2024

A Social Network Analysis on Abu Sayyaf Kidnappings

Brenz Gwynne Hababag, Laica Pearl Alcantara, Blessy Tale, & Jamal Kay B. Rogers

Date received: June 30, 2023
Date revised: September 2, 2023
Date accepted: May 3, 2024
Similarity index: 0%

Abstract

The Abu Sayyaf Group (ASG) is a Philippine-based extremist organization globally known for engaging in terrorism, kidnappings, and various criminal activities. This study sought to comprehensively analyze Abu Sayyaf's kidnapping incidents using social network analysis to better understand their operational structures, patterns, and dynamics. The researchers applied centrality measurements to assess the significance of nodes in the network, along with the Girvan-Newman algorithm for community detection to identify groups sharing similar characteristics and extract groups for various purposes. The findings revealed one kidnapping node to have the highest centrality score and holding the most significant influence and numerous incoming connections within the network. Another kidnapper node in the analysis of out-degree centrality displayed a proactive role, initiating multiple connections and shaping the network's dynamic. The community detection uncovered seven distinct communities within the network, each demonstrating unique patterns and characteristics. The findings imply that kidnappings were conducted through groups rather than individuals. The majority of networks involving ASG members participating in multiple kidnapping events hold significant implications for national security strategies.

Keywords: social network analysis, Abu Sayyaf Group, kidnappings, patterns, terrorism

Author Information:

[1]**Brenz Gwynne Hababag**
bgmhababag@usep.edu.ph
orcid.org/0009-0005-1935-9587

[1]**Laica Pearl Alcantara**
lplalcantara@usep.edu.ph
orcid.org/0009-0008-9336-7659

[1]**Blessy Tale**
bptale@usep.edu.ph
orcid.org/0009-0006-7838-5440

[2]**Jamal Kay B. Rogers**
jamalkay.rogers@usep.edu.ph
orcid.org/0000-0001-5839-0791

[1]Alumni
College of Information and Computing,
University of Southeastern Philippines
Davao City, Philippines

[2]Associate Professor
College of Information and Computing,
University of Southeastern Philippines
Davao City, Philippines

https://doi.org/10.53899/spjrd.v29i2.258

Research has explored rebel groups and organized crimes to understand underlying relationships in and outside their networks (Derpanopoulos, 2018; Eaton, 2021; Ficara et al., 2021). However, analysis of the kidnap-for-ransom networks have not yet investigated its operational structure and patterns.

According to Satriawan and Mustofa (2023), terrorism in the Philippines appear to be motivated by conflicts such as those from history, economic conditions, and religious disparities. In this country, rebel groups exist to fight for their beliefs and needs, and one of these is the Abu Sayyaf Group (ASG), known for its violent tactics. The Abu Sayyaf Group is an Islamist rebel faction from the Southern Philippines that broke away from the Moro Islamic Liberation Front (MILF) that acted on internationally recognized terrorism, kidnappings, and illegal activities (NCTC, 2022). While there is a decline in violent activities from the Islamist rebel group, it has not completely dissolved yet and can still be a threat to security (International Crisis Group, 2022).

The ASG also has involvement in transnational crimes. Several kidnapping cases have been carried out by the ASG since 2016, including in other ASEAN countries such as Malaysia and Indonesia (Margiati et al., 2023). The kidnappings commonly took place in the Malaysian and Philippine borders. The Ministry of Defense in Indonesia prepared an early strategy to foster deterrence capabilities of these crimes; the strategy would not only be carried out by military means but is composed of three main pillars: (1) defense force, (2) international cooperation, and (3) development of defense forces. Moreover, the Indonesian Coast Guard established a strategy for increasing Sulu security collaboration with an emphasis on maintaining the framework for both national and international cooperation, strengthening the law in handling and overcoming threats, increasing elements of patrols, increasing the impenetrability of communication and information systems, and emphasizing, the need to increase maritime security (Margiati et al., 2023).

