adoption of FS model suggest that they are fundamental in optimal use of science in solving crime. As such the interrelation of the three elements create an environment that accelerate the adoption of FS. It is argued in the study that the three pillars form a good foundation for accelerating the adoption of FS in developing economies. To this end, this study concludes that there is a need for a deliberate contemplation of attitude towards new technology, consideration of quality and levels of education during recruitment, continuous professional education and efforts to build police officer's capacity to the accelerate use of FS in crime investigation. In addition, there is a need to streamline police organizational structures in every forensic department to guarantee efficient and effective forensic investigations. Although culture was not found to be significant, there is a need to conduct further research in the area to ascertain if there is any contribution to the adoption of technology.

Limitation of the Study

The study was limited in the sense, no qualitative data was collected, the approach to questions was self-report and no key informants' interviews were conducted to provide more in-depth perspective on forensic science use. Also, it is envisaged that the study would have yielded more comprehensive results if it was a longitudinal study and direct observation approach was applied in collecting data as compared to the cross-sectional approach applied.

Declaration of Competing Interest

The authors declare that they have no known competing personal or financial interests that influenced this research work.

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