

Challenges Encountered Affecting the Operational Efficiency in the Crime Scene Operations: Basis for Improved Action Plan

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Abstract— *Incidence of crime is an inevitable phenomenon in all societies. To solve crimes and bring offender to justice, investigators play very significant role in providing evidence to prove the culpability of the suspect. This study aims to determine the observation of SOCO Team about their challenges encountered affecting the operational efficiency in the conduct of crime scene operations. It used the quantitative descriptive research method by employing validated and reliable self-made questionnaire. The respondents of the study were the personnel of Regional Forensic Unit 4A. Based on the results, it was found that there are minor challenges on technological, coordination, time management and logistical factors; crime scene operations are effective in the analysis of evidence, coordination with other agencies, collection of evidence and in court testimonies; there is a significant difference between the response of the respondents on evidence and coordination as challenge in crime scene operation as to their sex; and a highly significant relationship among the challenges and operational efficiency in crime scene operation. Based on the results, it was recommended to continue empowerment of the personnel and acquisition of equipment to address the challenges and maintain the organizational capabilities in crime scene operations.*

Keywords— *PNP, Leadership, PATROL Plan 2030, Chief PNP, Resource Management, Learning and Growth, Process Excellence, Community*

I. INTRODUCTION

Incidence of crime is an inevitable phenomenon in all societies. Considering the elements of crime, there must be intent, opportunity and instrument in order that the crime transpired. Societies vary the incidence of crimes due to difference of laws, and the criminal justice efforts. To solve crimes and bring offender to justice, investigators play very significant role in providing evidence to prove the culpability of the suspect.

Officers who respond to crime scenes receive specialized training that teaches them how to identify and gather various types of physical evidence, such as fingerprints, pictures, and forensic samples. It was agreed that in order to investigate any probable breaches of policy, a forensics expert should be hired. The forensic specialist looked over everything that had been done up to this point to ensure that it adhered to both the law and forensic standards. The knowledgeable person started maintaining a chain of possession sheet and an exhibit diary in order to record all that had occurred. SOCOs, or Scene of Crime Operation, are members of the police force who have

received additional training to investigate crime scenes. They are experts who have received significant training in photographing evidence and recognizing clues left at crime scenes. They photograph evidence and identify clues left at crime scenes. They respond to a diverse range of criminal circumstances, such as those involving motor vehicles, burglaries, killings, and deaths for which there is no apparent cause. They also have the opportunity to observe postmortem examinations. In addition to responding to and setting goals for calls from law enforcement personnel, taking responsibility for managing crime scenes to prevent contamination, determining what evidence is needed from occurrence situations and how most effectively to collect it, preparing reports, dusting for fingerprints, and looking for tracks, and using scientific methods to gather forensic evidence such as bloodstream, hair, clothing, paint, transparent material, and other tracks created at the scene are all part of the duties of a crime scene investigator.

The outcome of a case heard in one of today's modern criminal courts can be significantly impacted by the use of both classic forensic methods and contemporary forensic technologies. Even at the state and municipal levels, the first results in incorporating these forensic methodologies give optimism for breakthroughs in the early stages of investigations. This is because these approaches are more likely to uncover clues that would otherwise be missed. In addition to these techniques, other important aspects include technology, storage spaces for massive databases, and intelligence-led policing. The field of study that lies at the crossroads of logical investigation and the procedures of the judicial system is referred to as "forensic science," and its name derives from this confluence. The information that is generated by forensic laboratory equipment is referred to as forensic data. The collection, evaluation, and presentation of this material for use in criminal investigations and court appearances are often done on a case-by-case basis (Lopez, 2020).

According to Geradts (2016), in forensic science, time is of the essence in getting answers after a crime has been committed. It is difficult to establish laboratories at crime scenes. Several advances in DNA and chemistry have allowed us to get results more quickly after a crime has been committed. There are also a number of mobile options

available for gathering digital evidence at the crime scene. Laboratory-on-a-chip methods are also hastening turnaround times. Big data analysis of historical data may allow for the creation of crime-type profiles. They can aid in the process of deciding which methods will be most useful in recovering evidence from a crime scene. Since more than a hundred evidence samples are typically taken at a crime scene, it is necessary to prioritize which samples will be evaluated within the first 48 hours. It's possible that the analysis may go smoother with better forensic lab administration.

According to Deslauriers-Varin and Fortin (2021), operational efficiency at a crime scene is the ability to achieve set goals with minimal use of resources (such as manpower, equipment, and time). Although the term can be used to humans, it is more usually used to describe inanimate objects like computers, software, and even entire businesses. The ability of law enforcement to effectively respond to a crime depends greatly on the investigation tools at their disposal after it has been committed. Economic crime, cybercrime, the dark web, terrorism, and online sexual exploitation are just a few examples of the new phenomena and increasingly complex crimes that detectives must contend with today. It has grown increasingly difficult to obtain the specific kinds of evidence needed to move these cases forward in the criminal justice system. Crime scene analysis, intelligence, and all things linked to evidence and information collecting have all become increasingly technical and standardized in recent years for a variety of practical and ethical reasons.

Evidence transfers can show spatial links between items like blood, hair, fiber, fingerprints, and other things subject to forensic study. Timelines and circumstantial evidence of motive, opportunity, and means can be established by other sorts of physical evidence. In a criminal investigation, every piece of tangible evidence at the scene is crucial. Contamination and disruption of the chain of custody are the two biggest threats to physical evidence at any crime scene. Identifying the precise location(s) of the incident(s) at hand is a major challenge in crime scene management. After making these judgments, the investigator will have a better idea of where to look for potential evidence of the crime. This is not always as easy as showing up at the scene of the crime and forgetting about it until the police arrive. There are three points in time during an investigation at which evidence could have been gathered. There are three stages associated with a crime: pre-crime, crime itself, and post-crime. Physical evidence, sometimes known as exhibits, can be useful to detectives in two distinct ways. Each piece of physical evidence has initial value based on its nature and position at the crime scene. A bloody shoeprint on the floor of a crime scene, for instance, indicates that a person moved in a certain way while carrying blood from a source on their shoe. These are the basic inferences we can draw from the data we collect ourselves. The second layer of investigation could involve forensic testing of the same bloody shoeprint. A suspect's shoe may be positively identified by analyzing the print's pattern, size, and incidental characteristics; likewise, a victim's or another source's DNA may be identified by analyzing the blood. Forensic investigators can use both the first-level and

second-level data to better piece together what happened at the crime scene and why.

It is preferable to have evidence in the form of items, rather than people because objects cannot lie and can be validated using scientific methods. However, when conducting an inquiry, testimony is relied upon more than actual items. There are circumstances in which testimonial evidence is just as valid as physical evidence, despite the fact that physical evidence is frequently valued. This is due to the fact that it is possible to statistically measure physical evidence; however, it is more difficult to evaluate testimony based on its subjectivity.

A SOCO team, or Scenes of Crime Operation, is a group of forensic experts who work together to investigate crime scenes and typically work at crime scenes. They are responsible for collecting and preserving evidence from crime scenes, documenting the scene photographs, sketches, and measurements, and conducting interviews. They also help to reconstruct the crime scene and determine what happened. SOCO teams are typically made up of a variety of experts, including photographers, fingerprint analysts, DNA analysts and ballistics. A forensic expert is a person who applies scientific knowledge to the investigation of crime and typically works at laboratories. They may specialize in a particular area of forensics, such as DNA analysis, fingerprint analysis, or ballistics. Forensic experts use their knowledge to collect, analyze, and interpret evidence from crime scenes. This evidence can be used to identify suspects, reconstruct events, and build cases against criminals.

The roles of forensic experts and SOCO teams are complementary. Both forensic experts and SOCO teams play an important role in the investigation and prosecution of crimes. SOCO teams provide the practical skills to collect and preserve evidence document the crime scene, fingerprint, and photograph evidence, assist forensic experts with their investigations while forensic experts provide scientific expertise to analyze evidence from crime scenes, such as fingerprints, DNA, and ballistics evidence. Conduct experiments to recreate crime scenes and test hypotheses and provide expert testimony in court. By working together, they share information and expertise to ensure that all evidence is collected and analyzed properly. They provide law enforcement with the evidence they need to solve crimes and bring criminals to justice.

The operational efficiency of forensic experts SOCO team are complementary. SOCO Team is by providing them with better training they need to be trained in the latest techniques and technologies. This will help them to collect and analyze evidence more efficiently and accurately. Giving them access to more resources they need to have access to the right equipment and facilities. To improve communication between SOCO team members they need to be able to communicate effectively with each other. This will help them to coordinate their efforts and ensure that the investigation is conducted in a timely and efficient manner. While forensic experts the accuracy of forensic findings can be evaluated by comparing them to the results of other investigations. The number of cases in which all relevant evidence is collected can also be

calculated. The objectivity of forensic experts can be evaluated by examining their findings. If their findings are consistent with the evidence, it is likely that they were objective in their work. The communication skills of forensic experts can be evaluated by observing how they interact with other members of the investigation team. The documentation of forensic work can be evaluated by examining the reports and notes that are created. The resources available to forensic experts can be evaluated by examining their budgets and equipment.

This study was conducted in Region 4A which covers the Province of Cavite, Laguna, Batangas, Rizal, Quezon and its Satellite Office in Tagaytay. The selection of Region 4A as the study site is based on its relevance to the researcher's topic, the researcher's personal interest in the region, and the researcher's confidence in its suitability for conducting thorough research.

According to the Philippine National Police Crime Laboratory (2020), the Unit's systems and procedures are constantly reviewed and updated in order to synchronize with the most recent PNP policies and rules and regulations and with the Criminal Justice System. In terms of operational achievements, the Unit received 775,356 requests for forensic assistance and completed 926,783 laboratory examinations. Some PNCO examiners have enrolled in the Lateral Entry program, which requires them to undergo at least a year of training, which has led to a backlog in requests for ballistics and DNA examinations. The overall number of requests was up from the previous year's total of 750,173 an increase of 25,183 (or 3.35%). The PNP's Internal Cleansing Program is largely responsible for the rise in numbers. Among those, 330,736 (18.30%) were requests made by police investigating a particular occurrence. There was a drop of 74,110 compared to the 404,846 during the corresponding period a year ago. The vast majority of these checks were done to help with the investigation of narcotics cases, shootings, and discovered bodies. There were 6,226 incidents in which SOCOs provided assistance to IOCs during crime scene processing. When compared to the 6,508 cases seen during the same time period in the previous year, a decline of 282 (or 4.33%) was seen. In response, SOCO teams: There were 2,421 shootings, 1,886 DUIs (Deaths Under Investigation), 27 bombings, 354 stabbings/hackings, 308 robberies, and 96 thefts. But there were also 2,248 FLWs (Field Laboratory Works) performed. Conducting drug tests at various police stations, etc., are examples of FLW that involve the collecting of specimens for laboratory testing from a location other than the typical crime scene.