In a related study conducted by Rödder et al. (2021), a new concept in social network analysis called switch networks was developed to analyze centrality measurements on the Bali and 9/11 terrorism attack network dataset in order to uncover information for intelligence services. The study presents a distinct approach by conceptualizing the network as a conditional-logical framework. The concept works as follows: if actor *i* possesses information about an impending attack in the future, the adjacent actor *j* also possesses it. The network allows for the activation or deactivation of actors, enabling the assessment of the significance of each member within the terrorist cell through this concept. The study stated that by analyzing terrorist networks, the information on the organizational, social, and operational structure of the terrorists will hopefully aid in developing prevention strategies for potential future attacks.

For this study's analysis, the dataset from a study on Abu Sayyaf's strategic and learning capacities was used (Borgatti, 2021). The prior research sought to assess the ASG's ability to transmit knowledge to conduct kidnappings; meanwhile, this social network analysis will study the group's patterns and dynamics. With this analysis, the kidnap for ransom operations conducted by the rebel group members can be explored to gain more insight and understanding.

The findings of this study can provide information for decision-making processes, risk assessments, and overall security measures for government entities and private sectors. Moreover, the network information gathered from the analysis can help identify appropriate resource allocation, specifically regarding rescue operations by national and transnational security for better management of personnel and resources. By extension, similar terrorist groups like ISIS, Jemaah Islamiyah, and Al Qaeda may also indicate similar kidnapping patterns.

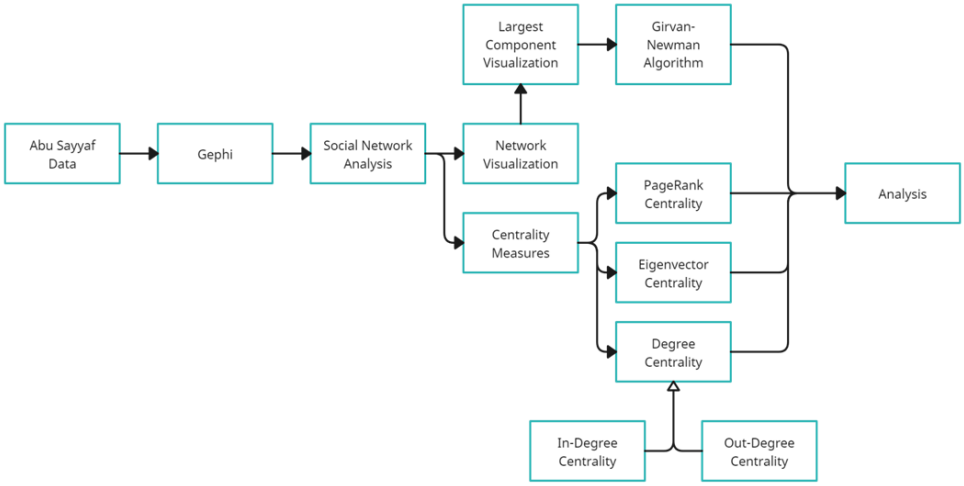
Conceptual/Theoretical Framework

Terrorist networks are used to uncover the ranks of group members, identify significant nodes and communication patterns (Nagdive et al., 2020), in this case, the Abu Sayyaf terrorist group's kidnapping patterns and other counterintelligence to mitigate the criminal activity of terrorist groups. With the help of social network analysis methods, as stated in the study by Rödder et al. (2021), the researchers can analyze and visualize networks of Abu Sayyaf member involvement in kidnappings to map out their kidnapping patterns and analyze potential orchestrated and important kidnappings. Moreover, the researchers argue that traditional analyses of terrorist groups all fall into a critical, labor-intensive, opinionated, and descriptive manner. Although descriptive analysis can be drawn from this study, social network analysis is equally reliable in providing insight with minimal resources spent (Johnson & Chew, 2021).

Figure 1 shows the conceptual framework of this study's utilization of Social Network Analysis on Abu Sayyaf Data UCINET Software (2021). A detailed description of each centrality measure is shown in Table 1 under Materials and Methods.

Figure 1

Social Network Analysis Conceptual Framework



Materials and Methods

Data Collection

In this study, the researchers used the Philippine Kidnappings (2021) dataset, a bipartite network of Abu Sayyaf group members involved in kidnapping cases in the Philippines (Borgatti, 2021). The secondary dataset was obtained from UCINET Software, a catalog, repository, and software package for analyzing social network data and other forms of data. The dataset contains the kidnapping members of Abu Sayyaf as the source, denoted by the label N# (ex. N12), and a kidnapping event as the target, denoted by the label E# (ex. E16). The dataset predefined the labels of each node; furthermore, no alterations were made to the dataset.

