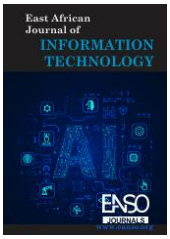

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Original Article

An Improved Systematic Management Model for CCTV Footage in Police Criminal Investigations. A Case Study of Uganda Police Force

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ABSTRACT

Criminal investigations with CCTV footage are still having a lot of challenges being faced most especially in relation to footage management. A qualitative comparative study involving getting opinions from the experienced CCTV management team and the investigation team has been conducted to gather some information regarding the current CCTV management model. These findings were compared with the challenges reported by several media and individuals. The study revealed inadequate CCTV system audits, unauthorised footage recordings with personal devices by staff, footage leakages to social media, insufficient training for some staff, low coordination between Uganda Police Force CCTV management and stakeholders involved in road constructions, water supply constructions, billboard installations and electricity supply operations that interrupts CCTV camera operations in case of unexpected occurrences of their related activities. An improved model that involves cloud-based system audits, footage automated shutdown up-on detection of recording devices, cloud-based footage analysis and automated system backups have been incorporated into the current CCTV management model. The system computerisation procedure for the improved model have as well been outlined.

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INTRODUCTION

Criminal investigation had been one of the most challenging tasks across the entire world simply because it is a multi-faceted, problem-solving challenge that involves arriving at the crime scene and rapidly making critical decisions, sometimes involving life and death [1]. This is normally based on limited information in a dynamic environment, and after a criminal event is over, the investigator is expected to preserve the crime scene, collect the evidence, and devise an investigative plan that will lead to the forming of reasonable grounds to identify, arrest and/or prosecute the person or persons responsible for the crime [2].

The evidence that is always collected from eyewitnesses is highly subject to the beliefs and inconsistent information provided by the eyewitnesses. For instance, Laney & Loftus reported that "Eyewitnesses can provide very compelling legal testimony, but rather than recording experiences flawlessly, their memories are susceptible to a variety of errors and biases. They (like the rest of us) can make errors in remembering specific details and can even remember whole events that did not actually happen" [3]. The information provided are not real facts that make prosecution of the culprits or principal suspects hard or even impossible if the court-house is least satisfied with the evidence provided [4].

Besides the mentioned challenges, preserving the crime scene alone is a difficult task that cannot be held for a long time and this greatly affects investigation processes when something at the crime scene is tempered with [38]. These therefore called for a reliable method that could strengthen investigations as well as curbing down the setbacks of physical investigations. In response to these, the security agencies tried solving the gaps by introducing full-time surveillance systems, most commonly by using Closed Circuit Televisions (CCTVs).

CCTV has proven effective in criminal investigations because of its real-time recording of crime and it creates evidence that can be used for court trials. For instance, Ashby observed "that a good-quality recording could potentially allow investigators to watch an entire incident unfolding detail, providing information about the sequence of events, the methods used and the entry and exit routes taken by the offender-:" further noting that "even if this is not possible, CCTV may be useful in corroborating or refuting other evidence of what happened, such as witness testimony". [5].

According to UK CCTV, "most investigators have been using CCTV footage to locate or confirm the identity of a suspect. They have also been using the video to determine whether an offence had occurred, observe relevant events surrounding incidents, corroborate victims and generate other investigative leads". [6]

Based on the above-mentioned use cases, CCTV footage had accounted for the preservation of crime scenes since the video can easily be preserved and stored for a very long time. The use cases are a great

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achievement as far as a criminal investigation is concerned. However, Saferspaces clearly mentioned on its website that "there are drawbacks and complexities concerning the public use of CCTV". [7].

CCTV usage in criminal investigation has had drawbacks as earlier quoted from the statement made by Saferspaces on their website [7]. These drawbacks included the mishandling of footage, lack of proper procedures to be followed for acquiring footage, the sudden disappearance of footage, and sudden disconnection of CCTV cameras, amongst others. For instance, in China, there was disbelief during an investigation that part of the footage that would have been captured on CCTV had not been captured [8].

A report on Mail Online News of the UK stated that "Crucial security camera footage had 'gone missing'" [9]. In Uganda, a new vision paper reported in March 2020 that several incidents had happened in Kampala Metropolitan Policing (KMP) area, where there are cameras, but the footage capturing them had gone missing [10]. The Newspaper also published that "When the image of a suspect is clearly captured by the cameras, most times the investigating officers settle the case with the suspects upon showing them the footage". A senior officer also anonymously revealed that on many occasions, requests for footage by investigators were made after the footage retention period had expired [10].

Since the CCTV network brings in the functionality of linking cameras together and all work together to link a suspect and as well administration point according to the Ministry of Finance, Planning and Economic Development [11], it is obvious that all that was happening and many more were as a result of ineffective footage management. Gillwald et al. also evident that Uganda needed to have done some things differently to ensure improved outcomes in addressing inconsistencies in policy that affect the information and communication technology (ICT) sector [12]. In other words, the inconsistencies in the ICT sector of the Uganda Police Force, especially in the Close Circuit Television monitoring system are the inconsistencies in its management model pipeline that could further reduce the drawbacks of this technology in criminal investigations. Otherwise, this study looked at the improvement of the current CCTV footage management model for Police criminal investigation.

Concept of a Good CCTV Management Model

An Improved CCTV management model for CCTV footage highly depends on the level of Command Centre security, full capacity recruitment of qualified staff, quality assurance, maintenance and proper disclosure protocol [42][41][40][39].

The high level of Command Centre security and full-capacity recruitment of qualified staff involves:

- Ensuring full capacity staffing, especially in the CCTV control room to enable the smooth running of the business
- Full access control of the CCTV room, CCTV devices and CCTV control area perimeter to ensure high security within the system and confidentiality.
- Constantly staff training and flexibility amongst staff to enable the adaption of changes and increasingly invented technologies.

Quality assurance and maintenance on the other hand, include constant system audits, footage quality maintenance process, quality assurance set-up, and real-time error alert set-up to reduce chances of malfunction at any point in time. Long retention periods, records access control, and constant and immediate backups guarantee the presence and security of footage for investigations that are long overdue.

Proper disclosure protocol, which ensures initial assessment of footage requests, formal, and timely purposive disclosure of the footage leads to an effective discloser protocol hence effective footage management model. The framework is diagrammatically presented in *Figure 1* below:

