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Mathematics of Criminals and Intelligence of Organised Crime

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Abstract
This paper addresses the issue of the intelligence analytics model in organized crime detection and prevention. The article describes the intelligence's role in detecting and preventing organized crime. We describe three classes or levels of the informational needs of the criminalist for the detection and prevention of organized crimes: information classes A, B, and C. The information in class A signifies operational information, class B provides information about investigation purposes, and class C provides information about the intelligence's role/purpose. The paper established the generic intelligence analytic detection and prevention strategies, which are desire-based strategy (DBS), which changes the behavior of the individual (e.g. parenting, radicalization, etc.), ability-based strategy (ABS), which aims to limit the criminal power or ability in conducting crime (e.g. Seizing the assets, restrict access of information, use of a password, anti-virus software, etc.), and opportunistic based strategy (OBS) which aims to limit the opportunity of the crime to commit crimes by increases the risk of the commit crime (e.g. Extra police or community patrols, prison sentences, surveillance device, etc.). The paper concludes that the informational need of criminalists is determined by pyramid hierarchal information class A (operational), class B (investigative role), and class C (intelligence roles). Consequently, we recommend information class A for combating crime, class B for detecting crime, and class C for prevention. If the criminalist only wants to combat crimes, he needs only class-A information. If the criminal needs to detect the presence of criminality, use class B, and the criminalist intends to prevent the crime, he needs class C information. The criminal analyst needs the information in the sequence of ABC.

Keywords: Crime Prevention, Intelligence Analytic Model, Information Classes, Criminal Associative Coefficient

1. Introduction

In security studies, learning the techniques for detecting and preventing crime is a matter of great importance. Due to the advancement of communication technology, criminals now use communication technology such as mobile phones, WhatsApp, telegram, etc., to coordinate or organize their illegal activities. This communication technology facilitates and enables the commission of organized transnational crimes such as terrorism, human trafficking, smuggling, drug dealing, etc. The detection and prevention of such crimes became cumbersome because most organized crimes are well-planned, calculated, and timely implemented (Seger, 2003; Albanese, 2001) [6, 1]. The organizer can communicate from one country to another or within the countries due to the advancement of communication technology that criminals may use. A country must have the capacity or ability to detect and prevent crime using *manned and unmanned plans* to be secure and peaceful. The manned planned crime detection and prevention models/plans are the plans or models that involve the use of people to detect and prevent crime in the sources, such as trained police, community, experts, and others. On the other hand, the unmanned crime detection and prevention model is a plan that aims to use unmanned technology such as optical surveillance tools, radar, satellites, etc. One of the champions of police modernization is Sir. Robert Peel (1829) first introduced the nine principles of effective policing for law enforcers to prevent crimes and to maintain peace and security by using community support. The first principle of Robert Peel states that the fundamental mission for which the police exist is to prevent crime and disorder as an alternative to the repression of crime and disorder by military force and severity of legal punishment. Avoiding crime and disorder is fundamental to creating and maintaining societal peace.

Crime prevention is now the priority consideration in maintaining security and peace in any country. The Crime Prevention Directive, UN Economic and Social Council Resolution No. 2002/13 confirmed that there is clear evidence that well-planned crime prevention strategies not only prevent crime and victimization but also promote community safety and contribute to the sustainable development of countries. Effective, responsible crime prevention enhances the quality of life of all citizens. It has long-term benefits in terms of reducing the costs associated with the formal criminal justice system and other social costs resulting from crime. Crime prevention offers opportunities for a humane and more cost-effective approach to the problems of crime. The present guidelines outline the necessary elements for effective crime prevention (UN, 2002) [8]. The UN guidelines defined crime prevention as *strategies and measures* that seek to *reduce the risk of crimes occurring* and their potentially harmful effects on individuals and society, including *fear* of crime, by *intervening to influence their multiple causes (*UN, 2010*)* [9].

Determining what factors are associated with different types of crime can lead to developing strategies and programs to change those factors and prevent or reduce the incidence of those crimes (UN, 2010; Home Office, 2016) [9, 3]. Some scholars on crime prevention report that optimal crime prevention strategies involve the multi-sector tackling of the multiple causes of crime (Home Office, 2016; Waller, n.d) [3, 10]. The components of such an integrated strategy would include but are not limited to interventions focusing on children and families at risk, increasing social cohesion, improving the environmental conditions of crime hot spots, and placing more emphasis on problem-oriented policing (Waller, n.d; Sherman *et al*. 1998) [10, 7]. These strategies are centered on diagnosing the local crime problem, implementing a plan, and evaluating the implementation process and impacts on local crime rates (Waller, n.d; Home Office., 2016) [10, 3]. Moreover, studies suggest that prevention strategies and programs involve the institute setting such communities (e.g. Robert Peel's Principles, social morals, and rules, etc.), families (e.g. visits and early child moral development, reduce child abuse), schools (e.g., Peer group counseling, life skill program, labor markets (e.g., employment opportunities, etc.), places (e.g. businesses, hotels, and other locations), police (e.g. extra patrol) and criminal justice agencies after arrest (Home Office, 2016; Waller, n.d; Sherman *et al*. 1998) [3, 10, 7]. Effective crime prevention strategies and programs are multi-sectoral (Sherman *et al*. 1998) [7].

Kapur (n.d) identifies four prevention strategies/models; the first model is the developmental model, which emphasizes the early intervention of the individual's criminal behavior to deter crime in the future. It involves programs such as parenting programs, school upgrading initiatives, preschool administrations, and improvements in changes to school procedures. The second model is the social model. In this, the society or community's morals and rules incorporate reinforcing crime prevention. This model supports the principle of modern policing of Sir. Robert Peel (1829) used the community to prevent crime and disorder. The third model is a situational model, which puts a restraint upon the instances of crime as an active way of preventing crime (Kapur, n.d). This model emphasizes increasing the risks of discovery, reducing the rewards for insulting and offending individuals, and increasing the efforts of supporting and helping individuals in all ways to prevent crime (Kapur, n.d). Situational crime prevention can be as modest as installing locks and alarms, increasing investigation through lighting, and making buildings harder to enter, damage, or hide near. The houses and buildings should be constructed in such a manner that they cannot be destroyed, and during the night time, one should keep the windows and doors locked (Kapur, n.d). The fourth model is criminal justice, which aims to change and strengthen the laws that impose severe penalties upon individuals for the serious criminal acts that they have committed. Progressively, there is an acknowledgment that there are sharper ways to curb crime; this model and the other models of crime prevention work together to implement crime prevention strategies in an operative manner (Kapur, n.d).

Most studies identify five stages of formulating crime prevention: First is to develop the crime profile to enable the criminalist to know clear ideas on the types of crimes that are prevented within the area (Home Office, 2016 [3]; Kapur, n.d). The crime profile will be categorized in 5W+H information. Most important in this stage is to understand the why factors behind the occurrence of the crime, who the individuals that are involved in it, and who are the victims of it will contribute to the development of the strategies that can precisely lead to a reduction in crime (Kapur, n.d). The second stage is to research the why factors. In this stage, the criminalist wants to investigate the factors that lead to crime prevention (Home Office, 2016 [3]; Kapur, n.d). Crimes are usually committed when an individual has to attain something. Hence, the most vital approach is the hardening of the targets (Kapur, n.d). When the targets become difficult to achieve, the individuals must return from engaging in any criminal act (Kapur, n.d). The third stage is seeking or negotiating the stakeholders' support because implementing the strategy shall involve crime prevention stakeholders. Therefore, we need to negotiate the support of the agencies and other organizations that influence the factors causing crime (Kapur, n.d). For example, if the consumption of alcohol, which leads to murder or rape, has proved to be disruptive within the community, then support would be negotiated with local licensees and transport providers (NSW, n.d [5]; Kapur, n.d). The fourth stage is to develop an action plan involving the activities to reduce or prevent the specific crime. The last stage, the fifth, is implementing and monitoring the crime prevention strategy. In this stage, one should enable the actions and projects to be appropriately targeted. Enable selecting the appropriate participants and locations for carrying out the plan and assist with measuring the project outcomes. Evaluation of the crime prevention strategy is considered vital because the evaluation system should primarily focus on the consequences and results (Kapur, n.d).