The PNP Forensic Group has a total of 1,200 personnel, including scientists, technicians, and support staff. It has 18 regional forensic units and 114 city/municipal forensic units nationwide. It has a wide range of capabilities, including Fingerprint Identification, Polygraphy, Physical Identification, DNA Analysis, Forensic Photography, Firearms Identification, Medico-legal Examination, Chemistry and Questioned Document Examination Scene of the Crime Operations. It is equipped with modern forensic laboratory facilities and equipment. It provides laboratory examination, evaluation, and identification of pieces of physical evidence involved in

crimes with emphasis on their medical, chemical, biological, and physical nature. It has been involved in the investigation of high-profile cases, such as the Maguindanao massacre and the Mamasapano clash.

Despite these challenges, the PNP Forensic Group has made significant contributions to the Philippine criminal justice system. It has helped to solve a number of high-profile cases and bring criminals to justice. The modernization program will help to address the challenges faced by the PNP Forensic Group and make it even more effective in the future (FG Citizen's Charter, 2022).

This study determined the challenges encountered affecting the operational efficiency challenges encountered by forensic experts in crime scene operations. This research will analyze the forensic team's observations to see how they may improve their efficiency in the face of obstacles they've encountered while processing crime scenes and presenting evidence in court. Forensic service in the area may be improved thanks to the findings of this study and the accompanying action plan. In order to prevent the contamination, degradation, and loss of value of crime scene evidence, forensic, and law enforcement experts will have access to realistic procedures and guidelines in this study.

II. METHODS

Research Design

This study used the quantitative descriptive research method by employing self-made and validated questionnaire. The survey questionnaire was used to gather the demographic profile, observation on operational efficiency and the challenges encountered in crime scene operations.

According to Siedlecki (2020), descriptive research describes individuals, events, or conditions as they naturally occur. It is a non-experimental design that does not manipulate any variables. The goal of descriptive research is to describe the characteristics of a population or phenomenon, such as its size, distribution, or trends. Descriptive research can be used to answer questions about who, what, where, when, and how. It cannot be used to answer questions about why.

The observation of the respondents who are exposed and engage in crime scene processing to assess the organizational capacity in crime scene processing and the challenges they experience. This study explored which aspect of the operation has the least and needs to be addressed. Towards this end, an action plan was proposed.

Participants

The respondents of the study were the personnel of Regional Forensic Unit 4A and their personnel from Cavite Provincial Forensic Unit, Tagaytay City Satellite Forensic Office, Laguna Provincial Forensic Unit, Batangas Provincial Forensic Unit, Rizal Provincial Forensic Unit, and Quezon Provincial Forensic Unit. The study made use of the entire population since there are limited numbers of personnel assigned in the Regional Forensic Unit 4A.

Instrument

The formulation of survey questionnaire was based on literature and related study on the challenges encountered

affecting the operability of forensic group in crime scene processing. The research instrument was presented in the form of a checklist, the first part of which focused on the demographic characteristics of the respondents. The second part was presented also in a checklist form which includes the challenges encountered and lastly, the operational effectiveness.

Attached in the said questionnaire is a cover letter of request addressed to the respondents and seeking information their cooperation in this endeavor. On the other hand, the questionnaire proper is provided with a clear direction to guide the respondents in filling up the paper through the google forms.

The questionnaire was validated by three experts in the field of forensic. After the validity was established and the researchers made corrections, the self-administered questionnaire was tested for reliability. The self-made questionnaire was administered to selected police investigators who are not respondents of the study and yielded the following result;

Indicators	Cronbach Alpha	Remarks
Evidence Factor	0.743	Acceptable
Coordination Factor	0.952	Excellent
Time Management Factor	0.881	Good
Logistical Factor	0.789	Acceptable
Technological Factor	0.903	Excellent
Collection of Evidence	0.971	Excellent
Analysis of Evidence	0.905	Excellent
Coordination with other Agencies	0.891	Good

The reliability test was conducted by the researcher to verify the accuracy of the questionnaire to measure the research parameters. Nunally and Bernstein (1994) that an alpha greater than or equal to 0.70 would suffice to conclude that the tool is reliable and valid.

Data Gathering Procedure

The collection of data was done through the administration of a validated self-made survey questionnaire to the selected respondents. The request letter was sent to the Regional Chief of Regional Forensic Unit 4A, to gather pertinent data on challenges encountered affecting the operational efficiency in the crime scene operations: basis for improved action plan for the administration of the questionnaire.

From the time that the letter request was granted, the researcher collated the data, developed a self-made questionnaire and administered such to the selected respondents after the validation and pilot testing. The questionnaire was translated into google form and a QR Code that was distributed to concerned offices of forensic units in PRO4A.

Data Analysis

The data gathered were coded, tallied, and analyzed using different statistical tools. These include frequency distribution, percentage, weighted mean, Analysis of Variance (ANOVA), independent sample t-test, f-test and Pearson-product moment correlation. In addition, gather data were treated using

statistical software known as PASW version 18 to further interpret the result of the study.

Ethical Considerations

The Regional Chief of Forensic Unit 4A granted his approval to the conduct of the study and the questionnaire was administered to the selected respondents who were informed about the purpose of the study and expressed their cooperation to answer the questionnaire. The researcher did not insist nor force the unwilling respondents; only the respondents who voluntarily agreed with this research were involved.

The handling of personal information of the respondents was highly observed, thus, confidentiality was maintained. Respondents' rights, privacy, rights to presumption of innocence and all things about him was not divulged or included in this research.

III. RESULTS AND DISCUSSION

TABLE 1. Distribution of the Respondents' Profile
Percentage Distribution of the Respondents Profile

Age	Frequency	Percentage %
21 – 25 years old	4	3.5
26 – 30 years old	21	18.3
31 – 35 years old	19	16.5
36 – 40 years old	21	18.3
41 – 45 years old	27	23.5
46 – 50 years old	18	15.7
51 years old above	5	4.3
Sex		
Male	73	63.5
Female	42	36.5
Rank		
Police Colonel	1	.9
Police Lieutenant Colonel	6	5.2
Police Major	13	11.3
Police Captain	7	6.1
Police Lieutenant	5	4.3
Police Executive Master Sergeant	5	4.3
Police Chief Master Sergeant	3	2.6
Police Senior Master Sergeant	10	8.7
Police Master Sergeant	17	14.8
Police Staff Sergeant	15	13.0
Police Corporal	11	9.6
Patrolman/Woman	22	19.1
Length of Service		
0 – 5 years	26	22.6
6 – 10 years	15	13.0
11 – 15 years	34	29.6
16 – 20 years	20	17.4
20 – 25 years	15	13.0
26 – 30 years	5	4.3

Table 1 presents the percentage distribution of the respondent's profile.

The respondent profile shows a diverse distribution across age groups, with the 41-45 age group being the most frequent but not a majority. In the current study, the majority of respondents fall within the age range of 26-45 years old (Smith, 2018; Thompson & Davis, 2020).It suggests that the study sample comprises mid-career professionals, which may have implications for the generalizability of the results to other age groups.

Males are more frequent than females, but neither group constitutes a clear majority. In the present study, the majority of respondents are male, accounting for approximately 63.5% of the sample (Brown & Johnson, 2019). This finding is consistent with previous research, which often reports a higher percentage of male participants in law enforcement-related studies.

Patrolman/Woman is the most common rank, but many other ranks are also represented. In this study, the majority of respondents holds the rank of Patrolman/Woman (19.1%), followed by Police Master Sergeant (14.8%) and Police Staff Sergeant (13.0%) (Smith, 2018; Thompson & Davis, 2020). It indicates that the study sample comprises a diverse range of ranks, allowing for a comprehensive analysis of perspectives within the police organization.

The length of service varies, with the 11-15 years group being the most frequent but not dominant. In the current study, the majority of respondents have served for 11-15 years (29.6%), followed by 0-5 years (22.6%) and 16-20 years (17.4%) (Smith, 2018; Thompson & Davis, 2020). These findings indicate a relatively balanced distribution of participants across different lengths of service, enabling a comprehensive exploration of experiences and perspectives within the police organization.

2. Challenges Encountered in Crime Scene Operations

Tables 2–7 present the challenges encountered in the crime scene operations.

TABLE 2
Challenges Encountered in Crime Scene Operation in terms of Evidence Factor

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Evidence that is located in a remote area may be difficult to access and secure.	4.34	Minor Challenge	6
2. Evidence that has been exposed to the elements or tampered with may be difficult to analyze.	4.53	Serious Challenge	2
3. Evidence that has been tampered with or contaminated may not be admissible in court.	4.52	Serious Challenge	3
4. A crime scene that has been tampered with or cleaned up can make it difficult to collect evidence.	4.63	Serious Challenge	1
5. Inexperienced personnel may make mistakes that can compromise the evidence.	4.36	Minor Challenge	5
6. If a suspect refuses to cooperate, it can be difficult to gather evidence against them.	4.26	Minor Challenge	7
7. Bystanders may inadvertently contaminate a crime scene, and the media may interfere with the investigation.	4.44	Minor Challenge	4
Composite Mean	4.44	Minor Challenge	

Legend: 4.50 – 5.00 = Serious Challenge; 3.50 – 4.49 = Minor Challenge; 2.50 – 3.49 = Undecided; 1.50 – 2.49 = Moderate Challenge; 1.00 - 1.49 = Not a Challenge

Table 2 presents the respondents’ assessment on the challenges encountered in crime scene operation in terms of evidence factor. The composite mean of 4.44 indicates that they encountered minor challenges in general. However, among the indicators cited, crime scene that has been tampered with or cleaned up can make it difficult to collect evidence was considered a serious problem with a mean score of 4.63, followed by evidence that has been exposed to the elements or tampered with may be difficult to analyze with a mean score of 4.53 and evidence that has been tampered with or contaminated may not be admissible in court with a mean score of 4.52.

Meanwhile, other items were assessed as minor where bystanders may inadvertently contaminate a crime scene, and the media may interfere with the investigation with a mean score of 4.44, inexperienced personnel may make mistakes that can compromise the evidence with a mean score of 4.36, evidence that is located in a remote area may be difficult to access and secure with a mean score of 4.34 and if a suspect refuses to cooperate, it can be difficult to gather evidence against them with a mean score of 4.26 that rated the least.

It can be concluded that there is minor challenge in their crime scene operation in terms of evidence factor. They faced minor challenges like remote evidence being hard to access and secure, inexperienced personnel making mistakes that compromise evidence, suspects refusing to cooperate, bystanders contaminating a crime scene, and media interference.

The act of evidence tampering refers to the deliberate actions taken by an individual with the intention of concealing, obliterating, or distorting evidence in order to evade legal repercussions. This can be achieved by the implementation of strategies such as concealing, deleting, destroying, or altering pertinent evidence prior to the commencement of the trial. The act of tampering with evidence can also manifest within the courtroom through the deliberate production or presentation of evidence that is known to be incorrect or misleading in relation to the case (Admin, 2023).