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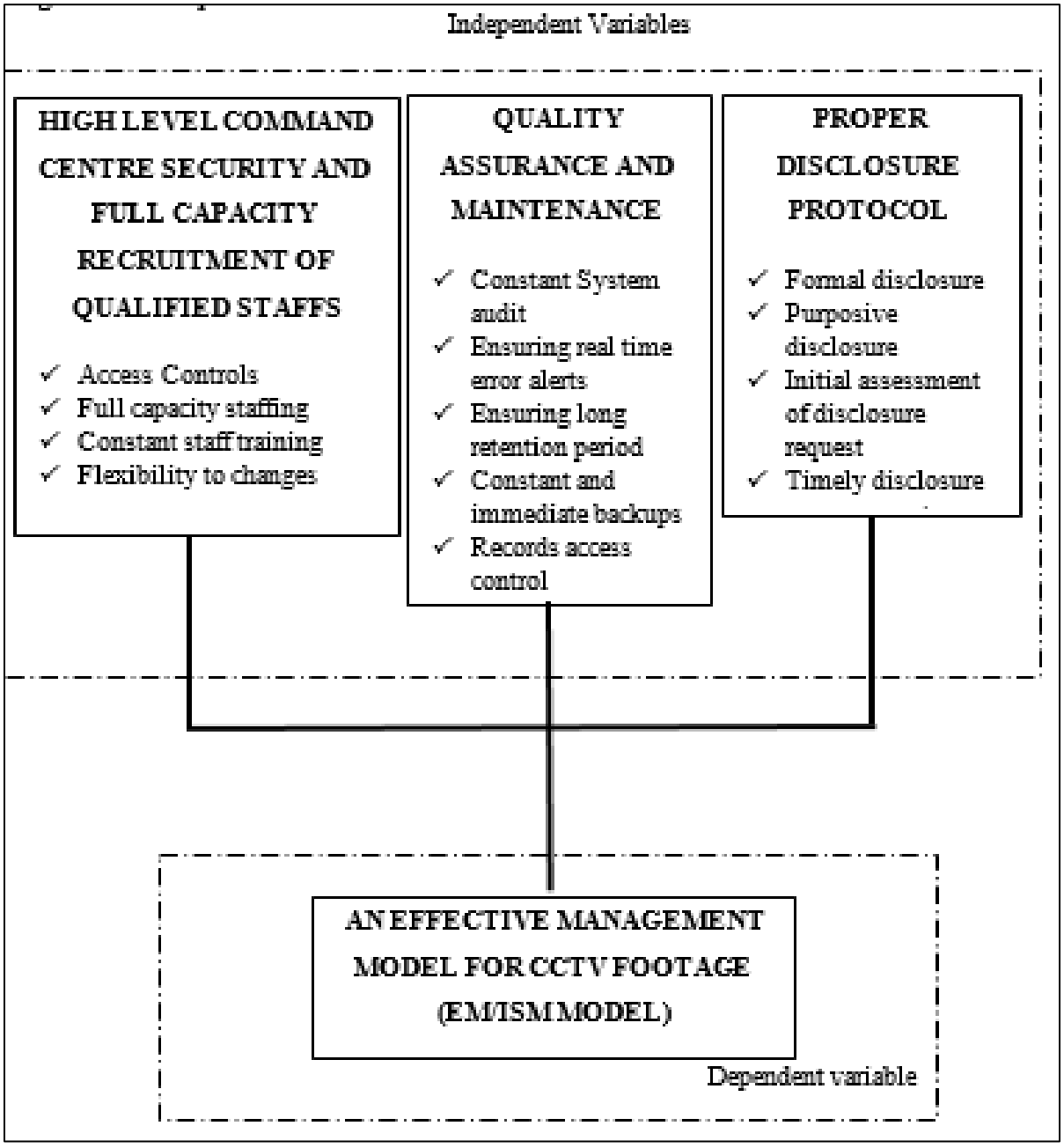
Figure 1: Conceptional framework



Objectives of the Study

- To determine the drawbacks of the current CCTV footage management model in Police criminal investigations.
- To investigate reasons for the drawback of the current CCTV management model for criminal investigation

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- To incorporate and update improvement strategies into the current CCTV footage management model
- To recommend a computerisation procedure for the improved CCTV footage management model.

METHODS

Study Design

The study adopted qualitative exploratory paradigms whereby opinions were collected from respondents through self-enumerated questionnaires with the aim of minimising the bias that could come if other parties were brought alongside the respondents. Individuals-related posts on social media and reports from media houses alongside reports from other scholars, were coherently considered in the study.

Study Strategies Used to Achieve the Objectives

The study has achieved its intended objectives through ideas availed by the respondents and the literature reviewed as described below:

Drawbacks of Current CCTV Footage Management Model for Criminal Investigation

The drawbacks of CCTV footage management have mainly been registered through public complaints on social media, newspapers, and social interaction complaints. This makes the collection of information regarding such drawbacks through self-enumerated questionnaires and in conjunction with the reviews of literature majorly from social media, newspapers and individuals experienced with handling CCTV footage-related activities more optimal.

In this study, questions about the existing challenges and other challenges reviewed from the literature were incorporated into the questionnaire seeking whether respondents agree that such challenges still exist. These therefore provided the drawbacks of CCTV footage management in criminal investigations.

Investigating reasons for the drawbacks in the current CCTV management.

The drawbacks and the reasons were observed to be best looked at together. Thus, the questionnaire comprised the queries seeking drawbacks as well as how they occurred. The literature from newspapers, social media, and ideas from CCTV system management experienced staff were considered in investigating reasons and solutions to the drawbacks.

Suggesting an Improved CCTV Footage Management Modal Pipeline for Criminal Investigation

Possible solutions obtained from respondents' ideas and literature have been consolidated and the ones considered to be the most optimal were used to suggest the improvement strategies for the CCTV management model. The entire CCTV management model has been re-outlined and the incorporated or updated protocol has been indicated with the brackets at the extreme right end of the procedure of the CCTV management model pipeline.

Recommending a Computerised CCTV Footage Management Model Pipeline for Criminal Investigation

The outlined CCTV management model is in a programmable procedure that is possible to incorporate into a computerised CCTV management system, thus creating a computerised CCTV footage management pipeline.

Study Population

In order to obtain better results from teams who have significant knowledge and experience in CCTV footage management and criminal investigations, teams of investigators, CCTV analysts, and CCTV system administrators were interviewed since they deal most in criminal investigations and footage management; thus, they constituted the study population. Only those who had dealt in investigations involving CCTV footage, court trials involving CCTV footage, footage recording, footage management, and footage analysis were considered in this study. Only the respondents that reside within the geographical boundaries of the Kampala metropolitan area were also considered. The selections of the study population as stated were made using recent two

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years records registered at the CCTV Command Centre.

Sample Size Determination

The appropriate sample size (88) was determined using Slovin's formula of sample size determinations with a 5% error tolerance [13].

Mathematically the formula is denoted as;

$n = N / (1+Ne^{2)}$

Where; n is the sample size; N is the population size; e is the error tolerance level

The floating values arising from the calculation were rounded upwards to the nearest integer value.

Table 1: Distribution of population and sample respondents by role

Designation	Population	sample	Percentage of total samples
CCTV Analyst	33	26	30%
CCTV system administrator	26	20	23%
Investigator	54	42	48%
Grand Total	113	88	100%

Respondents Sampling

Sampling Technique

Proportionate stratified simple random sampling was carried out to ensure the representation of all sample groups, reduce bias, and improve precision. Investigators, CCTV system administrators, and CCTV analysts constituted three different strata and simple random sampling was carried out within each stratum. The number of samples per stratum was proportional to the population size of the stratum.

Distribution of Respondents by Gender

The rationale for routinely considering gender in implementation research is multifold. Gender is important in decision-making, communication, stakeholder engagement, and preferences for the uptake of interventions [14]. Gender roles, gender identity, gender relations, and institutionalised gender influence the way in which an implementation strategy works, for whom, under what circumstances and why. In response to the environmental implications both males and females were considered to take part in this study and were sampled proportionally to their respective population sizes.