Social Network Analysis

Social network analysis (SNA) studies the social structures of groups of individuals, organizations, or any social interaction through the use of network and graph theory (Columbia University Irving Medical Center, 2023; Saqr & López-Pernas, 2022). SNA involves nodes and edges, formally called actors and relationships/ties. Different actors have certain relationships depending on the context of the social network. In the context of this study, the network consists of members of the Abu Sayyaf and kidnapping events as actors and involvement as the ties. The researchers used social network analysis methods to measure the networks included in this study.

Centrality Measurements

A set of quantitative metrics in social network analysis, called centrality measurements, assesses the importance of the nodes or actors present within the network and is used as an indicator of the nodes' productive activity (Saqr & López-Pernas, 2022). These metrics provide insights into the structural properties of the network and help identify key actors or nodes that play prominent roles in it. The researchers used the following common centrality measures: PageRank Centrality, Eigenvector Centrality, and Degree Centrality (Ahmed et al., 2018).

Table 1

Descriptions of Centrality Measurements Used

Centrality Measurement	Brief Description	Significance
PageRank	It is a variant of EigenCentrality that was developed by two Google founders for ranking web content and measuring its importance through hyperlinks between pages. PageRank applies to any network (Disney, 2020).	This measurement helps uncover influential and important nodes that extend beyond direct connections, which is helpful for link direction purposes such as understanding citations and visualizing network activity (Disney, 2020).
Eigenvector	The indirect influence of nodes in a network is evaluated using the Eigenvector Centrality approach. Each node is given a score based on the significance of its connections. Compared to nodes with lower scores, those with higher scores have a bigger influence on a node's overall score. A node with a high eigenvector score is related to many others with high scores (Umadevi, 2013).	The objective of this measurement is to consider the nodes with high centrality scores that also have connections to other nodes with high centrality scores. This measurement can uncover variable values of nodes that explain the better connections a node has to other nodes (Hansen et al., 2020).
Degree Centrality	Degree centrality counts the connections linked to a vertex, indicating its popularity, but it does not differentiate between quantity and quality. Degree measures the total number of edges connected to a vertex. In directed networks, there are two-degree measures: in-degree (connections pointing towards a vertex) and out-degree (connections originating from a vertex and extending outward) (Hansen et al., 2020).	This metric is employed to identify highly connected individuals within a network who are often considered popular or influential. These individuals tend to possess a significant amount of information and can establish connections swiftly throughout the broader network (Disney, 2022).

Community Detection

Girvan-Newman Clustering Algorithm

The Girvan-Newman method is one of the classic community clustering algorithms that detect communities in large networks. The algorithm separates the network into different clusters or communities by removing the edges with the most prominent edge betweenness and the number of shortest paths passing the edge; after edge removal, two communities are recognized (Chiang, 2021). Since the algorithm can consider the edge type and edges in parallel, the algorithm can be used with directed or undirected networks. The algorithm takes the edge betweenness of each edge in the network; the full algorithm works step by step as follows:

1. A node X is selected to perform Breadth First Search (BFS) to find the shortest path from the selected node to other nodes and assigns numbers as a score to each node.
2. Starting from the leaf nodes, calculation of the credit of the edge by 1, plus the sum of the edge credits to the node multiplied by the score of the destination node or the selected starting node.
3. Computation of all the edge credits of edges in the network, and repetition step 1 until all nodes are selected.
4. Summing up all the edge credits calculated in step 2, divided by 2, which results in the edge betweenness.

After the edge betweenness is calculated, the edges with the highest edge betweenness are removed; this process is repeated until a good community split is found:

1. Removal of edges with the highest edge betweenness
2. Calculation of the modularity of the current community split
3. Repetition of step 1 if modularity is greater than 0.3-0.7

Gephi

This analysis used free, open-source graphic and network visualization and exploration software. The Gephi software is a high-performing rendering engine with an ergonomic interface, supports multiple native file formats, and allows customization through plugins for layout, metrics, and data sources, among the many more listed. It is applicable for exploratory data analysis, link analysis, social network analysis, biological network analysis, and poster creation (Gephi, 2022).