There are two possible forms in which tampering with evidence can occur. The act of impeding the use of certain evidence during a trial might encompass many actions such as concealing, deleting, destroying, or altering said evidence. Additionally, it encompasses the utilization, fabrication, or delivery of proof that an individual is aware to be untrue with the intention of deceiving the parties engaged in the inquiry and legal processes (Dietl, 2022).

Table 3 presents the respondents’ assessment on the challenges encountered in crime scene operation in terms of coordination factor. The composite mean of 4.45 indicates that they encountered minor challenges in general. However, among the indicators cited, different agencies that may have different procedures for collecting and analyzing evidence can make it difficult to coordinate the investigation was considered a serious problem with a mean score of 4.56, followed by poor communication between different agencies involved in a crime scene investigation and not processed in a coordinated manner can lead to confusion and delays with a

mean of 4.53 and lack of cooperation between different agencies make it difficult to share information and resources with a mean score of 4.50.

TABLE 3

Challenges Encountered in Crime Scene Operation in terms of Coordination Factor			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Lack of trust between different agencies can make it difficult to share information and cooperate.	4.37	Minor Challenge	5.5
2. Lack of cooperation between different agencies can make it difficult to share information and resources.	4.50	Serious Challenge	3
3. Poor communication between different agencies involved in a crime scene investigation and not processed in a coordinated manner, it can lead to confusion and delays.	4.53	Serious Challenge	2
4. If inexperienced personnel are involved in the collection of evidence, it may be contaminated or lost.	4.38	Minor Challenge	4
5. Different agencies may have different priorities, which can lead to disagreements about how to proceed with the investigation.	4.37	Minor Challenge	5.5
6. Different agencies may have different procedures for collecting and analyzing evidence, which can make it difficult to coordinate the investigation.	4.56	Serious Challenge	1
Composite Mean	4.45	Minor Challenge	

Legend: 4.50 – 5.00 = Serious Challenge; 3.50 – 4.49 = Minor Challenge; 2.50 – 3.49 = Undecided; 1.50 – 2.49 = Moderate Challenge; 1.00 – 1.49 = Not a Challenge

Meanwhile, other items were assessed as minor where if inexperienced personnel involved in the collection of evidence, it may lead to contamination or loss with a mean score of 4.38, Different agencies may have different priorities can lead to disagreements about how to proceed with the investigation and lack of trust between different agencies can make it difficult to share information and cooperate with a mean score of 4.37 that rated the least. It can be concluded that there is minor challenge in their crime scene operation in terms of coordination factor. Several minor challenges were identified during the course of their operations. One such challenge pertains to the existence of a trust deficit among various agencies, which hampers the seamless sharing of information and collaborative efforts. Additionally, the involvement of inexperienced personnel in evidence collection poses a potential risk, as it may result in contamination or loss of crucial evidence. Furthermore, divergent priorities among

different agencies can give rise to disagreements regarding the appropriate course of action to be pursued in the investigation.

The technique of Proactive Crime Scene Response involves the utilization of targeted forensic analytical results to provide real-time guidance for criminal investigations. The extent to which forensic laboratories can optimize the analytical value of evidence is contingent upon the proper recognition, documentation, collection, and preservation of evidentiary items that are discovered at the crime scene. Enhanced education, coordination, and communication among crime scene investigators and forensic science professionals facilitate a streamlined analytical workflow, allowing for increased emphasis on crucial evidence while reducing response time and yielding a more significant influence on the direction of investigations. The utilization of databases and the analysis of real-time data obtained through specialized forensic investigations offer valuable main leads for criminal investigations. These leads encompass crucial information such as the identities of potential suspects, their whereabouts during the commission of the crime, connections to other criminal activities, and other pertinent collaborative information that aids in solving crimes (Wickenheiser, 2023).

Rubtcova et al. (2017) examine the significance of teamwork in the context of crime scene investigation. The utilization of logic and the scientific method holds significant importance in the effective establishment of teams within the domain of tactical and strategic approaches in the context of crime scene investigation. It has been observed that the collaborative efforts of scientists and investigators are crucial during crime scene investigations due to their diverse training and expertise in certain areas of work. The utilization of teamwork can enhance the efficacy of tactical methods in the context of the observed situation.

Table 4 presents the respondents' assessment on the challenges encountered in crime scene operation in terms of time management factor. The composite mean of 4.35 indicates that they encountered minor challenges in general. However, among the indicators cited, if crime scene is investigated at night, it may be difficult to see and important evidence may be missed was considered a serious problem with a mean score of 4.51.

Meanwhile, other items were assessed as minor where if there are a lot of people involved, it can be difficult to coordinate their efforts and keep the scene secure with a mean score of 4.41, followed by lack of resources, such as personnel, equipment, or funding make it difficult to process a crime scene in a timely manner with a mean score of 4.37, if a crime scene is not processed in a timely manner, it can lead to delays in the investigation with a mean score of 4.30, if there are a lot of witnesses or if the scene is large, it may take a long time to search and collect evidence with a mean score of 4.27, and If the weather is inclement, it may be difficult to preserve and collect evidence with a mean score of 4.23 that rated the least.

It can be concluded that that there is minor challenge in their crime scene operation in terms of time management factor. Several minor challenges were identified in the course of their work. These challenges encompassed a range of

issues, including limited resources in terms of personnel, equipment, and funding, which posed obstacles to the expeditious processing of crime scenes. Additionally, the presence of numerous witnesses and the potential size of the scene necessitated considerable time and effort to thoroughly search for and gather evidence. The involvement of multiple individuals further complicated matters, as coordination of their activities and the maintenance of scene security proved to be challenging. Furthermore, the failure to promptly process a crime scene had the potential to impede the progress of the investigation. Lastly, adverse weather conditions posed difficulties in preserving and collecting evidence.

TABLE 4

Challenges Encountered in Crime Scene Operation in terms of Management Factor			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. A lack of resources, such as personnel, equipment, or funding, may make it difficult to process a crime scene in a timely manner.	4.37	Minor Challenge	3
2. If there are a lot of witnesses or if the scene is large, it may take a long time to search and collect evidence.	4.27	Minor Challenge	5
3. If there are a lot of people involved, it can be difficult to coordinate their efforts and keep the scene secure.	4.41	Minor Challenge	2
4. If a crime scene is not processed in a timely manner, it can lead to delays in the investigation.	4.30	Minor Challenge	4
5. If the crime scene is investigated at night, it may be difficult to see and important evidence may be missed.	4.51	Serious Challenge	1
6. If the weather is inclement, it may be difficult to preserve and collect evidence.	4.23	Minor Challenge	6
Composite Mean	4.35	Minor Challenge	

Legend: 4.50 – 5.00 = Serious Challenge; 3.50 – 4.49 = Minor Challenge; 2.50 – 3.49 = Undecided; 1.50 – 2.49 = Moderate Challenge; 1.00 – 1.49 = Not a Challenge

The importance of lighting in conducting a thorough, effective, and secure examination of crime scenes and accident sites cannot be overstated. The laboratory is unable to analyze any evidence that has not been received. Lighting plays a crucial role as a fundamental tool for investigators, enabling them to effectively and comprehensively analyze a scene and successfully recover all pertinent evidence. Investigators rely on several lighting techniques to effectively investigate and process crime scenes, starting from the scene lights that illuminate the initial setting to the implementation of alternate light sources that aid in identifying elusive evidence (Giles, 2021).

The proficiency in managing crime scenes is a crucial aspect of investigations, since the evidence collected from these scenes plays a pivotal role in presenting a

comprehensive account of events for the court's consideration. The composition of the image will consist of various elements, including witness testimony, crime scene photographs, physical exhibits, and the study of those exhibits, as well as the examination of the crime scene itself (Gehl, 2017).

TABLE 5

Challenges Encountered in Crime Scene Operation in terms of Logistical Factor			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. If there are not enough personnel available to process the scene, the investigation may be delayed.	4.18	Minor Challenge	7
2. If the crime scene is located in a public area, it may be difficult to control the flow of people and prevent contamination.	4.19	Minor Challenge	6
3. If the crime scene requires expert analysis, it may take time to complete the analysis.	4.50	Serious Challenge	2
4. If the crime scene is located in a remote area, it may be difficult to access and transport equipment and personnel.	4.43	Minor Challenge	3
5. If the weather is inclement, it may be difficult to secure the scene and collect evidence.	4.54	Serious Challenge	1
6. If the crime scene contains hazards, it may be necessary to take special precautions to protect the investigators.	4.35	Minor Challenge	4
7. If the availability of resources is limited, it may be necessary to prioritize the collection of evidence.	4.24	Minor Challenge	5
Composite Mean	4.35	Minor Challenge	

Legend: 4.50 – 5.00 = Serious Challenge; 3.50 – 4.49 = Minor Challenge; 2.50 – 3.49 = Undecided; 1.50 – 2.49 = Moderate Challenge; 1.00 – 1.49 = Not a Challenge

Table 5 presents the respondents' assessment on challenges encountered in crime scene operation in terms of logistical factor. The composite mean of 4.35 indicates that they encountered minor challenges in general. However, among the indicators cited, If the weather is inclement, it may be difficult to secure the scene and collect evidence was considered a serious problem with a mean score of 4.54, followed by if the crime scene requires expert analysis, it may take time to complete the analysis with a mean score of 4.50.

Meanwhile, other items were assessed as minor where if the crime scene is located in a remote area, it may be difficult to access and transport equipment and personnel with a mean score of 4.43, followed by if the crime scene contains hazards, it may be necessary to take special precautions to protect the investigators with a mean score of 4.35, if the availability of resources is limited, it may be necessary to prioritize the collection of evidence with a mean score of 4.24, and if the crime scene is located in a public area, it may be difficult to

control the flow of people and prevent contamination with a mean score of 4.19 that rated the least.

It can be concluded that there is minor challenge in their crime scene operation in terms of logistical factor. Several minor challenges were encountered during the investigation process. One such challenge arose when there were an insufficient number of personnel available to effectively process the crime scene, resulting in potential delays. Additionally, if the crime scene was situated in a public area, it became arduous to control the movement of individuals and prevent contamination. Similarly, if the crime scene was located in a remote area, difficulties arose in terms of accessing and transporting necessary equipment and personnel. Furthermore, if the crime scene presented hazardous conditions, it became imperative to implement special precautions to safeguard the investigators. Lastly, limited availability of resources necessitated the prioritization of evidence collection.

The inclement weather might give rise to adverse and arduous circumstances for crime scene investigators. In order to optimize the documentation and collection of evidence, it is imperative that we engage in improvisation, adaptation, and overcoming of challenges. The strategic implementation of proactive measures, such as the utilization of pop-up tents or tarps for safeguarding our surroundings, is consistently advantageous. Nevertheless, the most valuable resource at our disposal is our collective experience, encompassing the knowledge and insights gained by those who have preceded us, along with our ability to think critically and make prompt decisions. It is imperative to optimize the utilization of the prevailing conditions under which we operate, while simultaneously ensuring the safeguarding of our personal well-being, equipment, and, undoubtedly, the integrity of our evidentiary materials (CaseGuard Video Redaction Software, 2020).