The aforementioned detection and prevention strategies or models are not described in intelligence analytic ways. Although the mentioned strategies and programs generally describe the changing behavior as a way of preventing, it is weighted on combating strategies that result in a reduction, not prevention of crime, especially organized crime. This is because the strategies or programs are drawn from the general causes of crime, not specific crimes. Thus, we are motivated to establish a prevention crime strategy based on the ***preventive crime triangle***. In this case, we introduce the classes or level of the information needed by the criminalist

in preventing organized crime.

2. Informational Need of Criminalists (Classes of Criminal Information)

In criminal decisions, law enforcers' organs, such as police, prisons, etc., need proper and timely information about the crime. Therefore, we need to establish the appropriate "model or theory of informational needs for criminalists. That is, in this paper, we establish the general model statement (theory of the informational need of criminalists) which states that "*the criminalist's need of criminal information are interacting and shifting up in pyramidal from operational, investigation to intelligence level of roles* (Fig 1).

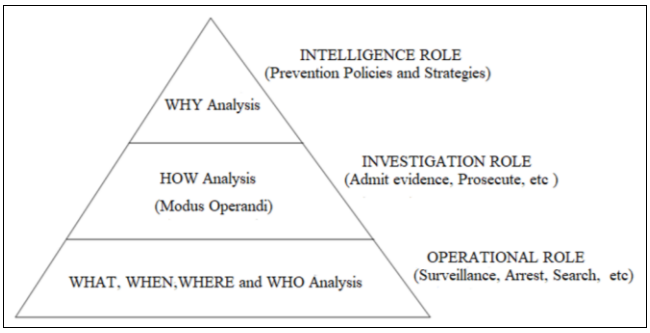


Fig 1: The Criminalist Hierarchy Functional-informational needs

Fig 1 shows the criminalist hierarchy of functional-informational needs. The model is relevant to crime and criminal analysts. The model has three distinctive role levels-*operational, investigation, and intelligence roles.* We describe these levels with their respective information need (question). At the operational level, the criminalist wants to know what (name or feature of the crime or incident), where (location or place), when (occurrence time), and who (victims, suspects, and witnesses) information. In that case, the criminalist wants to know what happened (crime, e.g., robbery), where (e.g., city A), when (e.g., July 25th, 2021, at 2321hrs), and who (Jane –victim; suspect John, the witness Kulwa-the neighbor. In this basic or first level of criminalist informational needs, the criminalist needs the information for operational purposes (role) such as arresting, patrolling, surveillance, searching, and controlling.

After being satisfied with the operational information, the criminalist will need the next upper (second) criminal information level – the investigative informational needs. At this level, the criminalist needs to understand how the crime happened. The criminalist wants to know the modus operandi for investigation purposes, such as admitting the evidence collected, prosecuting, and conducting other investigative processes/procedures to fulfill the investigation purpose/role. The modus operand is necessary for the investigator because it describes how the criminal committed the crime. This information is essential for the investigator to collect the evidence through the modus operandi information. For example, if the criminal breaks the front door and enters to commit a crime, using forensic science to collect the forensic evidence is relevant. The investigation will result in convicting or not convicting the offender/suspect.

After satisfying the investigation needs (second level), the criminalist will need the highest level of criminal informational needs – the intelligence needs. The criminalist requires this level to create crime prevention strategies or policies. At this level, the criminalist wants to know why the crime happened or why the individual committed that crime (*why-what analysis*), why the crime occurred at that location (*why-where analysis*) and that time (*why-when analysis*), and why for that population or victim (why-who analysis), why the crime was done in that manner or way (*why-how analysis*).

3. WHY-4W+H Analysis for Crime Prevention

The Why-4W+H analysis is done to produce the intelligence. That is, the analysis is done to determine the cause or actual root of the problem. This analysis provides intelligence on crime (what), location (where), time (when), the suspects and victim (who), and modus operandi (how). This analysis examines the nature and scope of criminal *motive (desire)*, *opportunity*, and *ability* to commit the crime. The criminalists agree that these elements are vital elements that form the "*triangle of crime"*. In the sense that once the criminal has a desire to do or acquire something illegally, he can act on his criminal plan and has an opportunity to implement his action. That is, if the criminal desires to commit a crime and has the opportunity and ability, then the criminal commits the offense. On the other hand, if the criminal lacks one or two of these elements, the crime will not happen. For example, the criminal will have desire and ability but has no opportunity to commit the crime; the crime will not be committed. Therefore, we can use the element of the triangle of crime to establish the "*triangle of crime prevention model* that describes the *intelligence product* of the 4W+H information model (Fig 2).

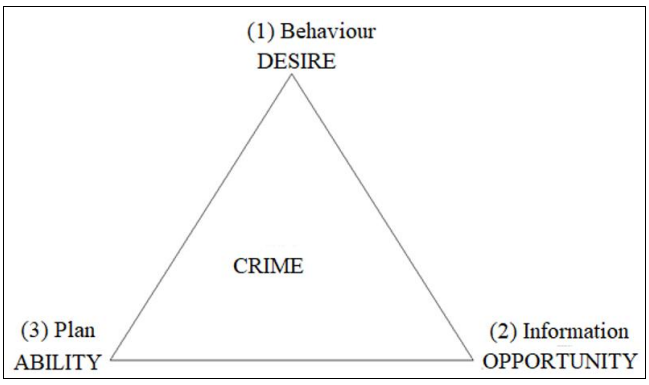


Fig 2: The triangle of crime prevention - intelligence model

Fig 2 describes the triangle of crime prevention that describes the intelligence product. Intelligence is the product of information (4W+H) collected by criminalists. The intelligence product has roles in policy or strategy formulation. Therefore, by using this model, we establish three distinctive crime prevention strategies /policies which are:-

3.1 Desire Based Strategy (DBS)

In crime or intelligence analysis, examining the desire is the foremost task the intelligence analyst or criminalist aims to achieve. The desire of the criminal to commit a crime is determined by the *behavior* of the individual who is committing the crime. Behavior is the key determinant of desires. An individual's behavior can be positively or negatively related to committing a crime. Therefore, we use the desire-based –strategy (DBS) to prevent negative desire.

We recommend the DBS, such as using religious leaders, respected institutions, Wiseman, and counseling services from social welfare officers and other formal and informal positive psychological socialization classes or groups. The common crimes in this category are predominantly immoral crimes such as rapes, unnatural offenses, underage pregnancy, etc.

3.2 Opportunity-Based Strategy (OBS)

Opportunistic intelligence is the second product of the collected information (4W+H) demanded by criminalists. This intelligence product helps the criminalist understand the nature and scope of the opportunity for a criminal to commit the crime. In this case, we examine the information available to the criminal. For example, the criminalist will want to know how the criminal understands the place, victim or object stolen or victim. Moreover, the criminalist will see why the criminalist does not *fear* committing the crime. In other words, the criminalist will know what positive associated risks the criminal avoids. Does the criminal think about the potential risk of committing the crime, such as being arrested by the police or interrupted by the community members? Therefore, the opportunity of the criminal may include the absence of the police or community patrol, geographic supports such as the presence of bushes, darkness, and other features. Moreover, factors such as time, the criminal sees the time variation as an opportunity, for example, midnight.

The best practice of opportunity–based strategy (OBS) is to minimize the opportunity for the criminal to commit the crime. These strategies include the police and community patrol guards. The community patrol services include private or civilian guards, etc. The best crimes described or prevented by this strategy are crimes against property and persons, such as theft, burglary, breaking, murder, terrorism, human trafficking, etc.

3.3 Ability Based Strategy (ABS)

The third product of the 4W+H information model is the ability intelligence. The ability intelligence describes the nature and scope of the ability of the individual to commit a crime. What is the ability of the criminal to commit a crime, and how is the ability acquired? Examining the criminal's ability helps the criminalist understand how to counter the ability of a criminal to commit a crime. The ability intelligence includes the skills, knowledge, technology, economic and financial, health, psychic, and others possessed by criminals. The criminalist aimed to examine the plan of the criminal to commit a crime. For example, the criminalist will analyze what skills and knowledge criminals use. What and how the criminal applied the technology to commit a crime? What is the physics of the criminals? Close examination of the criminal's action plan will disclose the ability intelligence.

The best practice of ability-based strategy (ABS) is reducing or minimizing the ability of the criminal to commit a crime. Therefore, ABS includes the seizure of assets of the criminals, destruction of the criminal economic activities and financial flow, limiting/avoiding the use of technology for criminals, etc. The common crimes that this strategy can prevent include organized crimes such as terrorism, human trafficking, smuggling, and others.