A total of 88 respondents were sampled with 19 (22%) being females and 69 (78%) being males

Table 2: Distribution of sample respondents by gender

Gender	Number of respondents	Percentage of total
Female	19	22%
Male	69	78%
Grand Total	88	100%

Distribution of Respondents by Role/Designations

30% of the respondents were CCTV analysts, 23% were CCTV system administrators, and 48% were investigators. This is because these are professionals who always handle CCTV footage and could have insights into its management.

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Table 3: Distribution of sample respondents by role

Designation	Number of respondents	Percentage of Total
CCTV Analyst	26	30%
CCTV system administrator	20	23%
Investigator	42	48%
Grand Total	88	100%

Distribution of Respondents by Experience Categories

To achieve the desired goal, signal, and metrics and to get insights into qualitative findings, a Key Experience indicator needs to be used, according to Lindfors, Viitanen, and Tomer, and to ensure that respondents' key experience indicators relating to footage and footage management were considered. Respondents were selected based on time in years of operations as an analyst or system administrators [15] [16]. However, to avoid sampling individuals who had multiple years of experience in investigations but without experience in investigations with CCTV footage, investigators were considered only if he or she has had an investigation involving CCTV footage. In other words, the number of investigation cases handled by an investigator was used as a measure of experience (Key Experience indicator).

Table 4: Distribution of CCTV administrations staff by years of experience

Years	CCTV Analyst	CCTV system administrator	Grand Total	Percentage of Total
5+ years		14	14	30%
3-4 years	16	3	19	41%
6 months-1year	10	3	13	28%
Grand Total	26	20	46	100%

30% of the respondents had at least five years of experience, 41% had 3 to 4 years of experience, and 28% of the respondents had six months to 1-year experience. None of the respondents had 2 years of experience or less than 6 months of experience.

On the side of investigators, 39% had worked on 5 to 9 cases by the time of data collection, 22% had worked on 20 or more cases, 17% had worked on 1 to 4 cases, 17% had worked on 10 to 14 cases, and 5% had worked on 15 to 19 cases involving CCTV footage by the time the data was collected.

Table 5: Distribution of Investigators by number of CCTV footage cases handled

Cases group	Number of investigators	Percentage of total
5-9 cases	16	39%
20+ cases	9	22%
1-4 cases	7	17%
10-14 cases	7	17%
15-19 cases	2	5%
Grand Total	41	100%

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Data entry, Cleansing, Analysis, and Presentation

The collected data were entered, cleaned, and analysed in Microsoft Office Excel. During the cleansing process, similar responses for the open-ended questions were grouped together and coded with the briefest relevant self-explanatory words. The analysis and presentation comprised a table of values with counts, percentages, graphs where applicable and a pie chart

Ethical Considerations

The following are the ethical considerations that were considered while conducting this research.

- Informed consent, privacy and confidentiality, Accuracy, Property, and Anonymity.
- The rights of the subjects in the study were also observed. These included the right to participate or not in the study and the right not to respond to some questions that he/she may perceive as sensitive to his/her privacy or wellbeing.
- Fair distribution of respondents in terms of age, gender, qualifications, and experiences were highly considered to ensure that all categories of respondents were part of the study.

Table 6: Distribution of sample respondents by age

Age	CCTV Analyst	CCTV system administrator	Investigator	Grand Total	Percentage of Total
21-30 years	8	0	9	17	19%
31-40 years	12	18	29	59	67%
41-50 years	6	2	4	12	14%
Grand Total	26	20	42	88	100%

Data protection policies of the Ugandan data protection and privacy act clause 13 were highly considered in this study [17]. In the questionnaire, the reasons for which the data were being collected were all declared and all data collected were kept exclusively within reach of the researcher and support teams (data collectors and entrants) with close supervision of the researcher himself to avoid some sensitive information from being accessed by non-authorised parties. Anonymity was maintained by asking respondents to provide their responses without having to give their identities.

Environmental and Gender Implication

Mounting evidence always shows that advancements in gender equality could have a profoundly positive impact on social and environmental wellbeing. But if not managed properly, environmental projects can actually spur gender inequality [18]. It is a connection that anyone working in the environment and sustainable development space must keep in mind. The researchers ensured that both men and women were given equal opportunities to participate and contribute during the research; however, the number of qualified women that held the roles considered in the study was very few, thus leading to a smaller proportion of women as compared to men.

Table 7: Distribution of sample respondents by gender

Gender	Number of respondents	Percentage of total
Female	19	22%
Male	69	78%
Grand Total	88	100%

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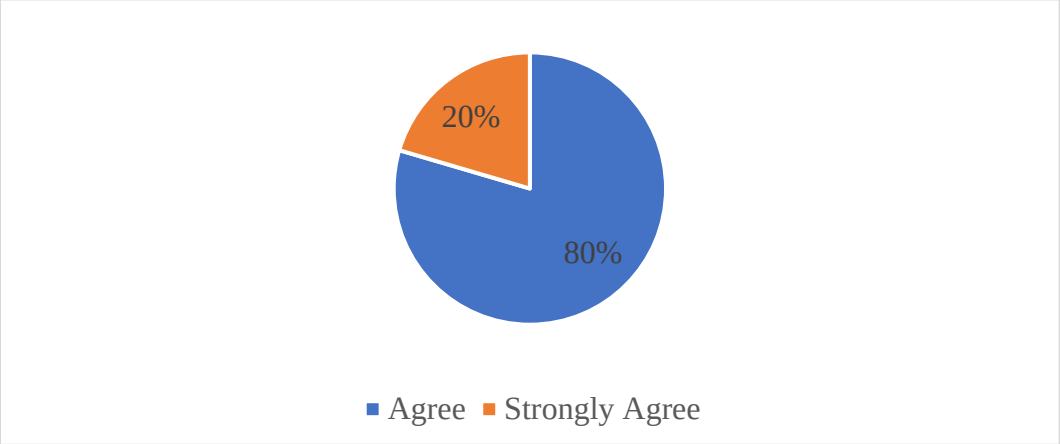
RESULTS

This section presents the results of the survey carried out to outline an improved systematic management model for CCTV footage in police criminal investigations. The results majorly focused on the registered drawbacks that aligned with the conceptual framework presented in *Figure 2* and most of these drawbacks were derived from literature reviews from newspapers, social media, and those suggested by the respondents as the major drawbacks of the current CCTV management model. The summary of findings can be obtained from tables of results and charts available in the preceding sub-sections.

Footage and Control Centre security management

All the respondents either agreed or strongly agreed that the footage is secured from access by unauthorised individuals.

Figure 2: Strength of agreement that premises access controls are present



The respondents believe that the footages are secured from unauthorised individuals, majorly because complete access to footages is restricted, the disclosure process has guidelines that need to be followed, and because passwords are often used to secure access to the footages. The entire reasons why respondents believe that footage are secured from unauthorised access are presented in the table below.

Table 8. Reasons for agreeing that footages are secured from unauthorised access

Reason	n	%
complete access is restricted	42	57%
Disclosure has guidelines	10	14%
passwords are used	10	14%
Download rights are limited to a few officers	5	7%
Constant staffs retraining	2	3%
Full-time surveillance is put in place	2	3%
Single analysis point set	2	3%
SOPs put in place at the monitoring Centre	1	1%
Grand Total	74	100%

Unauthorised recording of footages with personal devices and smuggling of footages to unauthorised individuals have been registered from at least 8 of the respondents and also in the preceding subsection. These internally related challenges contradict the findings from this section since the

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videos are smuggled out prior to the conclusion of the investigation and make the encryption purposes lose their objectives. Below is a table showing challenges facing CCTV footage access controls as presented by the 8 respondents.