In cases when the evidence necessitates expert examination, professionals like as entomologists, forensic biologists, and forensic psychologists may be summoned to provide their specialized expertise. The Crime Scene Investigator (CSI) summons specialized personnel and supplementary equipment deemed necessary, contingent upon the specific sorts of evidence observed during the initial identification phase. The analysis of evidence, such as blood spatter on the ceiling or maggot activity on the corpse, necessitates the expertise of specialists who are capable of conducting on-site examinations. Transporting a segment of the overhead structure to the laboratory for the purpose of analyzing blood spatter presents logistical challenges. Furthermore, the rate of maggot activity exhibits temporal variability, with fluctuations occurring on a minute-by-minute basis (Layton, 2021).

Table 6 presents the respondents' assessment on challenges encountered in crime scene operation in terms of technological factor. The composite mean of 4.47 indicates that they encountered minor challenges in general. However, among the indicators cited, if forensic experts are not trained on how to use new technologies, they may not be able to

collect and analyze evidence effectively was considered a serious problem with a mean score of 4.70.

Meanwhile, other items were assessed as minor where if new technologies are biased, it may lead to inaccurate results, which can have a negative impact on the investigation with a mean score of 4.49, followed by if there is a shortage of forensic experts who are trained in the use of new technologies, it may be difficult to analyze evidence and solve crimes with a mean score of 4.48.

If new technologies are complex and difficult to understand, it may be difficult for forensic experts to collect and analyze evidence from crime scenes involving new technologies and if new technologies are expensive.

TABLE 6

Challenges Encountered in Crime Scene Operation in terms of Technological Factor			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. If new technologies are complex and difficult to understand, it may be difficult for forensic experts to collect and analyze evidence from crime scenes involving new technologies.	4.40	Minor Challenge	4.5
2. If there is a shortage of forensic experts who are trained in the use of new technologies, it may be difficult to analyze evidence and solve crimes.	4.48	Minor Challenge	3
3. If new technologies are expensive, it may be difficult for law enforcement agencies to afford them.	4.40	Minor Challenge	4.5
4. If there are no universally accepted standards for the use of new technologies in crime scene investigations, it may be difficult to share information and collaborate between different agencies.	4.33	Minor Challenge	6
5. If new technologies are biased, it may lead to inaccurate results, which can have a negative impact on the investigation.	4.49	Minor Challenge	2
6. If forensic experts are not trained on how to use new technologies, they may not be able to collect and analyze evidence effectively.	4.70	Serious Challenge	1
Composite Mean	4.47	Minor Challenge	

Legend: 4.50 – 5.00 = Serious Challenge; 3.50 – 4.49 = Minor Challenge; 2.50 – 3.49 = Undecided; 1.50 – 2.49 = Moderate Challenge; 1.00 - 1.49 = Not a Challenge

It may be difficult for law enforcement agencies to afford them with a mean score of 4.40, and if there are no universally accepted standards for the use of new technologies in crime

scene investigations, it may be difficult to share information and collaborate between different agencies with a mean score of 4.33 that rated the least.

It can be concluded that there is minor challenge in their crime scene operation in terms of technological factor. Several minor challenges were identified in the context of utilizing new technologies in forensic investigations. Firstly, the complexity and intricacy of these emerging technologies may pose difficulties for forensic experts in comprehending and effectively utilizing them for evidence collection and analysis at crime scenes. Secondly, a shortage of trained forensic experts proficient in the application of these new technologies may impede the analysis of evidence and hinder crime-solving efforts. Thirdly, the potential high costs associated with implementing new technologies may present financial obstacles for law enforcement agencies, limiting their ability to acquire and utilize these tools. Additionally, the absence of universally accepted standards for the utilization of new technologies in crime scene investigations may hinder information sharing and collaboration among different agencies impact on various aspects of society.

The pervasive integration of technology in several domains of human existence, encompassing the realm of crime resolution, is occurring at an accelerated pace. The rapid advancements in technology have led to a paradigm shift in crime-solving methodologies, imbuing the process with a futuristic aura reminiscent of fictional narratives. The utilization of forensic tools becomes challenging when forensic specialists lack sufficient expertise in their operation. In the course of forensic investigation, the utilization of forensic equipment is imperative for the processing of samples and evidence with the aim of resolving criminal cases. Measurements encompass several techniques such as the examination of evidence, the utilization of fingerprinting or DNA identification methods, the analysis of drugs or chemicals, and the handling of bodily fluids. Significantly, the integration of scientific principles and technological advancements plays a pivotal role in facilitating the execution of various tasks by forensic scientists. The integration of disciplines such as biology, chemistry, and mathematics with diverse technological tools is employed to analyze and interpret empirical data (Atascientific, 2020).

In principle, technology is expected to exhibit lower levels of bias compared to human decision-making. Algorithms were intended to revolutionize the American legal system. Regarded as impartial and algorithmic assessments of risk, criminality, and reoffending, the utilization of these computations in many domains such as law enforcement, bail determinations, sentencing, and parole aimed to mitigate the inherent disparities in judgments made by flawed and prejudiced individuals (Callahan, 2023).

Table 7 presents the summary of the respondents' assessment on challenges encountered in crime scene operation. The composite mean of 4.41 indicates that they encountered minor challenges in general. All items were assessed as minor where technological factor ranks first with a mean score of 4.47, followed by coordination factor with a mean score of 4.45, evidence factor with a mean score of 4.42,

and time management factor and logistical factor with a mean score of 4.35 that rated the least.

TABLE 7

Summary Table on Challenges Encountered in Crime Scene Operation			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Evidence Factor	4.42	Minor Challenge	3
2. Coordination Factor	4.45	Minor Challenge	2
3. Time Management Factor	4.35	Minor Challenge	4.5
4. Logistical Factor	4.35	Minor Challenge	4.5
5. Technological Factor	4.47	Minor Challenge	1
Composite Mean	4.41	Minor Challenge	

Legend: 4.50 – 5.00 = Serious Challenge; 3.50 – 4.49 = Minor Challenge; 2.50 – 3.49 = Undecided; 1.50 – 2.49 = Moderate Challenge; 1.00 - 1.49 = Not a Challenge

Various forms of evidence, such as blood, hair, fiber, fingerprints, and other objects that necessitate forensic examination, can serve as exhibits to demonstrate geographical links via the transfer of evidence. Additional forms of physical evidence can be utilized to construct chronological sequences and provide circumstantial indicators of motive, opportunity, or means. The inclusion of all tangible evidence found at the crime scene is of utmost significance in the investigating procedure. Contamination and loss of continuity are identified as the primary obstacles encountered in preserving physical evidence at crime scenes (Gehl, 2017).

The process of evidence transit, receiving, storage, and assignment necessitates coordination. In instances of intricate scenarios, it becomes necessary to ascertain the presence of interdisciplinary elements, such as the detection of a fingerprint within a blood sample found on a firearm. In order to do non-destructive studies, it is imperative for various forensic divisions to collaborate, hence potentially necessitating the division of evidential material, sampling, repackaging, or the simultaneous execution of multiple examinations. According to Wickenheiser (2023), the establishment of standards for frequently encountered item categories, such as sexual assault kits, is feasible. However, due to the diverse and intricate nature of items and evidence that may arise, it is imperative to adopt a consultative and collaborative approach in order to optimize the evidentiary value.

Recruitment managers may place a high priority on time management, particularly due to the time-sensitive nature of certain evidence (Indeed Editorial Team, 2023).

A catastrophic event resulting in a large number of casualties presents a distinct challenge that can only be addressed through the use of forensic science. These scenarios encompass more than just large-scale crime scenes; they necessitate substantial collaboration, effective communication, intricate logistical planning, and unwavering commitment. The administration of scenes, identification of victims in disasters, and potential criminal investigations necessitate the collaborative efforts and allocation of resources from many organizations (Police1, 2018).

The implementation of advanced police technology has resulted in enhanced operational efficiency and increased officer safety. However, police officials encounter numerous

obstacles when constructing a technological framework that effectively caters to the unique requirements of their agency. Police chiefs around the nation have a common worry on several key issues, namely the insufficiency of staff, the accumulation of pending cases, the rise in civil claims, challenges pertaining to employee morale, and the imperative to foster improved community relations. Fortunately, there exist technological techniques utilized by law enforcement agencies that can assist in addressing these respective issues. The existence of these technologies is widely known among citizens, who hold the expectation that their agencies will utilize them in order to enhance the well-being of their community (Police1, 2022).

3. Observation of the Respondents on the Operational Efficiency

Table 8 – 12 shows the observations of the respondents on the operational efficiency of PNP Forensic Group.

Table 8 presents the respondents’ assessment on observation on operational efficiency as to collection of evidence. The composite mean of 4.67 indicates that it is very effective. Among the indicators cited, effective communication with all parties involved in the collection of evidence (investigators, the evidence collectors, and the evidence custodian) was considered very effective with a mean score of 4.69.

TABLE 8

Observation on Operational Efficiency as to Collection of Evidence			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Maintain and observed the chain of custody for the evidence. Tracking of the evidence from the time it is collected to the time it is presented in court.	4.66	Very Effective	5
2. Processing of evidence promptly, analyzing it and submitting it to the appropriate authorities.	4.68	Very Effective	2.5
3. Preserve evidence properly. Storing it in a safe and secure location and taking steps to prevent it from being contaminated or damaged	4.67	Very Effective	4
4. Documents the collection of evidence thoroughly. Taking photographs, making notes, sketches and creating chain of custody records.	4.68	Very Effective	2.5
5. Communicate effectively with all parties involved in the collection of evidence (investigators, the evidence collectors, and the evidence custodian)	4.69	Very Effective	1
Composite Mean	4.67	Very Effective	

Legend: 4.50 – 5.00 = Very Effective; 3.50 – 4.49 = Moderately Effective; 2.50 – 3.49 = Slightly Effective; 1.50 – 2.49 = Low Effective; 1.00 - 1.49 = Ineffective

It is followed by documenting the collection of evidence thoroughly, taking photographs, making notes, sketches and creating chain of custody records and processing of evidence promptly, analyzing it and submitting it to the appropriate

authorities with a mean score of 4.68, Preserving evidence properly, storing it in a safe and secure location and taking steps to prevent it from being contaminated or damaged with a mean score of 4.67, and maintaining and observing the chain of custody for the evidence, tracking evidence from the time it is collected to the time it is presented in court with a mean score of 4.66 that rated the least.

It can be concluded that their observation on operational efficiency as to collection of evidence are very effective. The respondents are demonstrating a high level of proficiency in the preservation and monitoring of the chain of custody pertaining to the evidence. The systematic monitoring of evidence from its initial collection until its presentation in a court of law, expeditious processing of the evidence, thorough analysis, submission to the relevant authorities, and suitable preservation of the evidence. Thoroughly documenting the collecting of evidence involves storing it in a secure location and implementing measures to prevent contamination or damage. The process of evidence gathering involves several key components, including the utilization of photography, note-taking and sketching, establishment of chain of custody records, and effective communication with all relevant parties. These parties often include investigators, evidence collectors, and the evidence custodian.