4. Intelligence of Organised Crime

Organized crime is more diverse and complicated than popular portrayals would have us believe (Albanese, 2001) [1]. This is due to its universality and the kinds of people who commit it. First, all societies report problems with organized crime at some level, and the ethnicity of the participants is not controlled (Albanese, 2001) [1]. Preventing and controlling organized crime is based on five ways: Improvements to data collection, utilizing a team approach to gather information, the application of a risk assessment instrument to target law enforcement efforts, understanding the parameters of such an instrument, and connecting organized crime risk assessment to the implementation of law and policy are practical ways in which organized crime activity can be better anticipated, investigated, and prevented (Albanese, 2001) [1]. Moreover, Albanese (2001) [1] identifies three primary sources of information on organized crimes for investigators: *Offenders, victims, and police*. Furthermore, he contends that the organized crime risk assessment considers three triangle elements or factors: Opportunity factors, the criminal environment, and special access or skills of the individual that may reduce the harm or risk potential among the criminals.

Seger (2003) [6] confirmed that the idea that traditional 'repressive' law enforcement bodies (police, prosecutors, courts) should have a monopoly on reactions to organized crime is under widespread revision because it is clear that alone, they are unlikely to have sufficient impact on levels of criminality. Therefore, the prevention of organized crime has been placed high on the agenda of national and international bodies (Seger, 2003) [6]. "There is a growing understanding amongst policymakers, professionals, and academics that the traditional enforcement approach to tackling organized crime will not, alone, bring about the hoped-for reduction in such activity (Seger, 2003) [6]. A specific aspect of the prevention of organized crime focuses on reducing existing or future opportunities for organized criminal groups to participate in lawful markets with proceeds of crime through appropriate legislative, administrative, or other measures. Measures can be taken at internal and external levels (Seger, 2003) [6]. Buscaglia and Dijk (2003) [2] used regression and correlation techniques to study the determinants of organized crime by the composite index of organized crime. They found that organized crimes correlate with socio-economic factors, the political sphere, the criminal justice system, private sector governance, public sector governance, and the independence and integrity of the judiciary.

Kleemans and Soudijn (2020) [4] advocate applying the *situational crime prevention theory*. In this theory, the routine activities approach three aspects of a crime, known as the crime triangle. These aspects are the offender, a suitable target, and the absence of capable guardianship. Moreover, situational crime prevention theory also holds that there is no explicit need to know any specific characteristics of individual offenders or the motivations behind their actions (Kleemans and Soudijn, 2020) [4]. Scholars emphasize that applying this theory is less effective in preventing organized crime due to the complexity of the criminal network (Albanese, 2001; Kleemans and Soudijn, 2020) [1, 4]. Therefore, there is a need to consider alternative options for disrupting illegal activities and making the

execution of criminal activities more difficult (Kleemans and Soudijn, 2020) [4]. Remember, situational crime prevention theory considers only the route activities of the offender, target, and guardianship. This theory is relevant to street-level crime prevention (Kleemans and Soudijn, 2020) [4]. This is because criminals engaged in organized crime are likely to be highly motivated and take great care in planning, reacting, and adapting to changing circumstances (Kleemans and Soudijn, 2020) [4]. Therefore, detecting and interrupting criminal activities remains an active challenge. This is why we aimed to study and interrupt routine illegal activities by using the communication relationship or association of the criminals. This is because routine criminal activities are done by communication. That is, the criminal communicates before, during, and after the illegal activities done. Therefore, the interruption of routine communication discloses the criminal identity and advances the prevention stage of organized crime.

4.1 Intelligence of Criminal communications in organized crimes

Due to the advancement of communication technology, criminals use this technological opportunity to commit a crime. The *means of communication* is a critical element in the detection and prevention of organized crime. Remember, the *criminals communicate*. Therefore, interrupting their communication is fundamental in detecting and preventing organized crime. Based on the assumption that criminals communicate, we identify two main types of criminal communication in organized crime: *Visiting and tele-message communication*. Visiting communication is the traditional way a criminal can communicate with his fellow through visits. The criminal visits their fellows using any means such as foot, bicycle, car, or public transport such as buses, railways, ferries and ships, airplanes, etc. This method of communication is less effective for criminals who are scattered in a large area. Still, it is effective for small areas, such as villages, streets, districts, and regions. On the other hand, the criminal can communicate by using tele-messaging communication. Tele-messaging is the communication in which a criminal uses *tele-devices* such as mobile phones, the internet (e-mail), etc. This method is most effective for international criminals or transnational crimes organized internationally or regionally—terrorism, drug dealing, human trafficking, smuggling, etc.

O*rganized crime* is one of the complex crimes planned, calculated, monitored, and evaluated by criminals (Seger, 2003; Albanese, 2001) [6, 1]. The criminal shared soft and hard resources such as skill, knowledge, technology, money, transporting equipment, and other relevant resources to commit the crime. Sharing resources for the criminal increases the ability to commit the crime. Therefore, the motive of the organized criminals is to conduct the crime by sharing the resources and skills to commit the crimes. *Consequently, we define organized crime as a crime that involves more than one person or organization (entity) covertly or overtly participating to necessary gaining profit (money) and criminal power (ability) by sharing both soft and hard resources.* The intelligence of organized crime indicates how the organized criminal is structured and communicated and how to detect the networked criminals in operation. We can identify two types of organized crime intelligence based on the intelligence of criminals' communication: Basic (overt) relational intelligence and advanced (covert or latent) relational intelligence of organized crime.

4.1.1 Basic (overt) relational (OR) Intelligence

Basic or overt relational intelligence is the intelligence that discloses the criminal relationship of the criminals by studying or examining the normal or *social reality relationship.* The social reality relationship can be examined or detected from the usual activities or occupations such as businessmen, teachers, student communication, visiting relatives, etc. The OR intelligence helps the criminalist identify distributors and receivers in the criminal network. This intelligence also discloses the organized crime's organizer, central supplier, or coordinator. The study of this relationship can be used by using the chain or event linking analysis of the communication record (phone link and event mapping) and visiting from and to. We analyze the OR intelligence using the open (structured) organized criminal network model (Fig 3).

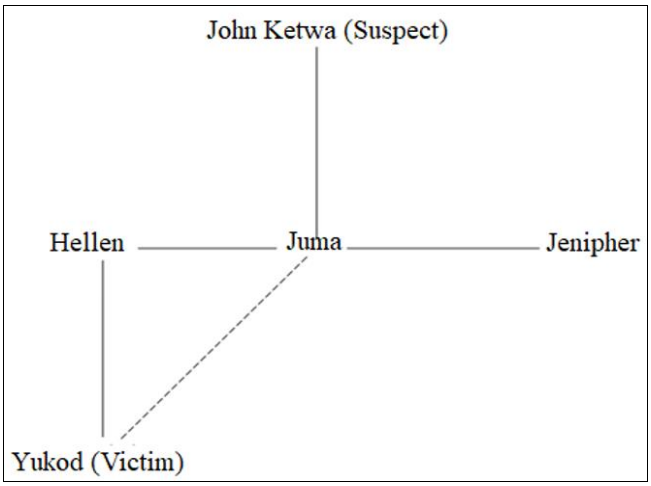


Fig 3: The structured (overt) organized criminal crime network

Fig 3 shows the structured (overt) organized criminal crime network for the five persons involved. The relational link analysis detects the overt structured connected organized crime network. The network shows John Ketwa is the suspect who was first identified or arrested by the Police. The interrogation reveals that John Ketwa has a little brother, Juma. Further information displayed that Juma and Jenipher work at the same school (teachers). On the other hand, Hellen is the girlfriend of the Juma, and Yukod is the brother of the Hellen. Further interrogation revealed Yukod is the victim whose drug store was broken, but John Ketwa doesn't know Yukod and does know Juma. John Ketwa transports drugs from Jenipher. Jenipher only knows Juma.

We can establish the arrest and interrogation plan from the network by identifying the *distributor, receivers, and leading distributor*. The best arrest plan is to start with Juma (central organizer), who will provide information about the other criminals associated with committing the crime. The interrogation with Juma will disclose Jenipher and Hellen. We use the communication or visiting flow to show/detect the distributor and receivers. We explain this concept later.