Table 9. Other challenges that affect CCTV footage access controls

Other challenges that affect CCTV footage access controls	n
Recording footages using phones in the monitoring Centre	4
Smuggling out footage to unauthorised people and on social media platforms	4
Grand Total	8

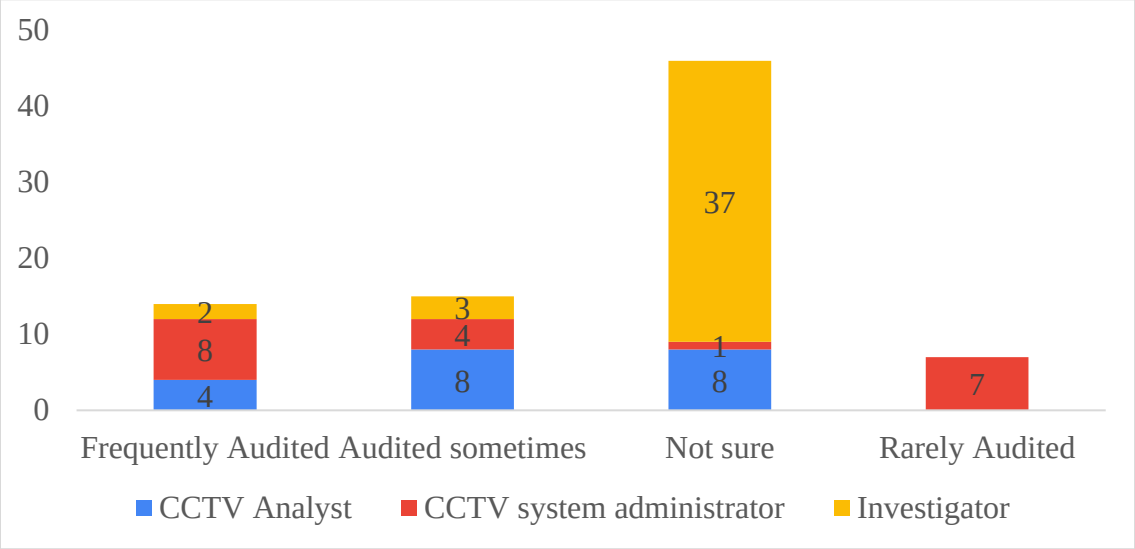
CCTV System Audit, Quality Assurance and Maintenance

Mixed reactions have been registered concerning the CCTV system audits, where 17% mentioned that the CCTV system is frequently audited, and 18% said that the system is audited sometimes. 56% of the respondents were unsure if the CCTV system is always audited. 7 CCTV system administrators, that is 9% of the respondents and nearly half of the CCTV system administrators have said that the CCTV system is rarely audited and one is completely unsure if the system is either always audited or not. The results are presented in *Figure 3* below.

Table 10. CCTV System audit frequency

Parameter	CCTV Analyst	CCTV System administrator	Investigator	Grand Total	% of total
Frequently Audited	4	8	2	14	17%
Audited sometimes	8	4	3	15	18%
Not sure	8	1	37	46	56%
Rarely Audited		7		7	9%
Grand Total	20	20	42	82	100%

Figure 3: CCTV System audit frequency



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Footage Quality Assurance and Maintenance

Mixed arguments have been registered concerning footage quality assurance and maintenance. 44% of respondents (35 respondents) were unsure if quality assurance and maintenance strategies were put in place, and they backed up their arguments with reasons as presented in *Table 13* below. 49% either agreed (44%) or strongly agreed (5%) that footage quality assurance and maintenance strategies were put in place. They are majorly based on the reasons that access to the footages are restricted, the footages are always clear, and timestamps are always available on the footage in *Table 12*.

Table 11: Strength of agreement that footage quality assurance and quality maintenance strategies are put in place to a great extent

Agreement strength	Number of respondents	Percentage of total
Agree	35	44%
not sure	35	44%
strongly Agree	4	5%
Disagree	3	4%
strongly disagree	2	3%
Grand Total	79	100%

Table 12. The reason why respondents believe that footage quality assurance and quality maintenance strategies are put in place

Reason	n	%
Access to footage is restricted	8	23%
The footages are always clear	7	20%
Timestamp available on footage	6	17%
The report given is always clear	3	9%
Infrared illuminators present to improve night vision	2	6%
CCTV have ideal resolutions	2	6%
Street lights installed to improve night footage visibility	2	6%
Maintenance protocols are put in place	2	6%
H268 video codec is put in place	1	3%
System analysts are deployed to ensure quality	1	3%
Footages are presented on time	1	3%
Grand Total	35	100%

However, 7% of the respondents either strongly disagreed (3%) or disagreed (4%) that footage quality assurance and maintenance are put in place. They argued that the footages are not clear and that sometimes cameras go off and as well they have not witnessed any serious quality assurance strategies put in place. The reasons why respondents do not believe/are not sure that footage quality assurance and quality maintenance strategies are put in place are presented in Table 13 below. Some clear observations of the related scenario, which illustrates the poor quality of the footage have also been registered in subsection 4.6, “Other challenges reportedly faced in CCTV footage management and investigations”. These include interference of footage playback on live footage recordings and unclear night images.

Table 13: Reason why respondents do not believe/are not sure that footage quality assurance and quality maintenance strategies are put in place

Reason	Number of respondents	Percentage of respondents

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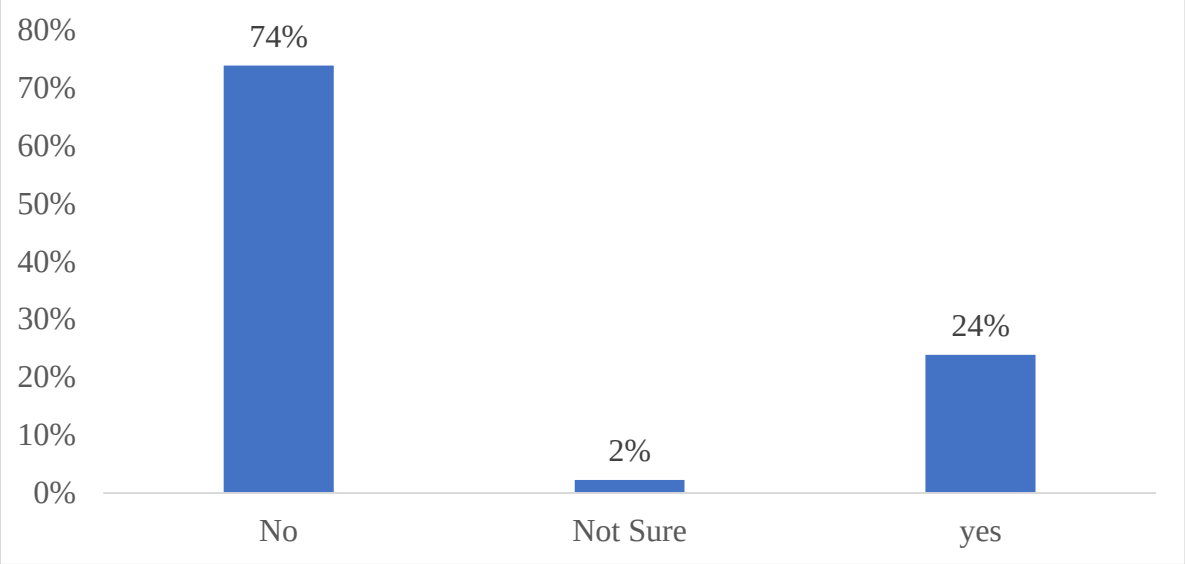
Footage is not very clear	4	36%
No serious quality assurance strategies	6	55%
Sometimes cameras go off	1	9%
Grand Total	11	100%

Footage Retention Period

At least 74% of the respondents claimed that the 90 days footage retention period is insufficient, but 24% said the retention period is adequate and 2% were not sure.