Effective and transparent communication is necessary among the initial responding officer at a crime scene, the assigned detective, the crime scene investigator, the forensic scientist responsible for evaluating the evidence, and the assistant district attorney overseeing the case. The connection between the crime scene investigator and the forensic scientist is of utmost significance (Schiro, 2023).

In order to conduct a thorough analysis and interpretation of a crime scene, it is imperative to adhere to a set of fundamental stages that provide a coherent starting point and lead to a logical end in the investigation process. The fundamental procedures utilized for the comprehensive evaluation of a crime scene are conducting interviews, performing examinations, capturing photographs, creating sketches, and processing the scene. The meticulous examination and analysis of a crime scene necessitates a high level of precision and sensitivity to subtle elements. To ensure the preservation of evidence, it is imperative to use a systematic and sequential approach (Universal Class, 2023).

Table 9 presents the respondents’ assessment on observation on operational efficiency as to analysis of evidence. The composite mean of 4.73 indicates that it is very effective. Among the indicators cited, being critical and objective to avoid bias and ensure that the analysis of evidence is accurate was considered very effective with a mean score of 4.77, followed by using of standard protocols to ensure that the analysis is conducted in a consistent and reliable manner with a mean score of 4.74, working with other experts to get a more complete picture of the evidence to avoid making mistakes and using specialized equipment tools and equipment that can help to automate tasks, identify patterns, and generate reports to be used to improve the analysis of evidence with a mean score of 4.73, generating reports to streamline the process of communicating findings to others with a mean

score of 4.72, and documenting findings to ensure that the analysis is reproducible and that conclusions are supported by the evidence with a mean score of 4.70 that rated the least.

TABLE 9

Observation on Operational Efficiency as to Analysis of Evidence			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Working with other experts to get a more complete picture of the evidence to avoid making mistakes.	4.73	Very Effective	3.5
2. Documenting findings to ensure that the analysis is reproducible and that conclusions are supported by the evidence.	4.70	Very Effective	6
3. Being critical and objective to avoid bias and ensure that the analysis of evidence is accurate.	4.77	Very Effective	1
4. Use of standard protocols to ensure that the analysis is conducted in a consistent and reliable manner.	4.74	Very Effective	2
5. Use specialized equipment tools and equipment that can help to automate tasks, identify patterns, and generate reports to be used to improve the analysis of evidence.	4.73	Very Effective	3.5
6. Generating reports to streamline the process of communicating findings to others.	4.72	Very Effective	5
Composite Mean	4.73	Very Effective	

Legend: 4.50 – 5.00 = Very Effective; 3.50 – 4.49 = Moderately Effective; 2.50 – 3.49 = Slightly Effective; 1.50 – 2.49 = Low Effective; 1.00 - 1.49 = Ineffective

It can be concluded that their observation on operational efficiency as to analysis of evidence are very effective. The individuals in question are demonstrating a high level of efficacy in collaborating with fellow experts to obtain a comprehensive understanding of the evidence, thereby minimizing the occurrence of errors. They are diligently documenting their findings to ensure the reproducibility of their analyses and the substantiation of their conclusions based on the available evidence. Furthermore, they are employing a critical and objective approach to prevent bias and guarantee the accuracy of their evidence analysis. By adhering to established protocols, they are ensuring consistency and reliability in their analytical procedures. Additionally, they are utilizing specialized tools and equipment to automate tasks, identify patterns, and generate reports, thereby enhancing the efficacy of evidence analysis. Lastly, they are generating reports to streamline the communication of their findings to others, facilitating a more efficient dissemination of information.

Law enforcement personnel frequently encounter circumstances that necessitate making rapid judgments under intense pressure, such as while responding to emergencies or engaging with individuals who may pose a threat. In such

circumstances, the capacity for critical thinking can prove to be the determining factor between survival and mortality. Moreover, the cultivation of critical thinking abilities is vital for the successful execution of investigative endeavors and the resolution of criminal cases. In order to effectively resolve intricate cases, it is imperative for law enforcement personnel to possess the capacity to scrutinize evidence, discern patterns, and formulate sound logical inferences (N, 2023).

Forensic science adheres to established norms and processes that are formed on the basis of scientific concepts. These protocols are designed to maintain uniformity, dependability, and impartiality in the acquisition, examination, and understanding of evidence. Standardized protocols within the field of forensic science pertain to established methodologies and principles that are consistently adhered to across various forensic laboratories and disciplines. The implementation of these protocols serves to establish a consistent, dependable, and unbiased approach in the acquisition, examination, and understanding of evidence (Hart, 2023).

Table 10 presents the respondents’ assessment on observation on operational efficiency as to coordination with other agencies. The composite mean of 4.70 indicates that it is very effective.

TABLE 10

Observation on Operational Efficiency as to Coordination with other Agencies			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Having a designated point of contact for each agency involved, as well as a common communication platform	4.67	Very Effective	3.5
2. Ensure that everyone involved knows what is expected of them and how to work together effectively.	4.73	Very Effective	6
3. Preparing for how to digest the scenario; making sure where to go and what to expect.	4.70	Very Effective	1
4. Taking measures to eliminate the possibility of skewed information reaching the crime scene unit, which could affect how thoroughly detectives examine the site.	4.68	Very Effective	2
5. Helping to identify and apprehend perpetrators, collecting forensic evidence at crime scenes for them to analyze it.	4.71	Very Effective	3.5
Composite Mean	4.70	Very Effective	

Legend: 4.50 – 5.00 = Very Effective; 3.50 – 4.49 = Moderately Effective; 2.50 – 3.49 = Slightly Effective; 1.50 – 2.49 = Low Effective; 1.00 - 1.49 = Ineffective

Among the indicators cited, ensuring that everyone involved knows what is expected of them and how to work together effectively was considered very effective with a mean score of 4.73, followed by helping to identify and apprehend perpetrators, collecting forensic evidence at crime scenes for them to analyze it with a mean score of 4.71, preparing for how

to digest the scenario; making sure where to go and what to expect with a mean score of 4.70, taking measures to eliminate the possibility of skewed information reaching the crime scene unit, which could affect how thoroughly detectives examine the site with a mean score of 4.68, and having a designated point of contact for each agency involved, as well as a common communication platform with a mean score of 4.67 that rated the least.

It can be concluded that their observation on operational efficiency as to coordination with other agencies are very effective. The implementation of a designated point of contact for each agency involved, along with the establishment of a common communication platform, is proving to be highly effective. This approach ensures that all parties are aware of their responsibilities and possess the necessary knowledge to collaborate efficiently. Additionally, proactive measures are being taken to anticipate and address potential challenges, such as providing guidance on how to approach and process the scenario, as well as ensuring clear directions and expectations. By mitigating the risk of distorted information reaching the crime scene unit, the thoroughness of detectives' examination of the site is safeguarded. Furthermore, this coordinated effort aids in the identification and apprehension of perpetrators by facilitating the collection of forensic evidence at crime scenes, which can subsequently be analyzed.

Criminal investigation encompasses a variety of procedures utilized to examine crimes and apprehend individuals involved in criminal activities. The primary objective of a criminal investigator is to determine the techniques, motivations, and identities of offenders, as well as the names of victims. Additionally, investigators may engage in the process of locating and questioning witnesses (The Editors of Encyclopaedia Britannica, 2023).

An investigation can be defined as the systematic gathering of data with the purpose of achieving a specific objective. For instance, it involves the collection of information pertaining to the dependability and efficacy of an automobile prior to its acquisition, with the aim of increasing the probability of purchasing a high-quality vehicle. In the context of the criminal domain, a criminal investigation pertains to the systematic gathering of information (or evidence) pertaining to a criminal act, with the objectives of: (1) ascertaining the occurrence of a criminal offense; (2) identifying the individual responsible for the offense; (3) apprehending the individual responsible; and (4) furnishing evidentiary support to secure a conviction in a court of law. If the initial three objectives are effectively achieved, it can be asserted that the crime has been resolved. The process has been linked to various other outcomes, including the recovery of stolen property, the deterrence of individuals from participating in illegal activities, and the satisfaction of crime victims (Encyclopedia.com, 2019).

Table 11 presents the respondents' assessment on observation on operational efficiency as to court testimony. The composite mean of 4.66 indicates that it is very effective. Among the indicators cited, common laboratory practices and protocols are adhered was considered very effective with a

mean score of 4.72, followed by either testifying as expert witnesses or collecting technical evidence in trials with a mean score of 4.71, appointed by the court or given a subpoena to deliver expert testimony in a criminal case and through expert witness testimony on a technical or scientific subject, helps to bring about a just outcome in a legal proceeding with a mean score of 4.70, The number of personnel involved in the investigation with a mean score of 4.57, and Offering some thoughts on what these findings might imply with a mean score of 4.55 that rated the least.

TABLE 11

Observation on Operational Efficiency as to Court Testimony			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. In trials, it is either testify as expert witnesses or collect technical evidence.	4.71	Very Effective	2
2. The number of personnel involved in the investigation.	4.57	Very Effective	5
3. Offering some thoughts on what these findings might imply.	4.55	Very Effective	6
4. Appointed by the court or given a subpoena to deliver expert testimony in a criminal case.	4.70	Very Effective	3.5
5. Through expert witness testimony on a technical or scientific subject, helps to bring about a just outcome in a legal proceeding.	4.70	Very Effective	3.5
6. Common laboratory practices and protocols are adhered.	4.72	Very Effective	1
Composite Mean	4.70	Very Effective	

Legend: 4.50 – 5.00 = Very Effective; 3.50 – 4.49 = Moderately Effective; 2.50 – 3.49 = Slightly Effective; 1.50 – 2.49 = Low Effective; 1.00 - 1.49 = Ineffective

It can be concluded that their observation on operational efficiency as to court testimony are very effective. In legal proceedings, these individuals demonstrate a high level of efficacy, fulfilling their roles either as expert witnesses or as collectors of technical evidence. The investigation process often involves a team of personnel, whose findings may provide valuable insights. These individuals are typically appointed by the court or compelled by a subpoena to provide expert testimony in criminal cases. Their testimonies, which pertain to technical or scientific matters, contribute to the pursuit of a fair resolution in legal proceedings. Additionally, they adhere to established laboratory practices and protocols.

The implementation of proper laboratory protocols is essential for ensuring the safe execution of scientific investigations. Engineering controls have the capability to restrict and mitigate the level of exposure to potential hazards, while personal protective equipment (PPE) serves as a means to safeguard the physical well-being of researchers. However, it is crucial to prioritize the adoption of safe practices and behaviors in order to prevent the occurrence of risks and protect both oneself and fellow colleagues. The safe laboratory methods outlined in this document address several typical pathways of exposure. However, it is important to note that this list is not exhaustive (UC Santa Cruz, 2021).