4.1.2 Advanced (covert) relational intelligence

Covert or advanced relational intelligence is the analyzed association or relationship information that criminals create by the existence of abstract or latent relationships among them. The fundamental indicators of this relationship are the *behavior and lifestyle of the individual*. We detect the hidden (latent) relationship among the criminals by studying

or examining the behavior and lifestyle of the suspect or criminal and associating the behavior or lifestyle. The network is called broken or unstructured organized criminal crime (Fig 4).

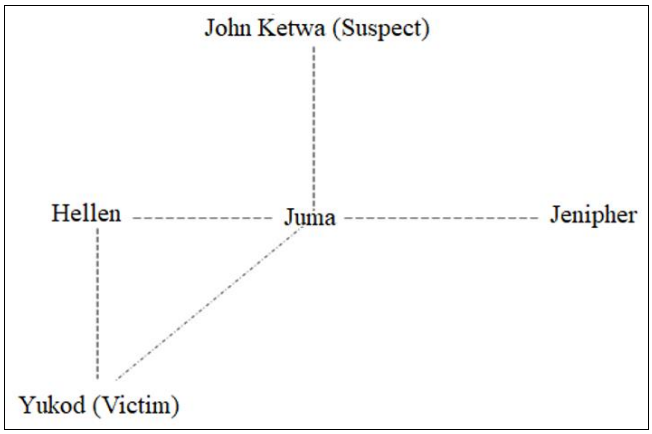


Fig 4: Unstructured/broken organised criminal crime network

Fig 4 shows an unstructured/broken organized criminal crime network for five persons involved in illegal activities. The relationship is established by using the study and associating the behavior attributes and lifestyles. Some indicators include physical behavior such as traveling, sleeping at night, being anti-social, and having unusual involvement or association with good-mannered groups or organizations. Moreover, lifestyle, such as dressing, eating, etc., is an associative indicator to establish a covert networked organized crime.

From this network, we reveal that the behaviour and lifestyle of Juma are highly matched or linked by John Ketwa, Jenipher and Hellen. Further examination reveals that John Ketwa is the brother of Juma, who both Juma and John Ketwa prefer to wear T-shirts and Jeans, Hellen is the girlfriend of Juma, and Jenipher is the best friend of Juma, who are both using the MW car model. This analysis helps to detect covertly organised crime. The common crimes likely to be committed in this way include terrorism, drug dealing, human trafficking, etc.

5. Criminal Communication Intelligence Analysis in Organised Crime

In intelligence analysis, to understand the relationship between the two individuals communicating through any means of communications is a fundamental requirement. By studying the called and received frequencies of the two or more criminals communications, criminalist or intelligence officer can able to discloses the nature of the relationship, that is, who is the boss or organiser in the criminal network. Therefore, the study of the criminal communication intelligence is a vital to investigator.

5.1 Associative Coefficient of Criminal Communication

The criminal communication associative coefficient (μ) is the numerical value that describes the relative communication (visiting or tele-messaging) among the criminals. The coefficient indicates the follow or direction of the tele-messaging communication or visiting done between the criminals. The minimum value of the coefficient is zero, and the maximum value is infinity. The μ for individual A to visit or communicate with B is calculated by using the formula,

$$\mu = \frac{\text{Communicating Frequencies of A to B}}{\text{Communicating Frequencies of B to A}} = \frac{\Gamma_T(\text{Gamma T})}{\Gamma_F(\text{Gamma F})}$$

The interpretation of μ is based on the optimal ranges from 0 to 1. That is, the value greater than one ($\mu > 1$) indicates that the communication frequencies of A to B are greater than that of B to A. We represent it as,

$$A \rightarrow B$$

This relationship discloses that A has a *special interest* in B, or A is the agent or organiser of B.

On the other hand, ($\mu < 1$) indicates that the communication frequencies of A to B are less than that of B to A. We represent it as,

$$A \leftarrow B$$

This relationship discloses that B has a *special interest* in A, or B is the agent or boss of A.

Moreover, ($\mu = 1$) indicates that the communication frequencies of A to B are equal to that of B to A. We represent it as,

$$A \leftrightarrow B$$

This relationship discloses that A and B have equal special *interests*; all are equivalent levels of status or authority. If the value of $\mu = 0$ indicates that individual A or B has not communicated. It demonstrates that no relationship is disclosed from the communication of the criminal. We represent it as,

$$A \not\equiv B$$

We interpret that behaviour, lifestyle, activities, and other associative features are not identical to B's. Hence, A and B are not associated; therefore, we test A on criminals like C, D, etc.

5.2 Empirical validation of: Case 1. Visiting Communication

An investigator received information that Mr. Helo, the businessman in the country, is the drug receiver. His history reveals that he was suspected to be a drug dealer in the country. The investigator assigned the intelligence officer to conduct surveillance on Mr. Helo. The surveillance reports that Mr. Helo has visited Mr. Juma for 5 days, Mr. Kaki for one day, and Mr Lupa for one day. On the other hand, Mr. Juma visits Mr Helo for 3 days, Mr. Kaki visits Mr. Helo for 7 days, and Mr.Lupa visits Mr. Helo for 4 days. The report also shows that Mr.Lupa visited Mr. Juma for 4 days, Mr. Kaki for 4 days and Mr. Helo for 4 days. On that period, Juma visits Lupa for 5 days, Kaki visits Mr. Lupa for 3 days and Helo visits Lupa for one day. Furthermore, the intelligence reveals that Mr. Kaki has visited Juma for 2 days, Mr. Lupa for 3 days and Mr. Helo for 7 days, and Mr. Juma visited Mr. Kaki for 7 days, Mr. Lupa visited Mr. Kaki for 4 days, and Mr. Helo visits Mr. Kaki for 1 day. Summarise the data by *communication frequencies cross-matrix table* (Table 1).

Table 1: Communication frequencies (visiting) cross-matrix table

From ↓ / To →	Helo	Lupa	Kaki	Juma
Juma	3	5	7	0
Kaki	7	3	0	2
Lupa	4	0	4	4
Helo	0	1	1	5

Source: Author (2023)

Table 1 shows the communication frequencies (visiting) cross-matrix table for the five suspects/criminals. From this table, we compute the criminal communication associative coefficient, μ, for each suspect or criminal to determine the direction of communication. We use the following formula,

$$\mu = \frac{\text{Visting frequencies of A to B}}{\text{Visting frequencies of B to A}} = \frac{\Gamma_T}{\Gamma_F}$$

We compute the criminal associative coefficient, μ, for Helo, Lupa, Kaki and Juma and summarise the calculated values in Table 2. Remember, the higher value of μ indicates a *unidirectional solid interest.* Therefore, the value far away from one indicates a robust unidirectional relationship and the value near to one shows a weak bidirectional relationship. We use linking analysis techniques to detect their relationship (Fig 5).

Table 2: The cross-matrix table of criminal associative coefficients

From ↓ / To →	Helo	Lupa	Kaki	Juma
Juma	0.60	1.25	3.50	0.00
Kaki	7.00	0.75	0.00	0.29
Lupa	4.00	0.00	1.33	0.80
Helo	0.00	0.25	0.14	1.67

Source: Author (2023)

Table 2 shows the cross-matrix tables for Helo, Lupa, Kaki and Juma criminal associative coefficient. We interpret the coefficient by considering the value in visiting pairs. That is, the criminal associative coefficient of Juma visiting Helo is $\mu = 0.60$; this means that the visits of Juma to Helo are less than those of Helo to Juma. But, because the value of 0.60 is not significantly far from zero, we detect the weak unidirectional relationship between Juma and Helo. The coefficient of Helo visiting Juma is just the reciprocal of $\mu = 0.60$, which is equal to $\mu = 1.67$. This value signifies the same meaning that Helo visits Juma more than Juma does. That is, Helo visits Juma 1.67 times Juma does. It means that Helo has a particular interest or task on Juma.