Figure 4: Adequacy of 90 days retention period



Most of the respondents recommended 365 days (1 year) which would be adequate, followed by those who recommended 180 days (6 months). The respondents recommended these claiming that the 90 days is too short and that the period expires before a step is taken up to request for footage to be presented in court. The retention period desired by the respondents are tabulated below

Table 14. The desired retention period in days

Period	Number of respondents	Percentage of total
365 days	25	42%
180 days	24	40%
730 days	5	8%
Infinite	4	7%
120 days	2	3%
Grand Total	60	100%

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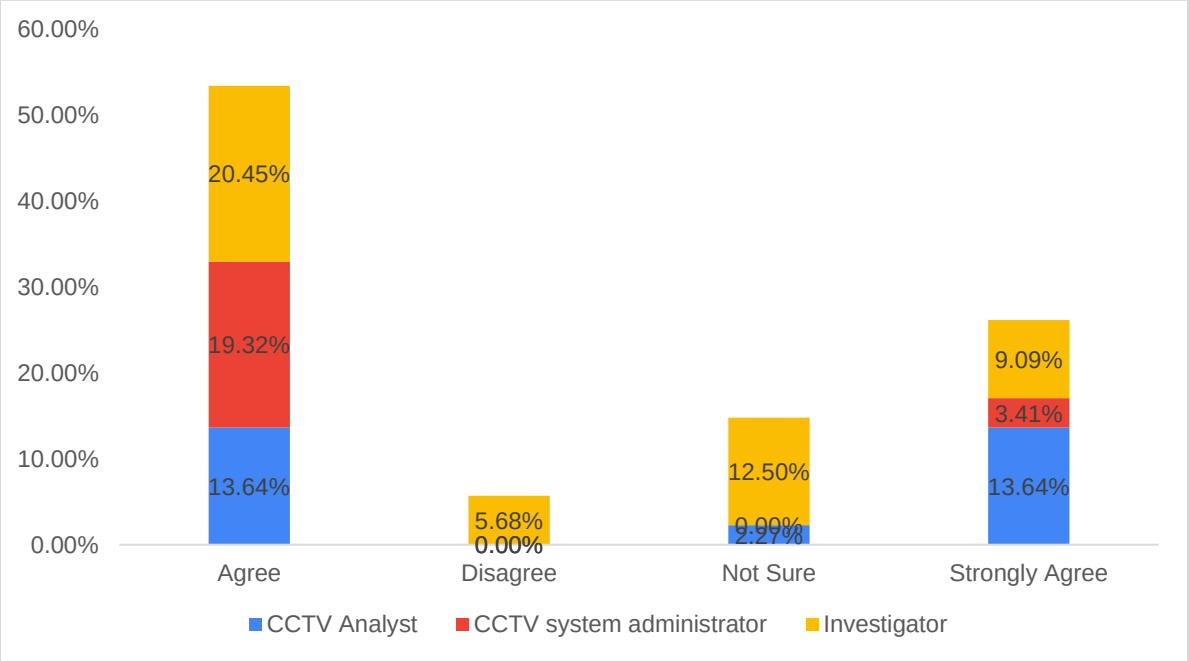
Footage Provision Services and Professionalism at Command Centre

Staff Training/Skills

More than 50% agreed and more than 25% strongly agreed that CCTV personnel had attained induction training. Approximately 15% of respondents were not sure and 5.68% disagreed. The graph showing the strength of agreement by respondents are plotted below:

Figure 5: Agreement that CCTV operations personnel go through training



The respondents who agreed or strongly agreed did so giving reasons that operations training is done, CCTV personnel are competent and individuals with IT backgrounds are the ones recruited and trained. The response is summarised in the table below

Table 15. Reasons for agreeing that CCTV operations personnel go through training

Reason	CCTV Analyst	CCTV system administrator	Investigator	Grand Total
Operations training is done	16	6	2	24
CCTV Personnel are competent	4	6	11	21
Individuals with IT backgrounds are the ones recruited and retrained		7	9	16
Proper management and operations of the systems		1		1
Grand Total	20	20	22	62

2 CCTV analysts and 9 investigators either disagreed or were not certain if all CCTV personnel are trained based on the challenges they experienced. These include reasons that the training

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is not provided to all, non-IT professionals are deployed at CCTV workstations, and some personnel are always too afraid to testify about the footage in court. The reasons given are tabulated in Table 16 below.

Table 16. Reasons for disagreeing that CCTV Operators went through training

Reason	CCTV Analyst	Investigator	Grand Total
Training not provided to all	2	2	4
None IT professionals deployed at the CCTV workstation		4	4
Some personnel are always afraid to testify in courts		1	1
Footages are retrieved over a very long time		1	1
Reports do not detail footage as expected		1	1
Grand Total	2	9	11

Other Challenges Reportedly Faced in CCTV Footage Management and Investigations

The literature reviewed did mention a few challenges and some others that were not captured in the questionnaires but revealed by the study include lack of cameras in some areas, poor coordination between the stakeholders, low facilitations, most especially whenever retrieving footage on sites, lack of good footage analytics tools, weather, and constructions interruptions of CCTV operations, amongst others that are presented in *Table 17* below;

Table 17. Other challenges that affect CCTV footage management and investigations

Challenge	n
Some corners do not have cameras	9
Poor coordination between the analysts and investigators	6
Transport resources/welfare in cases where you have to retrieve a footage from site	6
Interruption by weather and construction	5
Investigators lack footage analysis tools/devices	5
Few personnel	4
Playback interferes with live events	4
Recording footages using phones in monitoring centres	4
Response time is always long	4
Smuggling out footages to unauthorised people and on social media platforms	4
Some cameras have very low resolution	4
Unclear night images	4
Insufficient training for investigators	3
Limited backups	3
Cameras sometimes go off	2
Difficulty in the transportation of footages	2
Low storage capacities	2

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Grand Total	71

DISCUSSIONS

High-Level Command Centre Security and Full Capacity Recruitment of Qualified Staff

Introduction

As presented in the conceptual framework in Chapter One, a high-level command centre security and full capacity recruitment of qualified staff comprising of Access Controls, Full capacity staffing, constant staff training, and flexibility to changes are key attributes to attaining an Improved systematic management model for CCTV footage. Under these key attributes, footage and command centre security management together with low-capacity staffing and inadequate training for some staff have been registered in study results subsections as well as in the literature reviewed

Footage and control Centre Security Management

Payment Card Industry Data Security Standard (PCI DSS) requires organisations to restrict physical access to their buildings for onsite personnel, visitors, and media, as well as to have adequate logical access controls to mitigate the cyber security risk of malicious individuals stealing sensitive data [19]. This justifies how crucial access controls are important, and in this study, complete access security control from unauthorised individuals is not only reported by the respondents but also published by "The Independent" seven months after President Yoweri Museveni commissioned the National Closed-Circuit Television – CCTV Command Centre based at Naguru Police headquarters [20]. The media reported that the public had never been granted the chance to tour and assimilate with what is done inside. This clearly indicates that unauthorised access to the Command Centre is restricted. This was also confirmed by the witness on their website, where they published that the Police force's ICT director, Commissioner of Police (CP) Felix Baryamwisaki received the visitors who wanted to assimilate themselves with what transpires inside the Police CCTV command Centre [21]. The news media reported that Baryamwisaki quickly informed the visitors that no cameras should go beyond the reception and that no one would be allowed to take pictures inside the crucial security rooms. Everyone had to keep their phones in their pockets. This clearly highlights the access control security posed at the command Centre.