Results and Discussion

Centrality Measurements

Figure 2

Communities Based on PageRank

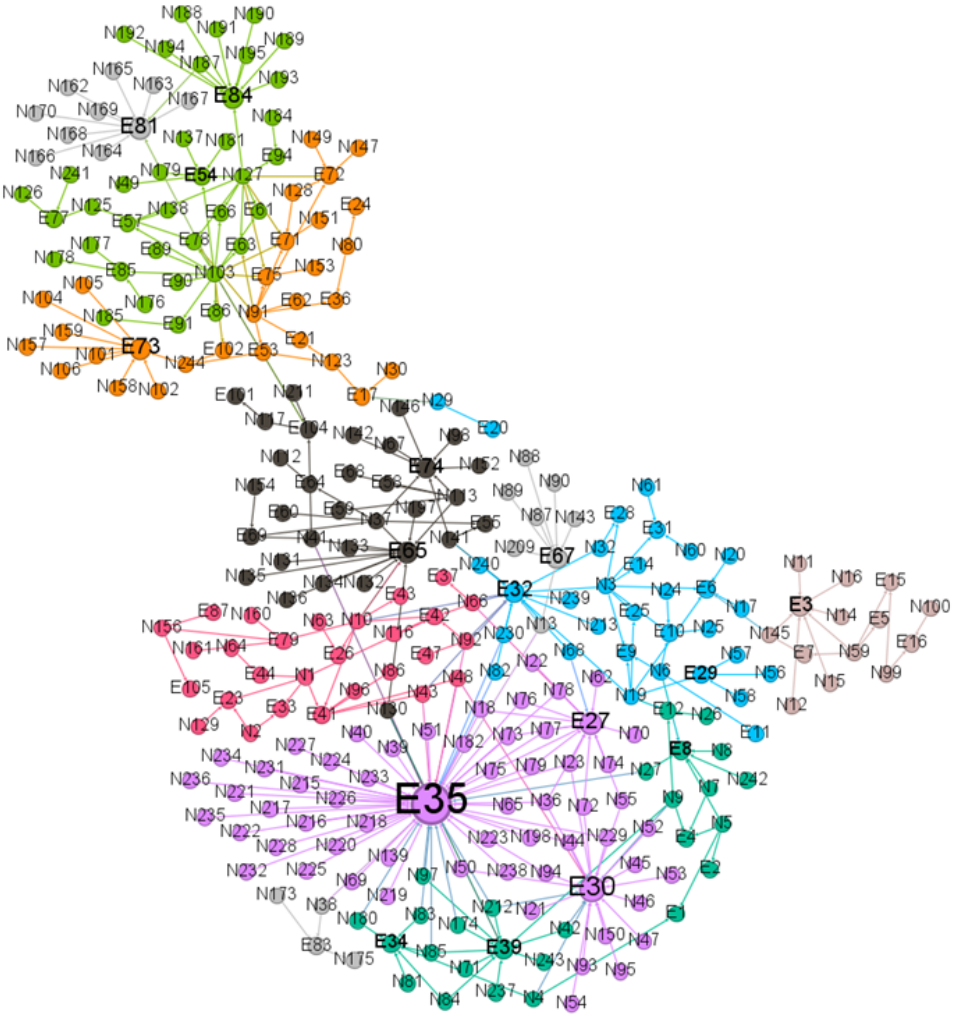


Figure 2 shows the largest social network of ASG Kidnappings. The social network also shows the communities generated through the Girvan-Newman Clustering algorithm represented as different colors.