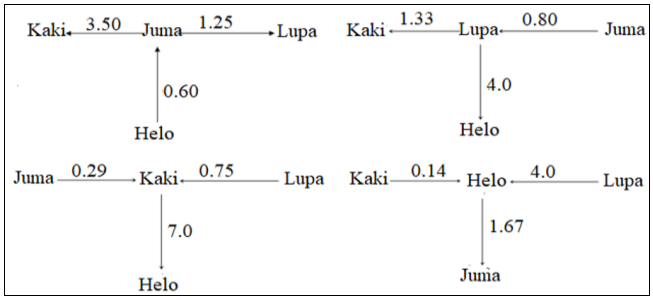
Moreover, we can interpret the criminal associative coefficient of Kaki visiting Helo, which is $\mu = 7.0$, while the coefficient of Helo visiting Kaki is 0.14. This value means that the visits of Kaki are seven times the visits of Helo. On the other hand, the visits of Helo to Kaki are 0.14 times that of Kaki. Therefore, we detect that Kaki has a special interest in Helo, and Kaki is the agent of Helo. We interpret the remaining values in the table in the same manner.

5.2.1 Network Topology of Organised Criminals

The criminal network topology is the physical configuration of the associative criminal activities. The activities may be unlawful, such as transporting drugs, exchanging illegal parcels, etc., or noncriminal activities, such as communication, visiting, etc. We classify the criminal network topology into two main classes*: Specific Criminal Network (SCN) Topology and General Criminal Network (GCN) Topology* of the criminals.

(a) Specific Criminal Network (SCN)Topology

The SCN topology is the criminal network framework of the relationship due to their activities. This network discloses the relationship of a single criminal to others. The aim is to detect the individual's contribution to the group of criminals. From our previous example, we can establish the SCN topology for each criminal, such as Juma, Helo, Lupa and Kaki, and we can detect how each criminal has a relationship in the group. Conveniently, we use the criminal associative coefficient to establish the SCN topology to examine how Juma, Lupa, Kaki and Helo are associated with each other (Fig 5).



Source: Author (2023)

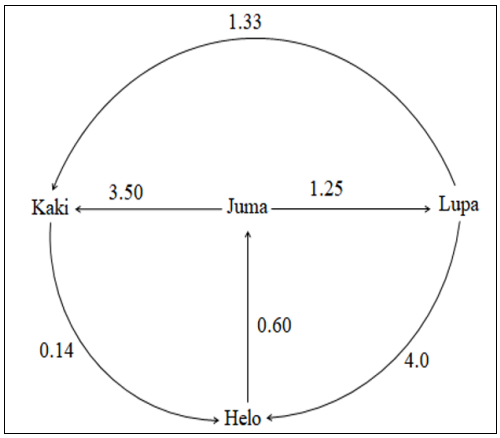
Fig 5: The SCN topology for the criminal activities (visiting)

Fig 5 shows the SCN of the criminal visiting. The number values on the relational link indicate the criminal associative coefficients, the higher the value, the stronger the relationship between the criminals. Therefore, the criminals examined are Juma, Lupa, Kaki and Helo. The topology shows that Juma visits Kaki and Lupa frequently, and Helo rarely visits Juma. This conveys the message that Juma is the agent of the Kaki and Lupa; moderately, Helo is the agent of Juma. On the other hand, Lupa has been visited by Juma, Kaki and Helo. That is, Lupa is the agent of Kaki, and Juma is the agent of Lupa. Moreover, Lupa is the agent of Helo. Juma and Lupa are agents of Kaki, and Kaki is the agent of Helo. Kaki and Lupa are agents of Helo, and Helo is the agent of Juma.

(b) General Criminal Network (GCN) Topology

The General Criminal Network (GCN) Topology is the criminal network that describes the general relationship among criminals. The network involves all the criminals with their associative coefficients. The relationship of one criminal is linked to the other criminal relationship in a criminal group to make a *looping relationship.* The looping relationship is a helpful model for detecting the *receiver and distributor* in the criminal network. The looping relationship indicates the relationship flows from and to the criminals. In the loop (Fig 6), the point at which two arrows meet means the *point receiving or a receiver*, and the point where the arrows are departing is called *the departing point or a distributor*. Therefore, we can use this GCN topology to determine the distributor or receiver. For example, from this example, we notice that Helo and Kaki are receivers, and Lupa and Juma are distributors. However, this way of determination is not optimal because it does not disclose the

receiver probability and distributor probability. Therefore, we recommend using receiver and *distributor probabilities*, which are discussed later in this paper. The GCN topology summarises the SCN topologies (Fig 6).



Source: Author (2023)

Fig 6: The General (looped) Criminal Network topology of the criminal visiting

Fig 6 shows the criminal visiting's general or looped criminal network topology. The loop or network indicates the linked relative relationship. This loop or general criminal network topology identifies the *central (leading) organiser*. Juma is the leading organiser linked with other criminals in the network. Juma receives from Helo, who is the receiver of Kaki and Lupa. Therefore, we detect Lupa is the **leading distributor** who receives from Juma and distributes to Helo and Kaki. Moreover, Kaki receives from Lupa and Juma and distributes to Helo. Therefore, Helo is the **leading receiver.**

5.2.2 Joint Criminals Detection

In organised crime, there is a high probability that more than one criminal will commit the crime simultaneously or at different times and locations. For highly networked organised crime, only a few selected criminals are exposed to act on the planned mission, and the remaining criminals remain covertly. Therefore, we introduce the concept of *joint criminals*, who commit the crime simultaneously, not necessarily in the same location. *Joint criminal operations (JCO)* are common in highly advanced organised crimes like terrorism. Detecting the joint criminal is necessary for organised crime because it helps the criminalist understand the criminal network's modus operandi and strength. In this case, we use the criminal associative probabilities (CAP) which includes three related event probabilities which are *joint probabilities, marginal probabilities and conditional probabilities* of the relative frequency of criminal communication or relationship; for this study, we use visiting, but you use other linked criminal activities such as communication, etc.

The joint probability of two criminals A and B is the probability that both occur simultaneously committed the crime. It is given as;

$P(A \cap B) = P(A) \times P(B \mid A)$ or $P(A \cap B) = P(B) \times P(A \mid B)$. This help the criminals to understand the relationship between two criminals through their communication frequencies probabilities.

Moreover, the marginal probability of a criminal A is the probability of A to commit a crime independently, regardless of the commission of other criminals. It is given as;

$$P(A) = \sum_{B} P(A \cap B)$$

For discrete variables, or

$$P(A) = \int P(A \cap B) dB$$

For continuous variables.

On the other hand, conditional probability is the probability of a criminal A committing a crime given that another criminal B has committed a crime. It quantifies the likelihood of A under the condition that B is known to be true. It is given as;

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

Where:

- $P(A \mid B)$ is the conditional probability of A given B.
- P(A∩B) is the joint probability of A and B occurring together.
- P(B) is the probability (communication ratio frequencies) of criminal B.

The criminal marginal probabilities disclose the likelihood (probabilities) of the two or more criminals to commit the crime together. We use the criminal communication-cross matrix table (Table 3).

Table 3: Communication frequencies (visiting) cross-matrix table

From ↓ / To ↑

Name	Helo	Lupa	Kaki	Juma
Juma	3	5	7	0
Kaki	7	3	0	2
Lupa	4	0	4	4
Helo	0	1	1	5

Source: Author (2023)

Table 3 shows the communication frequencies (visiting) cross-matrix table for suspected criminals who made the relative visit. From this table, we can establish the communication frequencies table and compute *the joint, marginal and conditional probabilities* of the committing crime of each individual/suspect.

Hypothese 1: Criminals (Juma, Kaki, Lupa and Helo) were did or commit crime independently.

Hypothese 2: Criminals (Juma, Kaki, Lupa and Helo) were did or commit crime jointly.

To test the hypotheses we need to compute the joint, marginal, and conditional probabilities is crucial in statistics, data analysis, and machine learning, as they provide insights into the relationships and dependencies between events (Table 3).