However, with the high-level access controls put in place, internal challenges regarding the drawbacks acts of some officers have been registered. These include unauthorised recording of footage on phones and smuggling of footages through social platforms. This is an absolutely unprofessional act and is clearly observed in a Twitter post by Uganda Broadcasting Corporation (UBC) showing exactly the footage recorded using a mobile device inside the control Centre and leaked through the social platforms [22]. The same scenario was also registered at Entebbe CCTV control Centre where a Police officer was allegedly arrested in connection with the leaked CCTV videos and photos of a secret meeting between the country heads of the Judiciary and the President [23]. These acts are contrary to the communication made by the Chief Political Commissar (CPC) and Assistant Inspector General of Police Kasingye that all officers in CCTV monitoring rooms have no legal permission to share clips with civilians because such footage must only be accessed by forensic or CCTV experts [24]. This communication came after CCTV video footage from Uganda Police force control rooms was leaked [25]. This is shown in Appendix 2.

Staff Training/Skills

According to Kazibwe, a total of 45 senior Police officers completed an eight days senior commanders' course in the use and monitoring of CCTV cameras by November 28 2019 at the Police headquarters in Naguru [26]. Jeanne reported that at least 1076 Police officers were trained to monitor the National Closed-Circuit Television Cameras installed by police to boost security surveillance [27]. These are a few indications that staffs undergo training similar to the findings of this study.

However, the Deputy Director of Information and Communication Technology said that about 3000 monitoring agents in different categories like

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operators, traffic, field officers, command and control, technical engineers, computer scientists, Analysts, and technicians would be trained to manage the day-to-day operations of the system and its maintenance [28]. The number that underwent training as reported by Jeanne did not account for even 50% of the 3000 targets estimated by the Deputy Director of Information Communication Technology, thus understaffing the CCTV personnel [27] [28].

On the other hand of CCTV system audit, constant staffs training, and flexibility at the workplace, the study has registered some complaints that some officers in charge were inexperience and had training gaps, as witnessed from sections 4.3 and 4.4 where the 56% and 44% of the respondents were unsure of the CCTV system quality assurance protocols. The findings here clarify the responses that were received by Lubowa when he tried to sort for Police intervention to look into the footage of the CCTV camera to help trail the suspects who abducted and murdered his daughter [29]. The answers he received included a lack of knowledge about the use of CCTV cameras and he was referred from one Police station to the other instead of giving correct guidelines on the procedures to be followed. James in his report stated that "In a swift action to comfort Uganda following the attempt made on Katumba's life, police officers who were manning the CCTV control room at Nateete when the incident was happening were arrested [30]. Police said the officers were interrogated to find out whether there was negligence at the time the incident happened since they were supposed to be watching live whatever was happening on the ground". These were quite unprofessional and reflected inadequate knowledge, experience, training gap, and under-capacity employment of staff at the command centre.

Quality Assurance and Maintenance

Introduction

High levels of quality are essential to achieve the organisation's business objectives. Quality, a source of competitive advantage, should remain a hallmark of organisation products and services. High quality is not an added value; it is an essential basic requirement. Quality does not only relate solely to the end products and services an organisation provides, but it also relates to the way the Organization's employees do their job and the work processes they follow to produce products or services. The work processes should be as efficient as possible and continually improve. The afore-cited reasons highlight Quality assurances and maintenance as key in managing organisations' performances effectively similar to the conceptual framework presented in Chapter One of this dissertation. In this study, system audit, footage quality assurances and maintenance issues and footage retention period have been registered both from respondents and literature.

CCTV System Audit

CCTV audit is important because it determines the security level of the organisation, according to Singapore CCTV [31]. The organisation continued and reported that security is always an important aspect of the organisation so it is important that the audit is done by qualified persons as well as implemented by people who are really passionate about security; otherwise, there is no need to continuously do CCTV audits that do not achieve results. Goradia stated in his course book that several organisations offer auditing services, often referred to as 'e-surveillance' or remote video auditing (RVA); however, most of these services do not audit or review an entire day's footage covering multiple cameras [32]. They are normally triggered and/or sample-based, thereby increasing the risk of several incidents escaping detection. Also, in all such purely third-party audits, the angle of situational awareness can be questioned to an extent. Goradia concluded that there is a need therefore to empower every user of CCTV with a tool to audit his/her own CCTV footage. This clearly indicates that there is a need for constant CCTV audits, contrary to some reactions registered in this study in regard to CCTV system auditing [32].

Footage Quality Assurance and Maintenance

Access to footage is restricted according to the respondents and Baryamwisaki clearly explained in a conference that the CCTV footage could only be released after seeking permission from the resident CID [33]. He continued and mentioned that the

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CCTV operators are no longer able to download or remove part or whole of the footage without these permissions. Chief Political Commissar and Assistant Inspector General of Police Kasingye [34] clearly clarified that the officers in CCTV monitoring rooms have no legal permission to share clips with civilians because such footage must only be accessed by forensic/ CCTV experts. However, he went ahead and clarified that even if he/she is a forensic officer, he/she is not supposed to release the footage unless a decision is made in consultation with commissioners or directors in charge of Information and Communication Technology (ICT) and forensics.

Concerning clarity of the footages, the respondents did agree that the footages are sometimes not clear and this is witnessed in the footage picture presented in the 2020 police annual report [35]. The picture appears to be in a clear environment, but the footage itself is unclear. However, it is also observed that not all pictures are unclear, but some of them are clear. For instance, a picture showing a real-time incident recorded at Nakawa Junction is observed to be very clear; thus, not all footages are unclear as shown in the picture below [43].

Footage Retention Period

Manchester Video did some evidential work at a motor trade business where the owners had excellent CCTV systems and records showed that they kept CCTV footage for several months [36]. They had previously experienced a number of spurious damage claims from customers and sometimes, the claims for damage to customer vehicles would be made several weeks after visiting the business. The owners decided to upgrade the CCTV installations and increase the retention period to 3 months. This gave them the ability to carefully check the footage and in most cases since the upgrade, they have nipped fraudulent claims in the yard. For that business, a long retention period of a few months was deemed appropriate [36]. Thus, a higher retention period is highly recommended, similar to the results of this study

However, in a judgment delivered in the names of Malta post plc vs Information and Data Protection Commissioner, the Court of Appeal quashed the Tribunal's decision and in confirming the IDPC's original position on the matter [37]. It emphasised that "a maximum retention period of seven (7) days shall apply to CCTV footage, with extensions only allowed in exceptional circumstances. In fact, the Court of Appeal agreed that for an exceptional scenario, a retention period of only twenty (20) days could be allowed for CCTV footage". This is contrary to the findings of this study, where the respondents recommended a retention period of over 90 days. This therefore indicates that the

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appropriate maximum retention period is best determined on a case-by-case basis. Low response time when it comes to disclosure is still a major challenge affecting investigations.