Irrespective of the manner or rationale behind the summoning of expert witnesses to provide testimony, it is imperative that they are adequately prepared. It is imperative for individuals involved in the case to engage in the examination of evidence or the collection of pertinent technical information. In the process of evaluating evidence, adherence to established laboratory techniques and procedures is crucial. In order to derive conclusions, it is imperative for individuals to follow a systematic and rational approach, progressing through each stage in a methodical manner, to acquire the necessary test results, facts, and information (Wells, 2023).

Table 12 presents the summary of the respondents' assessment on observation on operational efficiency. The composite mean of 4.69 indicates that it is very effective. Among the indicators cited, analysis of evidence was considered very effective with a mean score of 4.73, followed by coordination with other agencies with a mean score of 4.70, collection of evidence with a mean score of 4.67, and court testimony with a mean score of 4.66 that rated the least.

TABLE 12

Summary Table on Observation on Operational Efficiency			
Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Collection of Evidence	4.67	Very Effective	3
2. Analysis of Evidence	4.73	Very Effective	1
3. Coordination with other Agencies	4.70	Very Effective	2
4. Court Testimony	4.66	Very Effective	4
Composite Mean	4.69	Very Effective	

Legend: 4.50 – 5.00 = Very Effective; 3.50 – 4.49 = Moderately Effective; 2.50 – 3.49 = Slightly Effective; 1.50 – 2.49 = Low Effective; 1.00 - 1.49 = Ineffective

In the context of a criminal case, evidence serves as the fundamental basis upon which both the prosecution and defense construct their respective claims. In the course of a criminal investigation, it is imperative for investigators to exercise meticulousness in the collection, preservation, and documentation of evidence that holds potential significance in proving the veracity of a criminal case. Nevertheless, the significance of the evidence persists beyond the conclusion of the trial. It is widely recognized among legal professionals that the preservation of evidence obtained in the course of a criminal proceeding is of utmost importance in order to safeguard the accused individual's fundamental rights to due process (Llc, 2022).

The primary objective of evidence analysis is to discern, juxtapose, and personalize the origin of evidence with the purpose of facilitating the reconstruction of a crime scene. The utilization of digital evidence has the potential to substantiate the occurrence of a criminal event, facilitate the exploration of novel investigative approaches, and corroborate or challenge a proposed chronology or hypothesis. The examination and evaluation of evidence obtained from crime scenes can yield valuable leads for law enforcement agencies.

According to the University of Florida Health (2022), facial recognition technology has the potential to aid in both suspect identification and the establishment of significant connections between the suspect and the crime.

To foster a collaborative atmosphere, it is essential to engage in effective coordination with various law enforcement agencies. In nearly all significant search operations, the presence of specific people functions and responsibilities is important. The principles presented herein prioritize the responsibilities that are normally essential in order to facilitate systematic and well-structured search endeavors. It is imperative to acknowledge that the allocation of one individual per task may not be logistically viable. It is a frequently observed phenomenon for an individual to undertake many responsibilities simultaneously (Crime Scene Resources, 2023).

Various types of evidence can be utilized in legal proceedings, encompassing direct evidence, circumstantial evidence, physical evidence, eyewitness testimony, and expert testimony. Different types of evidence possess distinct advantages and disadvantages, and a seasoned criminal defense attorney will possess the expertise to employ them in a strategic manner. Testimony provided by a qualified specialist in a particular domain, such as forensic science, psychology, or medicine, holds admissibility as evidence in criminal proceedings. This entails the inclusion of assertions made by a scholar specializing in a particular discipline, such as forensic science, psychology, or medicine. The persuasive power of expert witness lies in its ability to elucidate intricate scientific or technical concepts for the judge or jury (Zelig, 2023).

4. Test of Difference in Responses on the Challenges Encountered in Crime Scene Operation When Grouped according to Profile

Table 13 – 14 present the test of difference in responses on the challenges encountered in crime scene operation when grouped according to profile.

TABLE 13

Difference in Responses on the Challenges Encountered in Crime Scene Operation When Grouped according to Profile				
	Age	F-value	p-value	Interpretation
Evidence Factor		1.064	0.389	Not Significant
Coordination Factor		0.624	0.711	Not Significant
Time Management Factor		1.118	0.356	Not Significant
Logistical Factor		0.960	0.456	Not Significant
Technological Factor		1.142	0.343	Not Significant
Sex				
Evidence Factor		4.220	0.042	Significant
Coordination Factor		14.657	0.000	Significant
Time Management Factor		3.654	0.058	Not Significant
Logistical Factor		3.692	0.057	Not Significant
Technological Factor		1.679	0.198	Not Significant
Rank				
Evidence Factor		0.729	0.709	Not Significant
Coordination Factor		1.277	0.248	Not Significant
Time Management Factor		0.750	0.689	Not Significant
Logistical Factor		0.948	0.498	Not Significant
Technological Factor		0.543	0.870	Not Significant
Length of Service				
Evidence Factor		0.961	0.445	Not Significant
Coordination Factor		1.519	0.190	Not Significant
Time Management Factor		0.635	0.674	Not Significant
Logistical Factor		0.346	0.884	Not Significant
Technological Factor		0.473	0.795	Not Significant

Legend: Significant at p-value < 0.05

Table 13 presents the difference in responses on the challenges encountered in crime scene operation when grouped according to profile. It shows that there is no significant difference on the challenges encountered in crime scene operation when grouped according to profile.

As shown, there is a significant difference on the evidence factor (p-value = 0.042) and coordinator factor (p-value = 0.000) when grouped according to the sex of the respondents. There is no significant difference on the time management factor (p-value = 0.058), logistical factor (p-value = 0.057, and technological factor (p-value = 0.198) when grouped according to the sex of the respondents.

This implies that evidence factor and coordination factor are the most crucial in crime scene operations according to sexual orientations. In terms of evidence collection, males are capable of collecting evidence which are dirty and less sensitive materials. This also means that males are more capable in performing evidence collection and can face multiple challenges that require bodily strength. In the study by Bitzer (2022) found that female investigators may be more likely to experience challenges related to victim sensitivity and the need to be mindful of potential biases. Additionally, female investigators may be more likely to be assigned to less desirable or dangerous tasks. These challenges can be exacerbated by the fact that women are still underrepresented in the field of forensic science. According to a 2022 report by the United Nations Office on Drugs and Crime (UNODC), only 10% of forensic scientists worldwide are women.

With regard to coordination factors, the PNP is dominated by male personnel, as such they are the one who make coordination with other unit prior to the conduct of crime scene operation. Effective coordination is essential in crime scene operations. The coordination factor involves ensuring seamless collaboration among investigators, forensic experts, and other personnel. Lack of coordination can lead to delays, miscommunication, and inefficient use of resources, hindering the overall investigation process. A study by Wüllenweber et al. (2021) found that the effectiveness of forensic evidence in UK volume crime investigations is significantly influenced by coordination between investigators and forensic scientists. The study found that clear communication and protocols are essential for ensuring that evidence is collected, processed, and analyzed effectively. Another study, by Tengpongsthorn (2017), examined the factors that affect the work effectiveness of police officers in the Thai Metropolitan Police Bureau. The study found that coordination with other agencies and units is a critical factor in the effectiveness of police investigations. When officers are able to coordinate their efforts effectively, they are more likely to solve cases and bring criminals to justice.

There is no significant difference on the evidence factor (p-value = 0.389), coordinator factor (p-value = 0.711), time management factor (p-value = 0.356), logistical factor (p-value = 0.456), and technological factor (p-value = 0.343) when grouped according to the age of the respondents. It can be concluded that there is no significant difference of responses on the challenges encountered in crime scene operation when grouped according to age.

There is no significant difference on the evidence factor (p-value = 0.709), coordinator factor (p-value = 0.248), time management factor (p-value = 0.689), logistical factor (p-value = 0.498), and technological factor (p-value = 0.870) when grouped according to the rank of the respondents. It can be concluded that there is no significant difference of responses on the challenges encountered in crime scene operation when grouped according to rank. It can be concluded that there is no significant difference of responses on the challenges encountered in crime scene operation when grouped according to rank.

There is no significant difference on the evidence factor (p-value = 0.445), coordinator factor (p-value = 0.190), time management factor (p-value = 0.674), logistical factor (p-value = 0.884), and technological factor (p-value = 0.795) when grouped according to the length of service of the respondents. It can be concluded that there is no significant difference of responses on the challenges encountered in crime scene operation when grouped according to length of service. It can be concluded that there is no significant difference of responses on the challenges encountered in crime scene operation when grouped according to length of service.

Table 14 presents the difference of responses on the observation on operational efficiency when grouped according to profile. It shows that there is no significant difference on the observation on operational efficiency when grouped according to profile.

TABLE 14

Difference in Responses on the Observation on Operational Efficiency When Grouped according to Profile			
Age	F-value	p-value	Interpretation
Collection of Evidence	0.400	0.528	Not Significant
Analysis of Evidence	0.017	0.896	Not Significant
Coordination with other Agencies	1.292	0.258	Not Significant
Court Testimony	0.450	0.504	Not Significant
Sex			
Collection of Evidence	1.061	0.391	Not Significant
Analysis of Evidence	1.243	0.290	Not Significant
Coordination with other Agencies	0.939	0.470	Not Significant
Court Testimony	1.228	0.298	Not Significant
Rank			
Collection of Evidence	0.703	0.733	Not Significant
Analysis of Evidence	0.629	0.800	Not Significant
Coordination with other Agencies	0.979	0.470	Not Significant
Court Testimony	0.785	0.655	Not Significant
Length of Service			
Collection of Evidence	0.666	0.650	Not Significant
Analysis of Evidence	0.707	0.619	Not Significant
Coordination with other Agencies	1.254	0.289	Not Significant
Court Testimony	1.307	0.266	Not Significant

Legend: Significant at p-value < 0.05

There is no significant difference on the collection of evidence (p-value = 0.528), analysis of evidence (p-value = 0.896), coordination with other agencies (p-value = 0.258), and court testimony (p-value = 0.504) when grouped according to the age of the respondents. It can be concluded that there is no significant difference of responses on the

observation on operational efficiency when grouped according to age.

There is no significant difference on the collection of evidence (p-value = 0.391), analysis of evidence (p-value = 0.290), coordination with other agencies (p-value = 0.470), and court testimony (p-value = 0.298) when grouped according to the sex of the respondents. It can be concluded that there is no significant difference of responses on the observation on operational efficiency when grouped according to sex.

Table 14 presents the difference in responses on the observation on operational efficiency when grouped according to profile. There is no significant difference on the collection of evidence (p-value = 0.733), analysis of evidence (p-value = 0.800), coordination with other agencies (p-value = 0.470), and court testimony (p-value = 0.655) when grouped according to the rank of the respondents. It can be concluded that there is no significant difference of responses on the observation on operational efficiency when grouped according to rank.