Table 3: Visiting frequencies table and Joint criminal probabilities of Helo

Name	To Helo	Helo to	Total	Associative Coefficient (μ)
Juma	3	5	8	0.60
Kaki	7	1	8	7.00
Lupa	4	1	5	4.00
Total	14	7	21	2.00
	Joint and Marginal Probabilities of Committing Crime of Helo			
Name	To Helo	Helo to	Total (Specific Marginal)	Remarks
Juma	0.14	0.24	0.38	Helo visited Juma > Juma
Kaki	0.33	0.05	0.38	Kaki visited Helo > Helo
Lupa	0.19	0.05	0.24	Helo visited Lupa > Lupa
Total (General Marginal)	0.67	0.33	1.00	Helo visited > Others (Receiver)
	Conditional Probabilities to Commit Crime of Helo			
	Name	Receiver	Distributor	Remarks
	Juma	0.38	0.63	Juma distributor of Helo
	Kaki	0.88	0.13	Helo receiver of Kaki
	Lupa	0.80	0.20	Helo receiver of Lupa

Source: Author (2023)

Table 3 shows the visiting frequencies table, joint, marginal and conditional probabilities of Helo committing a crime in collaboration with Juma, Kaki and Lupa. The table indicates that the number of visits to Helo is 14, and number of visits of Helo to his fellow, Juma, Kaki and Lupa is 7. It means that Helo has been visited more than others. On the other hand, the specific marginal probabilities of Helo committing a crime *jointly* with Juma, Kaki, and Lupa are 0.38, 0.38 and 0.24, respectively. The general marginal discloses that Helo's probability of committing a crime *jointly* with Juma, Kaki, or Lupa by being visited by his fellow is 0.67. Moreover, the conditional probabilities of Helo committing a crime, *given that* Juma, Kaki, and Lupa have committed the crime, is 0.63 (distributor), 0.88 (receiver) and 0.80 (receiver).

Premises: *"Therefore, we believe that the commission of the crime of Helo depends on the crime commission of the Juma, Kaki and Lupa. Helo is the receiver or distributor (market)."*

On the other hand, we examine the criminal involvement of the Lupa. We use the same method to construct the visiting frequencies table and joint criminal probabilities of Lupa committing the crime by involving his fellows. We provide the table summaries of the visiting frequencies table of Lupa relative to their fellow, joint, marginal and conditional probabilities (Table 4).

Table 4: Visiting frequencies table and Joint criminal probabilities of Lupa

Name	To Lupa	Lupa to	Total	Associative Coefficient (μ)
Juma	5	4	9	1.25
Kaki	3	4	7	0.75
Helo	1	4	5	0.25
Total	9	12	21	0.75
	Joint and Marginal Probabilities of Committing Crime of Lupa			
Name	To Lupa	Lupa to	Total (Specific Marginal)	Remarks
Juma	0.24	0.19	0.43	Juma visited Lupa > Lupa
Kaki	0.14	0.19	0.33	Lupa visited Kaki > Kaki
Helo	0.05	0.19	0.24	Lupa visited Helo > Helo
Total (General Marginal)	0.47	0.53	1.00	Lupa visits > Others (Distributor)
	Conditional Probabilities to Commit Crime of Lupa			
	Name	Receiver	Distributor	Remarks
	Juma	0.56	0.44	Lupa receiver of Juma
	Kaki	0.43	0.57	Lupa distributor of Kaki
	Helo	0.20	0.80	Lupa distributor of Helo

Source: Author (2023)

Table 4 shows the visiting frequencies table, joint, marginal and conditional probabilities of Lupa committing a crime *jointly* with Juma, Kaki and Helo. The table indicates that the number of visits to Lupa is 9, and the number of visits of Lupa to his fellow Juma, Kaki and Helo is 12. It means that Lupa has made more visits than others. On the other hand, the specific marginal probabilities of Lupa committing a crime *jointly* with Juma, Kaki, and Helo are 0.43, 0.33 and 0.24, respectively. The general marginal discloses that Lupa's probability of committing a crime *jointly* with Juma, Kaki, or Helo by visiting them is 0.53. Moreover, the conditional probability of Lupa committing a crime, *given that* Juma, Kaki, and Helo have committed the crime, is 0.56 (Receiver of Juma), 0.57(distributor of Kaki) and 0.80 (distributor of Helo).

Premise*: "Therefore, we notice that the Lupa commit a crime when Juma commits a crime (distribute to Lupa), and the market is available (Helo) who receives from Lupa."*

On the other hand, we examine the criminal involvement of the Kaki. We use the same method to construct the visiting frequencies and joint criminal probabilities of Kaki to commit the crime by involving his fellows. We provide the table summaries of the visiting frequencies table of Kaki relative to their fellow, joint, marginal and conditional probabilities (Table 5).

Table 5: Visiting frequencies table and Joint criminal probabilities of Kaki

Name	To Kaki	Kaki to	Total	Associative Coefficient (μ)
Juma	7	2	9	3.50
Lupa	4	3	7	1.33
Helo	1	7	8	0.14
Total	12	12	24	1.00
	Joint and Marginal Probabilities of Committing Crime of Kaki			
Name	To Kaki	Kaki to	Total (Specific Marginal)	Remarks
Juma	0.29	0.08	0.38	Juma visited Kaki > Kaki
Lupa	0.17	0.13	0.29	Lupa visited Kaki > Kaki
Helo	0.04	0.29	0.33	Kaki visited Helo > Helo
Total (General Marginal)	0.50	0.50	1.00	Equal visits
	Conditional Probabilities to Commit Crime of Kaki			
	Name	Receiver	Distributor	Remarks
	Juma	0.78	0.22	Kaki receiver of Juma
	Lupa	0.57	0.43	Kaki receiver of Lupa
	Helo	0.13	0.88	Kaki distributor of Helo

Source: Author (2023)

Table 5 shows the visiting frequencies table, joint, marginal and conditional probabilities of Kaki committing a crime *jointly* with Juma, Lupa and Helo. The table indicates that the number of visits to Kaki is 12, and the number of visits of Kaki to his fellow, Juma, Lupa and Helo are 12. It means that Kaki has been made equal visiting with others. On the other hand, the specific marginal probabilities of Kaki committing a crime *jointly* with Juma, Lupa, and Helo are 0.38, 0.29 and 0.33, respectively. The general marginal discloses that the probability of Kaki committing a crime jointly with Juma, Lupa, or Helo by visiting his fellows is 0.50. Moreover, the conditional probability of Kaki committing a crime, *given that* Juma, Lupa and Helo have committed the crime, is 0.78 (receiver of Juma), 0.57 (receiver of Kaki) and 0.88 (distributor of Helo).

Premise: *"Therefore, we find that the commission of the crime of Kaki depends on the crime commission of the Juma, Kaki and Lupa. Helo is the receiver (market)."*

On the other hand, we examine the criminal involvement of the Juma. We use the same method to construct the visiting frequencies table and joint criminal probabilities of Juma committing the crime by involving his fellows. We provide the table summaries of the visiting frequencies table of Kaki relative to their fellow, joint, marginal and conditional probabilities (Table 6).

Table 6: Visiting frequencies table and Joint criminal probabilities of Juma

Name	To Juma	Juma to	Total	Associative Coefficient (μ)
Kaki	2	7	9	0.29
Lupa	4	5	9	0.80
Helo	5	3	8	1.67
Total	11	15	26	0.73
	Joint and Marginal Probabilities of Committing Crime of Juma			
Name	To Juma	Juma to	Total (Specific Marginal)	Remarks
Kaki	0.08	0.27	0.35	Juma visited Kaki > Kaki
Lupa	0.15	0.19	0.35	Juma visited Lupa > Lupa
Helo	0.19	0.12	0.31	Helo visited Juma > Juma
Total (General Marginal)	0.42	0.58	1.00	Juma visited > Others
	Conditional Probabilities to Commit Crime of Juma			
	Name	Receiver	Distributor	Remarks
	Kaki	0.22	0.78	Juma distributor of Kaki
	Lupa	0.44	0.56	Juma distributor of Lupa
	Helo	0.63	0.58	Juma receiver of Helo

Source: Author (2023)

Table 6 shows the visiting frequencies table, joint, marginal and conditional probabilities of Juma committing crime *jointly* with Kaki, Lupa and Helo. The table indicates that the number of visits to Juma is 11, and the number of visits of Juma to his fellow, Kaki, Lupa and Helo is 15. It means that Juma has made more visits than others. On the other hand, the specific marginal probabilities of Juma committing a crime *jointly* with Kaki, Lupa, and Helo are 0.35, 0.35 and 0.31, respectively. The general marginal discloses that the probability of Juma committing a crime *jointly* with Kaki, Lupa, or Helo by visiting his fellows is 0.58. Moreover, the conditional probability of Juma committing a crime, *given that* Kaki, Lupa and Helo have committed the crime, is 0.78 (distributor of Kaki), 0.56 (distributor of Lupa) and 0.63 (distributor of Helo).

Premise*: Therefore, we notice that the Juma commits a crime when Juma commits a crime (distribute to Kaki), and the market is available (Helo) who distributes to Juma."*

Note: The receiver can be also a distributor. Hence, the receiver in this study can be also has a role of distribution.