Table 2

PageRank Centrality Measures

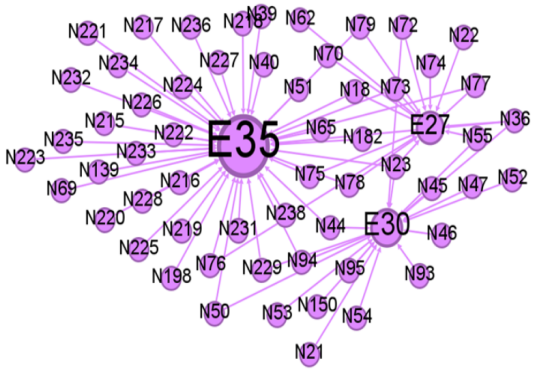
Id	Label	PageRank
E35	E35	0.065003
E30	E30	0.025176
E27	E27	0.016831
E81	E81	0.016294
E84	E84	0.01482
E73	E73	0.014429
E65	E65	0.014064
E67	E67	0.012912
E32	E32	0.012033
E39	E39	0.011268
E74	E74	0.010434
E3	E3	0.010257
…	…	…

PageRank was utilized to compute the centrality scores of the nodes in the network. PageRank assesses the significance and influence of a node by considering the "voting" or "recommendation" it receives from other prominent nodes in the network. Nodes with higher PageRank scores are regarded as more central and influential within the network. Figure 2 and Table 2 show that E35 has a PageRank centrality score of 0.065003, which indicates that E35 is the most influential and important kidnapping event within Abu Sayyaf's kidnapping network compared to other nodes.

This suggests that E35 can be speculated on as an important person, such as a direct enemy of Abu Sayyaf or a high-ranking individual. In the research conducted by Katagiri (2019), an exploration of the organizational dynamics and strategies of the Abu Sayyaf Group (ASG) is undertaken. Katagiri's investigation reveals that the individuals subjected to kidnapping by ASG were predominantly non-Muslim foreigners, and the primary driving force behind these abductions was primarily financial. The graphical representation included in the study indicates that hostage-taking emerged as the preferred method for securing a ransom, enabling ASG to bolster its financial resources while concurrently minimizing the number of casualties incurred. In addition, most of the kidnapper nodes have no prior involvement in other kidnappings; this is also evident in the visualization of the Girvan-Newman community detection algorithm shown in Figure 2.

Figure 3

E35 "Important" Community



The visualization shown in Figure 3 represents the community in which the prominent node E35 is involved. Three kidnapping events are present in the community: E27, E30, and E35. Ten or more Abu Sayyaf kidnappers have been involved in the three kidnapping events, and there are at least eight connections to kidnappers also involved in the kidnapping events present in the community network. Most nodes with a high centrality measure, according to Table 2, Table 3, Table 4, and Table 5, are present in the community network. Thus, it is labeled as an "Important" community.

Figure 4

Communities Based on Eigenvector Centrality

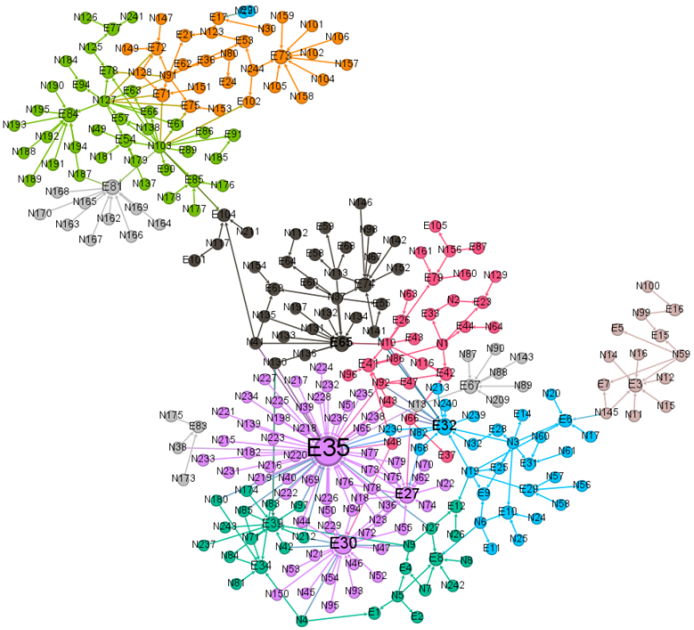


Figure 4 shows the communities based on the Eigenvector centrality measures denoted by node size; the larger the node, the higher the Eigenvector centrality score. It also shows the significance and influence of each node.