Proper Disclosure Protocol

Introduction

However, much as the footage would be well managed at an initial stage but not well managed at time of disclosure, all the gained glory gets lost and it is extremely important to take care of CCTV footages beyond backing up or court trial closure. This makes disclosure protocol a highly important attribute when it comes to effective CCTV footage management, as illustrated in the conceptual Framework in Chapter One.

Disclosure challenges reported by respondents

The disclosure protocol has been clearly revealed to be working well as per respondents' feedback since not many unsupportive arguments were registered. The stakeholders however, have faced low response time as was reported by just a few numbers in 4.7

RECOMMENDATIONS

The following need to be incorporated into the present model to perfect CCTV system management for investigations

Recommendations for the drawbacks of the current management model for CCTV footage in the criminal investigation

- Uganda Police Force should consider backing up footages on CCTV cloud storage even beyond the retention period since cloud service providers provide minimal charges for data stored for a long time without access and depending on the storage options available on the cloud.

- CCTV cloud storage services should be used since it provides CCTV users with a variety of options that simplifies the process of retrieving the saved footage and enable them to stay compliant with the law.

- Uganda Police Force's CCTV concerned departments should consider setting up a Memorandum of Understating with other stakeholders, preferably Local Governments, the Ministry of Works and UNRA to always notify the Uganda Police Force when commencing constructions work to avoid CCTV power cuts.

- Uganda Police force should consider disseminating information regarding procedures for acquiring footage and retention period to the public and preferably to both private and public investigators and local leaders to avoid the uncertainty of delays due to lack of knowledge of acquiring procedures and expiring of footage before one acquires it.

- Uganda Police Force should consider setting up joint technical teams between UMEME and Police to align unforeseen power outages and quick coordination for power restoration.

- Uganda police force Should consider setting up a field technical patrol team to frequently check CCTVs in the field for accurate operations and quality.

- Uganda Police Force should consider setting up field investigators who should be in a position to liaise with other authorities during the approval of putting up banners and billboards to avoid them from interfering with CCTV camera recording and operations.

- Machine learning models should be incorporated into CCTV management systems to shut down video reviews in case of detection of an active recording device in the monitoring room except for security cameras and to monitor the health and availability checks of CCTV cameras. This is to avoid the unauthorised recording of footage and improve the quality of the footages being recorded.

- Strict laws and strict monitoring of CCTV live footage monitoring staff should be put in place to reduce footage recording with personal devices and leakages.

Incorporate and update improvement strategies for the current Management model for CCTV footage.

The current CCTV footage management model would best be improved by incorporating or

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updating (indicated in brackets) the current model as below;

- A case must have happened at an area reachable by the camera (camera's viewshed)
- Somebody must have a complaint with interest.
- A case must be registered at any Police Facility.
- A licensed investigator takes up the case.
- Investigations commence on the same. (Incorporated)
- Investigator notifies the ICT director about the incident in writing.
- The ICT director reviews the requests and approves them for action (Incorporated)
- The ICT director initiates the process of securing the footage from the system for better management (incorporated)
- The system assigns the task randomly to an analyst (Incorporated)
- An analyst follows up on the matter as follows:
- Analysts should access the footage on the system and handle everything on the system. (Incorporated)
- The analyst examines the footage for its authenticity.
- Analyst reports and proves authenticity to the ICT director on the system (incorporated)
- The ICT director approves the continuity of the process on the system (incorporated)
- Analyst analyses the footage.
- The system backups the footage and the analysis automatically. (Updated)
- The ICT director approves the analysed footage for download (incorporated)
- The analyst's analysed footage is enabled for download from the system (incorporated)
- Analysts present the footage to the court
- Dispose of the footage

Computerisation procedures for ISM model for CCTV footage

In order to ensure a faster and more reliable CCTV footage management model, the CCTV management model outlined in the previous subsection 5.4.2 works better when computerised into a secure footage management system as shown below; Upon receipt of requests for footage by the director ICT.

- The computerised system should be corded to highlight the number of cameras within the perimeters defined.
- The system should be in a position to suggest the camera closest and facing the directions suggested.
- The director should not have access to the camera footages himself but should have access to enable the download of the camera footages for analysis. (This will reduce smuggling, corruption, and collaboration with criminals)
- The system has to allocate the task to any analyst randomly.
- A machine learning model that predicts the background activities and shuts down the footage if any recording devices are around and are operational with the exception of security cameras should be embedded in the system and enabled at this point.
- Any downloading software is disabled at this point.
- The analysts access the footage and examine it for authenticity.
- The analyst declares the camera(s) to be used during the process and provides the estimated length of the criminal act to the Directorate of ICT.
- The director approves and the analyst receives access to the footages and the length of time estimated.

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- The system automatically backs up the analysed footages at all points submitted by the analyst into the system.
- Analyst footage reviews are allowed by the system
- The analysts declare getting enough information on the system.
- The analyst's supervisor receives access to the analysed footage.
- The analyst's supervisor reviews the content and approves it on the system.
- The Analysts receive download access.
- The directorate closes the process upon receipt of the closure of cases and all access are revoked.

The incorporated information into the current management model will help to automate the process of managing the footage where the allocation of request, verification and approval will be done randomly to the analysts hence disrupting corrupt tendency, connivance, delay in reporting and many others among Analysts, administrators, investigators and other stakeholders. Further research should be carried out on training curriculum development that includes computerised system techniques for handling digital evidence remotely such as CCTV footage Note:

All footages are automatically wired to archival storage solutions such as archival google storage/google cold line storage, azure archival storage, and Amazon S3 glacier deep, amongst others since they have low storage cost per GB and this would solve the issue of expiry of the retention period. Message and email alerts should be set to automatically send health checks and availability checks of the cameras. This would improve the quality of the footages.

CONCLUSIONS

The security of the entire CCTV footage premises is well managed, but a lot of internally control management challenges, most especially using personal devices and social media to leak footages which in turn interrupts investigations, still exist within the Uganda Police CCTV footage management. A lot of unprofessionalism in handling external clients by the CCTV management team and setting straight standard operating procedures for the external stakeholders have a lot of missing gaps that need to be settled in order to enable smooth business interaction between stakeholders. The entire risk and quality control of footages are still not paid very high attention to, which has led to the production of unclear and less quality footage and this directly affects investigations as a whole. The Uganda Police CCTV management team is putting very little concern in retaining footage for long and proper backup of the footages, which greatly affects long-term investigations and court cases/hearings. There is little coordination between the CCTV management team and investigators, which greatly affects the effectiveness of investigations involving CCTV footages. The Uganda Police CCTV management team has not put in place a very strong hold on linkages and coordination with stakeholders concerned with construction, weather, and electricity power supply which has caused a lot of interruptions whenever the related activities/occurrences cause unforeseen cut out of CCTV operations.