Conclusion: *We made the conclusion of hypotheses from the premises generated from our findings, that is, the criminals are committed the crime jointly.*

5.2.3 Arresting Plan

The arresting plan is the fundamental document or tool necessary for organised or networked crimes. The improper arrest plan will result in difficulty in apprehending the associate's criminals in the network, increasing the cost and time for surveillance. Therefore, it recommended preparing an arrest plan at the end of the analysis to enable the investigator or other law enforcer to arrest the suspects promptly and with minimal cost. An arresting plan is a document that prescribes the personal and demographic information of the suspects or criminals for arrest, such as names, age, gender, location, etc. Moreover, the appropriate arresting plan reduces the risk that may be due to arresting misfortunes. For this analysis of the arresting plan, we provide the arresting plan for four suspects/criminals: Helo, Juma, Lupa and Kaki, who have been evaluated and analysed for their involvement in the crime commitment. We provide the table which summarising the arresting information (Table 7).

Table 7: The arresting planning for organised criminals

Name	Marginal Probabilities (Arresting Priority)	Role	Location	Time	Method
Helo	0.67 –(1)	Receiver	City A- Y Street, House No. 67	Midnight	Confining
Juma	0.58 –(2)	Distributor	City B-L street, P-Road	Daytime	kidnapping
Lupa	0.57 –(3)	Distributor	City C- T Street, House No. 612	Midnight	Confining
Kaki	0.50 – (4)	Equal Role	City C- T Street, House No. 610	At noon	Confining

Source: Author (2023)

Table 7 shows the arrest plan for the hypothetical four suspects using the marginal probabilities, which describe the role magnitude of each suspect. The arresting plan involves the criminal's name, role represented by the marginal probabilities, arresting priority or order, the location of the suspect, and the appropriate time for arresting them. Moreover, the plan describes the relevant arresting method, whether confining, kidnapping or other methods preferred or suggested by the analyst. Notably, the location, time and methods are described hypothetically and the arresting priority and roles were determined empirically.

5.3 Empirical validation of μ: Case II. Tele-Messaging Communication

The telephone is the common tele-messaging communication that criminals apply mainly. Therefore, we prefer to use the suspects' telephone calls to detect the criminal network by identifying the *leading organisers and their associates*. The leading organiser is the criminal who initiates or makes more calls for their members. On the other hand, the associates are criminals receiving calls or instructions from the leading organiser. In other words, the leading organisers are telephone callers, and the associates are telephone receivers. Consider the following real example that happened and investigated successfully using this technique. The murder incident was reported to have occurred in one of the cities in Tanzania. The woman, aged 35, was killed by unknown criminals. The woman lived alone at his house; her husband lived in the far region. The first suspect was her husband. We record the deceased and suspects' phone calls from 11th July 2023 to 17th July 2023 (seven days).

First, we construct the communication (calls) frequencies cross-matrix table for the suspects Maku, Upendo, Sibiti, Grace, Marce, Saidi, Neema and Mare (deceased). The matrix table summarised each suspect's outgoing and incoming calls from 11th July 2023 to 17th July 2023 (Table 8).

Table 8: The telephone call frequencies cross-matrix tables of the murder suspects

From \ To	Mare	Neema	Said	Marce	Grace	Sibiti	Upendo	Maku	Total
Mare	12	0	0	0	0	0	2	0	14
Neema	2	0	0	0	0	0	0	2	4
Said	1	0	0	0	0	0	0	0	1
Marce	29	0	0	0	0	0	0	0	29
Grace	24	0	0	0	0	0	0	0	24
Sibiti	7	0	0	0	0	0	0	0	7
Upendo	11	0	0	0	0	0	0	0	11
Maku	0	7	0	20	32	3	2	12	76
Total	86	7	0	20	32	3	4	14	166

Source: Author (2023).

Table 8 shows the telephone call frequencies cross-matrix tables for the murder suspects Maku, Upendo, Sibiti, Grace, Marce, Saidi, Neema and Mare (deceased). We recorded both incoming and outgoing calls. Therefore, we established the criminal network topology using each suspect's associative coefficient, as presented in Table 9.

5.3.1 Network Topology of Organised Criminals

We construct the network topology of organised criminals by using the criminal communication associative coefficients of the telephone calls of the criminals, which we calculate by using the following formula,

$$\mu = \frac{\text{Call Frequencies of Criminal A to B}}{\text{Call Frequencies of Criminal B to A}} = \frac{\Gamma_T}{\Gamma_F}$$

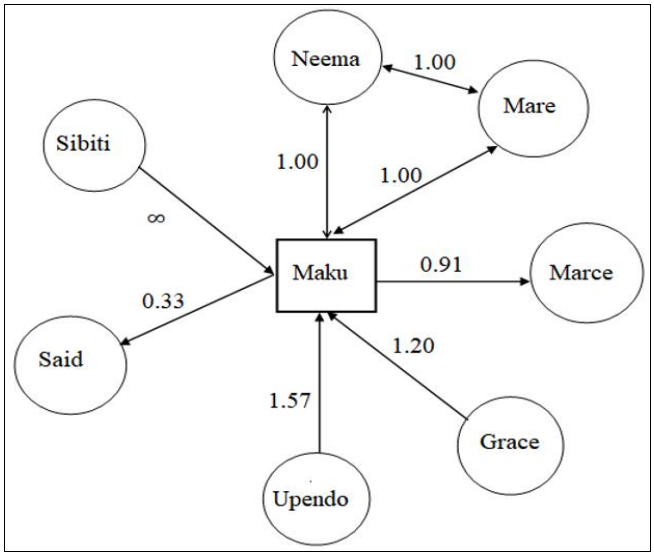
We summarise the value of μ in the criminal communication associative coefficient cross-matrix table (Table 9).

Table 9: Criminal associative coefficients cross-matrix for criminal calls

From \ To	Maku	Upendo	Sibiti	Grace	Marce	Said	Neema	Mare
Mare	1.00	0	0	0	0	0	1	0
Neema	1.00	0	0	0	0	0	0	1
Said	0.33	0	0	0	0	0	0	0
Marce	0.91	0	0	0	0	0	0	0
Grace	1.20	0	0	0	0	0	0	0
Sibiti	Undefined	0	0	0	0	0	0	0
Upendo	1.57	0	0	0	0	0	0	0
Maku	0	0	0	0	0	0	0	0

Source: Author (2023)

Table 9 shows the criminal commuinication associative coefficients cross-matrix for the criminal calls. We select only Maku as the leading organiser, and we construct the criminal network topology from this table by using the indicated criminal associative coefficients in the Maku, Neema and Mare (Fig 7).



Source: Author (2023)

Fig 7: The General (looped) criminal network topology of the criminals' communication

Fig 7 shows the general criminal network (GCN) topology of criminals. From the network, we can disclose the two distinctive relationships- *The special Task (mission) Relationship (ATR*) and the *common (normal) relationship (CR)*. We use the criminal associative coefficient to interpret the links of the criminal communication. From the network, we disclose the common (historical) communication between Maku, Neema and Mare (deceased) because the coefficient equals one, indicating that the communication was bidirectional information sharing. Moreover, the communication between Maku, Marce, and Pendo is normal because their coefficient is near one. On the other hand, the communication between Maku and Sibiti, Pendo and Said is unusual, indicating the communication of a special task or mission at a specific time.

5.3.2 Joint Criminal Detection

The joint criminal detection was done to disclose the criminal network associated with Maku, the leading organiser. Therefore, we use the same concept of joint and marginal probabilities and the conditional probability of the Maku committing the crime more than his fellow has committed. First, we use the frequencies of the calls cross-matrix table to construct Maku's call frequencies matrix table (Table 10).

Table 10: The call frequency matrix for Maku and his associate's criminals

Names	Received calls	Called calls	Total calls	Associative coefficient (μ)
Mare	12	12	24	1.00
Neema	2	2	4	1.00
Said	1	3	4	3.00
Marce	29	32	61	1.10
Grace	24	20	44	0.83
Sibiti	7	0	7	0.00
Upendo	11	7	18	0.64
Total	86	76	162	0.88

Source: Author (2023).

Table 10 shows the call frequencies matrix of Maku and his associates Mare, Neema, Said, Marce, Grace, Sibiti and Upendo, who we detected from the calling phone of Maku communication (mobile phone). The total number of calls received by Maku is 86, and calls made by Maku are 76 for seven days. More calls are made for Marce and Grace.