Table 3

Eigenvector Centrality Measures

Id	Label	Eigenvector
E35	E35	1.0
E30	E30	0.396552
E27	E27	0.293103
E32	E32	0.258621
E65	E65	0.206897
E81	E81	0.189655
E39	E39	0.189655
E84	E84	0.172414
E73	E73	0.155172
E67	E67	0.137931
E74	E74	0.137931
E3	E3	0.12069
…	…	…

The network underwent an analysis using the Eigenvector centrality measure to determine the centrality scores of its nodes. Eigenvector centrality assesses the significance and influence of a given node by considering both the quantity and quality of connections to other influential nodes. Nodes with higher Eigenvector centrality scores are regarded as having a more significant influence within the network. As with PageRank centrality, E35 had the highest Eigenvector centrality score in Figures 4 and Table 3, with a score of 1.0, which indicates that E35 has the most significant influence within the networks.

Table 4

In-Degree Centrality

Id	Label	In-Degree
E35	E35	58
E30	E30	23
E27	E27	17
E32	E32	15

Id	Label	In-Degree
E65	E65	12
E39	E39	11
E81	E81	11
E84	E84	10
E73	E73	9
E67	E67	8
E74	E74	8
E3	E3	7
…	…	…

Table 5

Out-Degree Centrality

Id	Label	Out-Degree
N103	N103	16
N127	N127	11
N3	N3	9
N91	N91	9
N10	N10	7
N19	N19	6
N37	N37	6
N1	N1	5
N113	N113	5
N5	N5	4
N6	N6	4
N9	N9	4
…	…	…

In social network analysis (SNA), in-degree and out-degree centrality measures provide insights into the network's connection dynamics and the roles played by individual nodes. The examination of in-degree centrality in Table 4 reveals that E35 possessed the highest number of incoming connections, with a count of 58 ties. This finding indicates that E35 was a prominent target for other nodes, suggesting heightened attention or influence within the network. On the other hand, the analysis of out-degree centrality in Table 5 identifies N103 as having the highest number of outgoing connections, totaling 16 ties. This result suggests that N103 actively initiated connections or influenced other nodes, potentially assuming a proactive role in shaping the network's dynamics.

Figure 5

Largest Community in the Network

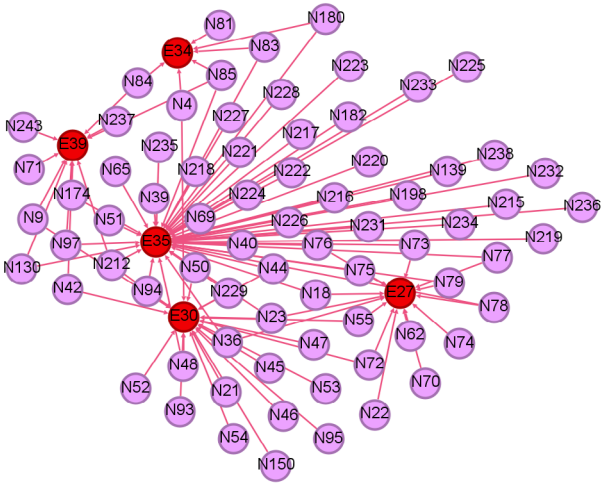


Figure 5 shows Community 1 of the ASG Kidnapping network, representing the largest community within the dataset. This particular community comprises five kidnapping events, denoted by nodes colored red, which have more than four kidnappers involved each.

Figure 6

Community of Kidnappers Involved in One or More Kidnapping Event Nodes

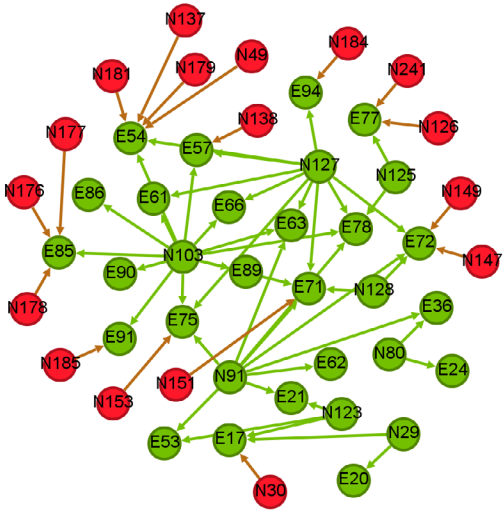


Figure 6 shows Community 2 of the ASG Kidnapping network. Within this community, some kidnappers have been involved in one or more kidnapping event nodes. Notably, a more significant

number of kidnappers have been involved in only a single kidnapping event, denoted by nodes colored red.