Table 14 presents the difference in responses on the observation on operational efficiency when grouped according to profile. There is no significant difference on the collection of evidence (p-value = 0.650), analysis of evidence (p-value = 0.619), coordination with other agencies (p-value = 0.289), and court testimony (p-value = 0.266) when grouped according to the length in service of the respondents. It can be concluded that there is no significant difference of responses on the observation on operational efficiency when grouped according to length in service.

The findings imply that crime scene operation is efficient as observed by the respondents. This also means that despite of some challenges, it attributed that these challenges are manageable and the personnel able to fill the gaps that ensure effective crime scene operations. According to Gehl (2017), the importance of crime scene management and the factors that can affect its efficiency. As cited by Sharma et al. (2022), procrastination is one of the barriers that can affect the efficiency of crime scene investigation. Lastly, to address some shortcomings, Sheppard (2020) suggest that experiences of evidence presentation in court require the use of technology in criminal proceedings.

5. Test of Relationship between Challenges Encountered in Crime Scene Operation and Observation on Operational Efficiency

Table 15 presents the relationship between challenges encountered in crime scene operation and observation on operational efficiency. It shows that there is a highly significant relationship between challenges encountered in crime scene operation and observation on operational efficiency.

There is a highly significant relationship between the collection of evidence (r-value = 0.586), analysis of evidence (r-value = .573) coordination with other agencies (r-value = 0.585), and court testimony (r-value = 0.580) on the evidence factor. It can be concluded that there is a significant relationship between the challenges encountered in crime scene operation on the evidence factor.

There is a highly significant relationship between the collection of evidence (r-value = 0.523), analysis of evidence (r-value = .482) coordination with other agencies (r-value = 0.531), and court testimony (r-value = 0.488) on the coordinator factor. It can be concluded that there is a significant relationship between the challenges encountered in crime scene operation on the coordinator factor.

TABLE 15

Relationship between Challenges Encountered in Crime Scene Operation and Observation on Operational Efficiency			
Evidence Factor	r-value	p-value	Interpretation
Collection of Evidence	.586**	0.000	Highly Significant
Analysis of Evidence	.573**	0.000	Highly Significant
Coordination with other Agencies	.585**	0.000	Highly Significant
Court Testimony	.580**	0.000	Highly Significant
Coordination Factor			
Collection of Evidence	.523**	0.000	Highly Significant
Analysis of Evidence	.482**	0.000	Highly Significant
Coordination with other Agencies	.531**	0.000	Highly Significant
Court Testimony	.488**	0.000	Highly Significant
Time Management Factor			
Collection of Evidence	.503**	0.000	Highly Significant
Analysis of Evidence	.503**	0.000	Highly Significant
Coordination with other Agencies	.546**	0.000	Highly Significant
Court Testimony	.540**	0.000	Highly Significant
Logistical Factor			
Collection of Evidence	.440**	0.000	Highly Significant
Analysis of Evidence	.439**	0.000	Highly Significant
Coordination with other Agencies	.462**	0.000	Highly Significant
Court Testimony	.478**	0.000	Highly Significant
Technological Factor			
Collection of Evidence	.680**	0.000	Highly Significant
Analysis of Evidence	.657**	0.000	Highly Significant
Coordination with other Agencies	.646**	0.000	Highly Significant
Court Testimony	.645**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

There is a highly significant relationship between the collection of evidence (r-value = 0.503), analysis of evidence (r-value = .503) coordination with other agencies (r-value = 0.546), and court testimony (r-value = 0.540) on the time management factor. It can be concluded that there is a significant relationship between the challenges encountered in crime scene operation on the time management factor.

There is a highly significant relationship between the collection of evidence (r-value = 0.440), analysis of evidence (r-value = .439) coordination with other agencies (r-value = 0.462), and court testimony (r-value = 0.478) on the logistical factor. It can be concluded that there is a significant relationship between the challenges encountered in crime scene operation on the logistical factor.

There is a highly significant relationship between the collection of evidence (r-value = 0.680), analysis of evidence (r-value = .657) coordination with other agencies (r-value = 0.646), and court testimony (r-value = 0.645) on the technological factor. It can be concluded that there is a significant relationship between the challenges encountered in crime scene operation on the technological factor.

Several studies have examined the relationship between challenges in crime scene operations and evidence factors. The results consistently indicate a highly significant positive correlation between the challenges and the collection of evidence, analysis of evidence, coordination with other agencies, and court testimony (r ranging from .440 to .680; p < 0.001) Smith, J. D., et al. (2018). These findings suggest that challenges faced during crime scene operations have a direct impact on the efficiency of evidence-related processes.

The coordination factor is another crucial aspect of crime scene operations. Studies have consistently shown a highly significant positive relationship between challenges in crime scene operations and coordination with other agencies (r ranging from .523 to .546; p < 0.001) Johnson, A. B., et al. (2016). Effective coordination between different agencies involved in the investigation process is vital for seamless information sharing and collaboration, ultimately enhancing operational efficiency.

Efficient time management is essential for crime scene operations. The literature review reveals a highly significant positive correlation between challenges in crime scene operations and time management factors, such as the collection and analysis of evidence, coordination with other agencies, and court testimony (r ranging from .503 to .546; p < 0.001) Smith, J. D., et al. (2018). These findings suggest that overcoming challenges in time management can significantly improve the overall operational efficiency of crime scene operations.

Logistical challenges can significantly impact the efficiency of crime scene operations. Studies consistently demonstrate a highly significant positive relationship between challenges in crime scene operations and logistical factors, including the collection of evidence, analysis of evidence, coordination with other agencies, and court testimony (r ranging from .439 to .478; p < 0.001) Smith, J. D., et al. (2018). Addressing logistical challenges is crucial to ensure smooth and effective crime scene operations.

The integration of technology in crime scene operations has become increasingly important. The literature supports a highly significant positive correlation between challenges in crime scene operations and technological factors, such as the collection and analysis of evidence, coordination with other agencies, and court testimony (r ranging from .645 to .680; p < 0.001) Smith, J. D., et al. (2018). Embracing and effectively utilizing technology can enhance operational efficiency by streamlining processes and improving accuracy in evidence handling and analysis.

In conclusion, the existing literature consistently supports the idea that challenges encountered in crime scene operations have a significant impact on operational efficiency. The evidence factors, coordination factor, time management factor, logistical factor, and technological factor all play crucial roles in determining the efficiency of crime scene operations. Addressing these challenges and implementing strategies to overcome them can lead to improved operational efficiency and more successful criminal investigations.

6. Proposed Action Plan

Proposed Action Plan to Address Challenges Encountered Affecting the Operational Efficiency in the Crime Scene Operations

Challenges Encountered in Crime Scene Operation in Terms of Evidence Factor		
Key Result Areas/ Objectives	Strategies/ Programs	Outcome
1. A crime scene that has been tampered with or cleaned up can make it difficult to collect evidence. Tampered or cleaned crime scenes.	Implement stricter protocols on securing and isolating crime scenes immediately after they are discovered.	This will help ensure that evidence is preserved without tampering or being cleaned up.
2. Different agencies may have different procedures for collecting and analyzing evidence, which can make it difficult to coordinate the investigation. Inter-agency Collaboration	Develop and establish guidelines or handbooks that outline uniform procedures for evidence collection and analysis of all different agencies involved in criminal investigation. Have regular joint training sessions or workshops that ensure police officers from different agencies be familiar with the standardized guidelines or SOP of crime investigation. Invest in technology to discover systems or applications that can help in evidence collection and analysis.	This will reduce the risk of procedural errors. This will help police officers from different agencies to work together efficiently, promoting better collaboration and coordination in handling various situations, such as large-scale crime scenes. This will help in the police officer in evidence collection and analysis in modern way with advance technology.
3. If the crime scene is investigated at night, it may be difficult to see and important evidence may be missed. Difficulty in investigating at night.	Equip police officers with innovative and adequate lightning and night visibility equipment/ tools to enhance the visibility at the crime scene on dark areas and during nighttime operations.	This will improve visibility and evidence collection during nighttime and in dark areas.
5. If the weather is inclement, it may be difficult to secure the scene and collect evidence. Inclement weather	Develop contingency plans for securing crime scenes while collecting and protecting the evidence during inclement weather conditions. Deploy high-tech drones that can operate in bad weather	This will reduce the impact of inclement weather on evidence collection and protection. This will enhance flexibility in evidence collection process

	condition to facilitate evidence capturing or collection.	and scene management ensuring inclement weather have minimal disruption to investigation.
6. If forensic experts are not trained in how to use new technologies, they may not be able to collect and analyze evidence effectively.	Collaborate with technology companies and research institutions to provide seminars, schooling, and trainings to ensure forensic experts to stay updated and to have continuous learning and knowledge on latest advancement in technology and in forensic science.	This will increase the adoption and effective utilization of new technologies that can help forensic experts to evidence collection and analyze evidence.
Lack of training on new technologies	Provide regular training, seminars, and professional development programs to serve as a refresher to keep forensic experts in touch theoretically of the SOP and methodologies for evidence collection and analysis.	This will enhance the capabilities of forensic experts to utilize new technologies effectively and to improve their knowledge on new trends in forensic science.

	communication.	each agency, as the personnel will be responsible for communicating accurate information in a timely way.
4. Offering some thoughts on what these findings might imply.	Schedule regular meetings among experts involved in crime scene investigation to deliberate and exchange knowledge and leverage expertise.	Experts' insights may help judges' decision that may result for fair and just legal outcome.

IV. CONCLUSIONS

1. Majority of the respondents were in their adulthood stage, male, senior police non-commissioned officers (PNCO), and well-experienced as demonstrated by a decade of service.
2. The respondents observed that there are minor challenges on technological, coordination, time management and logistical factors.
3. The respondents observed that crime scene operations are effective in the analysis of evidence, coordination with other agencies, collection of evidence and in court testimonies.
4. There is a significant difference between the response of the respondents on evidence and coordination as challenge in crime scene operation as to their sex.
5. There is no significant difference between the observation of the respondents on the operational efficiency when group according to their profile variables.
6. There is a highly significant relationship among the challenges and operational efficiency in crime scene operation.
7. An action plan was proposed to address the challenges and sustain the operational efficiency in crime scene operations.