Hypothesis 1: *Criminal are committed crime (murder) independently*
Hypothesis 2: *Criminals are committed crime (murder) jointly.*

We calculate Maku's joint and marginal probabilities of being involved in or *jointly* committing the crime with his fellows. The specific marginal probabilities indicate that Marce, Grace and Upendo have the highest probabilities of organising or planning the crime. They have 0.38, 0.27 and 0.11, respectively (Table 11).

Table 11: The joint and marginal probabilities of the Maku criminal involvement

Names	Received Calls	Called Calls	Total (Specific Marginal)
Mare	0.07	0.07	0.15
Neema	0.01	0.01	0.02
Said	0.01	0.02	0.02
Marce	0.18	0.20	0.38
Grace	0.15	0.12	0.27
Sibiti	0.04	0.00	0.04
Upendo	0.07	0.04	0.11
Total (General Marginal)	0.53	0.47	1.00

Source: Author (2023)

Table 11 shows Maku's joint and marginal probabilities to involve or organise jointly the crime with his fellows. The general marginal probability of Maku organising the crime by receiving the call is 0.53. On the other hand, we calculate the conditional probabilities of the Maku to organised crime, *given that* his fellows have committed crimes. It helps to identify the main role of each suspect or criminal, which is either organiser or associate (organised). We summarise the conditional probabilities and their identified corresponding roles (Table 12).

Table 12: The conditional probabilities of organising crime for Maku

Names	Received Calls (Associate)	Called Calls (Organiser)	Main Role
Mare	0.50	0.50	Equal
Neema	0.50	0.50	Equal
Said	0.25	0.75	Organised
Marce	0.48	0.52	Organised
Grace	0.55	0.45	Organiser
Sibiti	1.00	0.00	Organiser
Upendo	0.61	0.39	Organiser

Source: Author (2023)

Table 12 shows the probabilities of Maku to organise or commit the crime given that Mare, Neema, Said, Marce, Grace, Sibiti and Upendo have committed are 0.50 (equal role), 0.50 (equal role), 0.75 (organised), 0.52 (organised), 0.55 (organiser), 1.00(organiser), and 0.61 (organiser) respectively.

Premise: *"Maku has organised the crime involving Said, Marce, and Grace."*

5.3.3 Arresting plan

Therefore, establish the arresting plan for Maku, said Marce and Grace. The arresting information, such as full names, physical addresses, mobile numbers, and other relevant information, will be provided for the investigator for the arrest and interrogation.

6. Discussions

Crime prevention depends on the *information* available about the crime and society. The ability of the criminalist to detect and prevent relies on the quality of the information available about the crime and the society. This paper introduces the concept of information classes or levels the criminalist needs. These classes of information are called the Bundala class of criminal and crime information. Bundala, the author, divides the criminal and crime information into classes A, B and C. These classes or levels are classified according to the criminalist's needs. Class A is the information the criminalist wants to know about what crime happened or was committed. Who commits, and who are the witnesses and victims? When and where is the crime committed? This information is classified as the class, and the aim is to enable the law enforcers or a police officer to arrest the suspect. This class A information is sometimes known as operational information because it provides the operational information for the police or other law enforcers in operations.

The second information class is class B**,** which provides information about crime and criminal acts. It provided information on how the criminal did the crime. The criminalist needs this information class for investigation purposes such as admitting the evidence and collecting evidence. The third class is class C, the highest class, producing the intelligence role. In this class, the criminalist wants information about why the criminal committed that crime and at that place/location and time. The information class C aims to prepare the crime prevention strategy or action plan.

The paper introduced three crime prevention strategies: *desire-based*, *ability-based* and *opportunistic-based crime prevention strategy*. These strategies are products of information class C, which is the intelligence. The desire-based crime prevention strategies are action plans that aim to change the behaviour and lifestyle of the individual or criminal, such as counselling, radicalisation, etc. On the other hand, ability-based crime prevention strategies are a set of action plans that aim to reduce the criminal ability of individuals. It may include reducing the criminal's economic and financial ability or power by ceasing or seizing their assets, limiting their access to new technology, etc. Moreover, opportunistic-based crime prevention strategies are action plans that aim to increase the risk of arrest and conviction of the criminal. It may include increasing police measures such as patrols and beats, surveillance or strengthening the punishing laws, such as expanding the sentence period for offenders, etc.

The author believes interrupting their communication is the best approach for a successful or effective detection and prevention plan for criminal networks. We assume criminals communicate *before, during, or after* a crime commission. Therefore, interrupting their communication is the appropriate method to detect and prevent organised crime. However, the advancement of communication technology poses a great challenge and the complexity of detecting and preventing organised crime. This paper addresses two ways of communication: Visiting and tele-messaging communication. Visits communication is done using normal means of transportation such as feet, bicycles, cars, buses, trains, aeroplanes, etc. This transport-based communication type is less common for highly advanced organised crime.

On the other hand, tele-messaging communication includes highly advanced communication, enabled mainly by communication technology such as telephone, mobile phone, e-mail, and social media such as WhatsApp, telegram, fax machine, etc. This method is commonly used in transnational organised crime or the larger geographical areas. The typical crimes for this type of communication are terrorism, human trafficking, smuggling, drug dealing, etc.

For effective communication, the criminals apply both visits and tele-messaging communication. The crime can be organised in different stages, involving both types of communication. For example, the criminals can communicate by e-mail or telephone and then make visits themselves. For example, the criminal can organise the crime in city A; the crime will involve two criminals from city D. The leading organiser can communicate with the criminal in city D and plan to meet at city C, then at city A. Therefore, in most cases, criminals apply both types of criminal communication.

In practice, the common detection and prevention of criminal visiting are using the vesting of the travelling documents such as visa, passport, etc. This method is ineffective because it does not work effectively by disclosing the traveller's illegal motive or criminal. Usually, criminals cover their illicit visits for legal purposes or

missions, so it becomes difficult to detect and prevent this kind of communication effectively. But in small areas such as streets, monitoring and surveillance may be done to investigate the visiting movement from and to the criminals. Therefore, the visiting communication can be interrupted effectively in a small geographical area by using surveillance. However, even an international visit can be surveilled, but it will still be ineffective due to the complexity of the international laws and culture, even the environmental factors and cots.

On the other hand, we can interrupt the tele-messaging communication easily compared with the visiting communication. With the advancement of communication technology, the criminalist can record, store, or interrupt criminal communication. The criminalist can study or examine the flow of communication and establish the association or relationship between two or more communicated criminals. This paper identifies two relationships that can be disclosed by examining the criminal's communication: Special mission (task) and general (historical) relationships. The special mission relationship is the relationship the criminal communicates for a specific purpose and time. This relation is significant because it discloses the crime incident by instruction from the counterpart. On the other hand, the general or historical relationship shows the regular or long-term relationship between the criminal and the counterpart. In this kind of relationship, we disclose two types of relationship: One may be a close relative such as wife, husband, etc., and two may be chronic criminal partners, but in practice, the illegal use of particular task communication.

7. Conclusions and Recommendation

The paper addressed the main issues concerning detecting and preventing organised crime. It introduced the concept of information class of the criminalist needs in detecting and preventing organised crime- the classes A, B and C. The paper concludes that the *informational need of criminalists is determined by pyramid hierarchal information class A (operational), class B (investigation) and class C(intelligence roles).*

The paper also explained the means of criminal communication-visiting and tele-messaging communication. As we believe that the criminal communicates *before, during and after* the criminal commission, we conclude that interrupting the criminal's communication will disclose their criminal networking. Hence, criminalists can identify criminal relationships as relative-based, such as wife, husband, brother, son, or special mission-based ones. This classification of relationships helps the criminalist detect, prevent and combat organised crime. On the other hand, the paper explains the concept of crime prevention strategies: Desire, ability and opportunistic-based crime prevention strategies. Also, we conclude that the best crime prevention strategy should adhere to the theory of the *crime triangle.*

The paper strongly recommends using the Bundala classification of criminal information to detect, prevent and combat crimes. We recommend information class A for combating crime, class B for detecting crime, and class C for prevention. If the criminalist only wants to combat crime, he needs only class-A information. If the criminal needs to detect the presence of criminality, use class B, and the criminalist intends to prevent the crime, he needs class C information.

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