The optimal solution, as suggested by the respondents and review of the literature led to the conclusion of the study and recommendation of an outlined improvement model, as presented in the subsection below

REFERENCES

[1] L. Garis, Criminal Investigations Processes, *Practices and Thinking*, 2018.

[2] R. Gehl and D. Plecas, Introduction to Criminal Investigation, *Processes, Practices and Thinking*, BC campus, 2019.

[3] C. Laney and E. F. Loftus, Eyewitness testimony and memory biases. *Noba textbook series, Psychology. Champaign*, 2021.

[4] X. Agirre, M. Bergsmo, S. D. Smet, and C. Stahn, The Contribution of Analysis to the Quality Control in Criminal Investigation. In Quality Control in Criminal Investigation,

Article DOI: https://doi.org/10.37284/eajit.5.1.895

Torkel Opsahl Academic EPublisher Brussels,2020, p117

[5] M. P. J. Ashby, "The value of CCTV surveillance cameras as an investigative tool: An empirical analysis," *Eur. J. Crim. Pol. Res.*, vol. 23, no. 3, pp. 441–459, 2017.

[6] UK CCTV, Why do police request CCTV footage during investigation? *https://www.ukcctvinstallations.co.uk/blog/cctv-footage-used-in-crime-investigation/*, 2020

[7] Saferspaces, Closed Circuit Television (CCTV) and Crime Prevention, *Saferspaces*, 2021

[8] The Observer China, How missing CCTV footage turned a Chinese family's tragedy into a national conspiracy, *The Observer China*, May, 2021

[9] MailOnline News, Shock twist in search for missing toddler 'AJ' as family friend reveals crucial CCTV footage of the moment the three-year-old disappeared has been ERASED – and claims the toddler has been abducted 'without a doubt, *MailOnline News*, September, 2021

[10] S. Masaba, and C. Kiwawul, Several incidents have of recent happened in Kampala Metropolitan Policing (KMP) area, where there are cameras, but the footage capturing them has since gone missing, *New Vision*, 2020

[11] Ministry of Finance, Planning and Economic Development, The proposal to borrow up to USD 104.0 million from Standard Chartered Bank to finance the National CCTV Network Expansion Project, *Ministry of Finance, Planning and Economic Development*, 2018

[12] Gillwald, O. Mothobi, A. Ndiwalana, and T. Tusubira, The State of ICT in Uganda, *https://researchictafrica.net*, 2019

[13] S. Ellen, Slovin's Formula Sampling Techniques. Sciencing. *https://sciencing.com/slovins-formula-sampling-techniques-5475547.html*, 2017

[14] C. Tannenbaum, L. Greaves, and I. D. Graham, "Why sex and gender matter in implementation research," *BMC Med. Res. Methodol.*, vol. 16, no. 1, p. 145, 2016

[15] K. Lindfors and L. Viitanen, Product / service focus: How to choose what to measure with KEIs, *Siili https://www.siili.com/stories/keis-key-experience-indicators-to-transform-your-knowledge-of-your-business*, 17,09,2021

[16] T. Sharon, Key Experience Indicators: How to decide what to measure?, *https://tsharon.medium.com/key-experience-indicators-how-to-decide-what-to-measure-8b948a6a86b9*, 30, 06, 2018

[17] The Ministry of Information and Communications Technolog, The Data Protection and Privacy act. Kampala, *The Ministry of Information and Communications Technology*, 2019

[18] N. Elwell and Y. Williams, If You Care About the Environment, You Should Care About Gender, *World Resource institute*, 2016

[19] T. Tunggal, Why is Access Control Important, *UpGuard*, 2021

[20] The Independent, Inside the national CCTV command centre, *The Independent*, 18, 7,2020

[21] The Witness, Inside the Police CCTV Cameras Command Centre, *The Witness*, 18,7,2020

[22] UBC Uganda, Leaked police CCTV footage showing moments before the explosion near Kampala Central Police Station, *https://twitter.com/ubctvuganda/status/1460556815092047874?lang=en*, 16,11,2021

[23] E. Busingye, Police chief who leaked Dollo-Museveni private meeting CCTV film detained, *https://ekyooto.co.uk/2021/02/20/police-chief-who-leaked-dollo-museveni-private-meeting-cctv-film-detained*, 20,02,2021

[24] Kasingye, CCTV Video Footages From Uganda Police Force Control Rooms Leaked, the Officers Face Prosecution Over it, *https://osutayusuf.blogspot.com/2019/07/cctv-*

Article DOI: https://doi.org/10.37284/eajit.5.1.895

video-footages-from-uganda-police.html, 28,07,2019

[25] O. Yusuf, CCTV Video Footages From Uganda Police Force Control Rooms Leaked, the Officers Face Prosecution Over it, *https://osutayusuf.blogspot.com/2019/07/cctv-video-footages-from-uganda-police.html*, 2019

[26] K. Kazibwe, Police commanders trained in using CCTV cameras as Museveni prepares to open new command centre, *Nile Post Uganda*, 28,11,2019

[27] D. Jeanne, 1076 Police Officers Undergoing Training to Monitor CCTV, *Uganda Radio Network*, 21,11,2018

[28] C. P. Yusuf Sewanyana, 3000 Police Officers to be trained in CCTV management, *UPF*, 19,10,2018

[29] F. Lubowa, How you can access Police CCTV footage, *https://youtu.be/f6v- ZhOZXBk ?t=20s*, 2,9,2019

[30] James J. J, Its Time Uganda Proves Its CCTV Cameras Are Not Scarecrows,6,7,2021

[31] Singapore CCTV, Implementation of the audit, *Singapore CCTV*, 2021

[32] Gautam D. Goradia, Surveillance video auditing services and their challenges, 2020

[33] Elias Biryabarema, Uganda's cash-strapped cops spend $126 million on CCTV from Huawei. *REUTERS*, 15,08,2020

[34] Asan Kasingye, Police officers face prosecution for sharing CCTV footage, *The Independent*, 26,7,2019

[35] Uganda Police Force, Annual Crime Report - 2020. Annual Crime Report, *Uganda Police Force*, 84,2020

[36] Manchester Video, GDPR – How long should you retain CCTV, *Manchester Video*, 2019

[37] MamoTCV Advocates, Maltese Court of Appeal Confirms' 7 Day Rule' for Retaining CCTV Footage, *Data Protection Legal Update*, 10, 2018

[38] The Nevada Department of Corrections, Crime Scene Response & Evidence Management, slide 11, Crime Scene Protection, 2022

[39] Rick van Echtelt, How to make the most of capacity management, AG5, https://www.ag5.com/how-to-make-the-most-of-capacity-management/

[40] Meric Craig Bloch, Guide to Conducting Workplace Investigations, 2008

[41] Angela Scott-Briggs, What is Premise Management? Tech Bullion, March 20, 2022

[42] Sweet Process, Chapter 1: Quality Assurance: What Is It and Why Should You Care? Sweet Process; Blog & Podcast About Systemizing & Scaling Your Business, 26, April, 2022

[43] Uganda Police Force, Annual crime report 2020, CCTV photo showing an accident at real time at Nakawa Traffic Lights Junction, 82, 2020, https://www.upf.go.ug/wp- content/uploads/2021/04/ANNUAL-CRIME-REPORT-2020-1.pdf?x74136