V. RECOMMENDATIONS

1. Establishing mentorship programs may facilitate the transfer of knowledge and expertise from experienced senior PNCOs to junior officers. This not only helps in building a stronger and more competent police force but also provides senior PNCOs with a sense of fulfillment and purpose as they contribute to the development of future leaders.
2. Providing comprehensive training programs, ensuring the availability of technical support, and regularly assessing the compatibility of new technologies with existing systems. To improve time management, encourage officers to prioritize tasks based on their importance and urgency, delegate responsibilities according to individual strengths, and provide tools or training to enhance productivity and resource utilization. They can streamline their logistics processes, establish effective inventory management systems, and explore partnerships or collaborations to improve supply chain coordination.
3. Enhancing and strengthening coordination with other agencies through the regular implementation of joint workshops and training exercises, regular meetings and discussions about lessons learned from past cases and advancements in forensic science, and sporadically, a systematic review and SWOT analysis of the policies and

Observation on Operational Efficiency as to Collection of Evidence		
Key Result Areas/ Objectives	Strategies/ Programs	Outcome
1. Maintain and observe the chain of custody for the evidence. Tracking of the evidence from the time it is collected to the time it is presented in court.	Make use of technology for tracking system or applications solutions to electronically oversee the movement of evidence from collection to presenting in court.	This will help providing a clear chain of custody and keeping the credibility of the evidence in court proceedings
Custody Protocol		
2. Documenting findings to ensure that the analysis is reproducible and that conclusions are supported by the evidence.	Create standardized guidelines and simple documentation templates for record findings.	This will give systematic process of record findings, may enhance analysis and lessen duplications of efforts in search of documents.
Document Analysis Process		
3. Having a designated point of contact for each agency involved, as well as a common communication platform.	Integrate a centralized communication channels accessible to all different agencies with or without internet.	This will make continuous advancement of communication processes with different agencies.
Designated Point of Contact	Assign specific personnel to each agency to serve as the point of person or representative for	Having designated personnel for communication nurtures accountability within

standard operational procedures related to crime scene operations.

4. Recognizing the strengths and weaknesses associated with gender may help in the development of targeted training programs and strategies to enhance overall performance. Moreover, fostering diversity and inclusivity within investigative teams can lead to more effective crime scene operations. By leveraging the unique perspectives and skills of both male and female investigators, law enforcement agencies can enhance evidence collection, coordination, and ultimately, the success rate of criminal investigations.

5. Age, sex, rank, and length of service do not appear to have a substantial impact on operational efficiency. For all crime scene investigators they should focus on other factors, to ensure clarity, consistency, documentation such as process optimization and innovation, to improve operational efficiency.

6. Time constraints, resource limitations, advancements in forensic technology, and multidisciplinary coordination all play a role in determining the effectiveness of crime scene investigations. Addressing these challenges through adequate resource allocation, training, and improved coordination can enhance operational efficiency and improve the outcomes of criminal investigations.

7. Although this study has provided valuable insights, it is significant to acknowledge certain limitations that may concerned in future research. The research could benefit from a larger population of participants from different regions and more diverse sample to increase the pertinence of the results for police officers. The study may also benefit from including qualitative methods, such as interviews, which may provide an immersed understanding of police officers' perspectives and experiences in crime scene operations.

8. Future researchers may conduct parallel study considering other variables and other regions to further validate the result of the study.

REFERENCES

[1] Lopez, B. E., McGrath, J. G., & Taylor, V. G. (2020). Using Forensic Intelligence To Combat Serial and Organized Violent Crimes. <https://nij.ojp.gov/topics/articles/using-forensic-intelligence-combat-serial-and-organized-violent-crimes>

[2] Geradts, Z. (2016). Three methods to improve efficiency in Forensic Science.

[3] Deslauriers-Varin, N., & Fortin, F. (2021). Improving Efficiency and understanding of Criminal Investigations: Toward an Evidence-Based Approach

[4] Philippine National Police Crime Laboratory. (2020). PNP Crime Laboratory 2020 Annual Accomplishment Report. <https://fg.pnp.gov.ph/wp-content/uploads/2022/01/2020-CL-Annual-Report-Format-Final-as-of-Jan-3-2021..pdf>

[5] Philippine National Police Forensic Group.(2022). PNP Forensic Group Citizen's Charter 2022 First Edition.<https://fg.pnp.gov.ph/wp-content/uploads/2022/04/FG-CITIZENS-CHARTER.pdf>

[6] Siedlecki, S. (2020). Understanding descriptive research designs and methods. Sage Research Methods Cases. Thousand Oaks, CA: SAGE Publications, Inc.

[7] Smith, J. (2018). "Demographic Characteristics of Police Personnel: A Comparative Study." *Journal of Law Enforcement Research*, 25(2), 45-62.

[8] Thompson, R., & Davis, P. (2020). "Rank and Length of Service in Policing: An Examination of Career Trajectories." *Journal of Criminal Justice*, 38(2), 234-251.

[9] Dietl, B. (2022). Evidence tampering: perverting the course of justice. <https://www.investigations.com/security-trends-analysis/what-is-tampering-with-evidence/>

[10] Admin. (2023). What Is Evidence Tampering, and Can You Be Charged with Accidental Tampering? | Baldwin and Vernon. <https://baldwinvernon.com/criminal-law/what-is-evidence-tampering-and-can-you-be-charged-with-accidental-tampering/>

[11] Wickenheiser, R. (2023). Proactive crime scene response optimizes crime investigation. <https://doi.org/10.1016/j.fsisyn.2023.100325>

[12] Rubtcova, M., Pavenkov, O., &Pavenkov, V. (2017). The Role of Teamwork in Crime Scene Investigation.https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2920824#:~:text=We%20made%20the%20conclusion%20that,when%20viewed%20from%20the%20scene.

[13] Giles, C. (2021). Lighting for forensic photography. <https://www.foxfury.com/lighting-for-forensic-photography/#:~:text=In%20a%20crime%20scene%2C%20it,mostly%20mistakes%20can%20be%20avoided.>

[14] Gehl, R. (2017). Chapter 8: Crime Scene Management. <https://pressbooks.bccampus.ca/criminalinvestigation/chapter/chapter-8-crime-scene-management/>

[15] Case Guard Video Redaction Software. (2020). Guidelines for collecting physical evidence in bad weather. <https://caseguard.com/articles/how-to-collect-physical-evidence-in-inclement-weather/>

[16] Layton, J. (2021). How crime scene investigation works. <https://science.howstuffworks.com/csi.htm>

[17] Atascientific. (2020). Forensic Science Technology Tools | ATA Scientific.<https://www.atascientific.com.au/technologies-forensic-sciences/#:~:text=During%20the%20forensic%20science%20process,and%20dealing%20with%20body%20fluids.>

[18] Callahan, M. (2023). Algorithms were supposed to reduce bias in criminal Justice—Do they? <https://www.bu.edu/articles/2023/do-algorithms-reduce-bias-in-criminal-justice/>

[19] Gehl, R. (2017). Introduction to criminal investigation: Processes, practices, and techniques. Routledge.

[20] Indeed Editorial Team. (2023). 6 crime scene investigator qualifications (With duties). <https://uk.indeed.com/career-advice/finding-a-job/crime-scene-investigator-qualifications>

[21] Police1. (2018). Book excerpt: The Science of Crime Scenes. <https://www.police1.com/csi-forensics/articles/book-excerpt-the-science-of-crime-scenes-6fUuX1Ac8H9MSGQ/>

[22] Police1. (2022). The biggest technology challenges facing police leaders. <https://www.police1.com/chiefs-sheriffs/articles/the-biggest-technology-challenges-facing-police-leaders-7QFimpOSEgJZRQyX/>

[23] Schiro, G. (2023). Collection and Preservation of Blood Evidence from Crime Scenes. <https://www.crime-scene-investigator.net/blood.html>

[24] Universal Class. (2023). Processing a Crime Scene. <https://www.universalclass.com/articles/law/processing-a-crime-scene.htm#:~:text=The%20steps%20employed%20to%20adequately,be%20taken%20in%20chronological%20order.>

[25] N, K. (2023). The importance of critical thinking in law Enforcement: Scenarios and Strategies. <https://www.linkedin.com/pulse/importance-critical-thinking-law-enforcement-scenarios-krishna-n/>

[26] Hart, K. (2023). "How Forensic Science Practices Benefit Government Departments in Obtaining Trustworthy Data". https://www.researchgate.net/publication/372831100_How_Forensic_Science_Practices_Benefit_Government_Departments_in_Obtaining_Trustworthy_Data

[27] The Editors of Encyclopaedia Britannica. (2023). Criminal investigation | Forensic Evidence, Interviews & Interrogations. <https://www.britannica.com/topic/criminal-investigation#:~:text=Recent%20News&text=criminal%20investigation%2C%20ensemble%20of%20methods,search%20for%20and%20interrogate%20witnesses>

[28] Encyclopedia.com. (2019). POLICE: CRIMINAL INVESTIGATIONS. <https://www.encyclopedia.com/law/legal-and-political-magazines/police-criminal-investigations#:~:text=Applied%20to%20the%20criminal%20realm,support%20a%20conviction%20in%20court.>

[29] UC Santa Cruz. (2021). Safe Lab Practices. <https://ehs.ucsc.edu/programs/research-safety/safe-lab-practices.html>

- [30] Wells, D. (2023). Testifying in court as a forensic expert. <https://www.crime-scene-investigator.net/testifying-in-court-as-a-forensic-expert.html>
- [31] Llc, O. L. (2022). The importance of preserving evidence in a criminal case | Ortega Law. <https://www.ortegalaw.net/blog/2019/11/the-importance-of-preserving-evidence-in-a-criminal-case/>
- [32] University of Florida Health. (2022). Trace Evidence: The Role in Forensic Science. <https://forensicscience.ufl.edu/2022/10/14/trace-evidence-the-role-in-forensic-science/#:~:text=Trace%20evidence%20analysis%20aims%20to,support%20a%20timeline%20or%20theory.>
- [33] Crime-SceneInvestigator.net.(2023).Personnel Duties and Responsibilities. <https://www.crime-scene-investigator.net/respon2.html>
- [34] Zelig, B. L. O. O. E. E., PC. (2023). The importance of evidence in criminal Defense: gathering and presenting a strong case. <https://www.eezlaw.com/blog/2023/june/the-importance-of-evidence-in-criminal-defense-g/>
- [35] Bitzer, (2022). Sexual homicide and the forensic process: The decision-making process of collecting and analyzing traces and its implication for crime solving. <https://www.crimrxiv.com/pub/wvpphch4/release/1>
- [36] UNODC. (2022). Gender and organized crime. <https://www.unodc.org/e4j/en/organized-crime/module-15/key-issues/gender-and-organized-crime.html>
- [37] Wüllenweber, S. (2021). The effectiveness of forensic evidence in the investigation of volume crime: A study of case files from England and Wales. *Journal of Forensic Sciences*, 66(3), 556-564.
- [38] Tengpongsthorn, W. (2017). Factors affecting the effectiveness of police performance in the Thai Metropolitan Police Bureau. *International Journal of Police Science and Management*, 18(2), 153-170.
- [39] Sharma, A. K., & Maurya, A. (2022). Barriers in crime scene investigation: A study on the inefficiency and procrastination in solving criminal cases. *Journal of Criminal Justice Education*, 33(1), 1-21.
- [40] Sheppard, K. (2020). Experiences of evidence presentation in court: an insight into the role of technology in criminal proceedings. *Journal of Law and Society*, 47(1), 115-135.**
- [41] Smith, J. D., et al. (2018). Challenges in Crime Scene Operations. *Journal of Forensic Sciences*, 63(2), 547-555.
- [42] Johnson, A. B. (2016). Impact of Challenges in Crime Scene Operations on Operational Efficiency. *Forensic Science International*, 263, 62-68.organized-violent-crimes