Figure 7

Community with Emphasis on Node E32

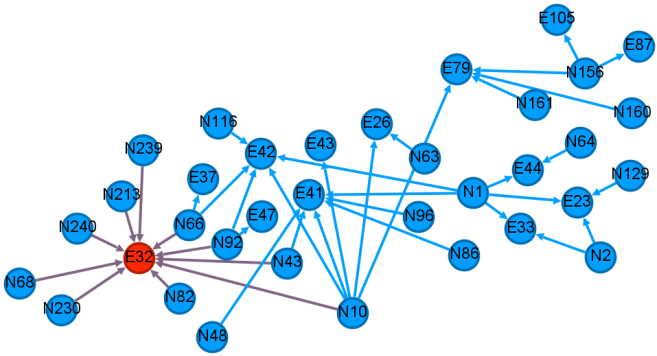
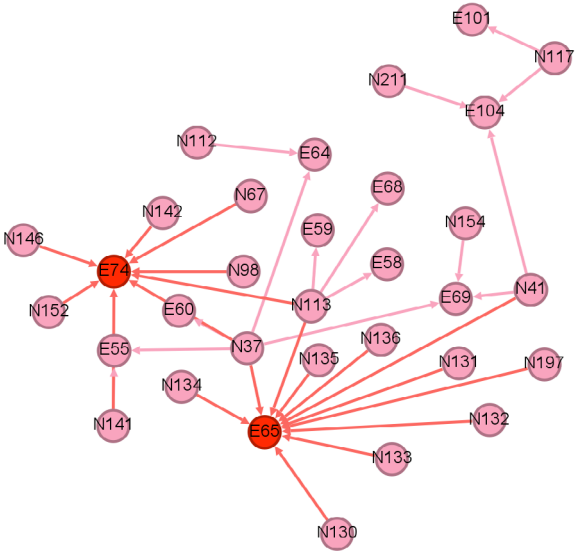


Figure 7 shows Community 3; the visual representation highlights that node E32 has more kidnappers than other nodes within this community.

Figure 8

Community with Emphasis on Nodes E65 and E74



The provided Figure 8 shows Community 4, representing a significant network community. The visualization highlights two noteworthy targets, namely E65 and E74. Additionally, it is observed that nodes N37 and N113 have more targets than other nodes within the community.

Figure 9

Community with Emphasis on Nodes E81 and E84

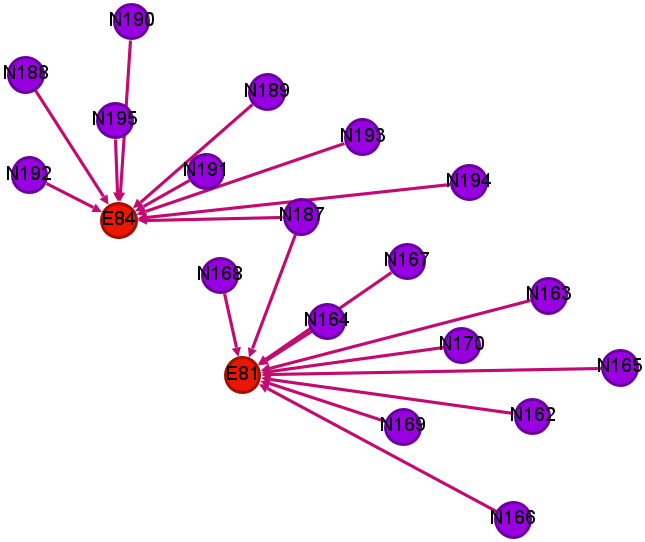


Figure 9 shows Community 5 in the visual representation. Within this community, it is evident that two specific targets are associated with a more significant number of kidnappers. Notably, these kidnappers have a maximum of one target each.

Figure 10

Community with Kidnappers Involved with Node E3

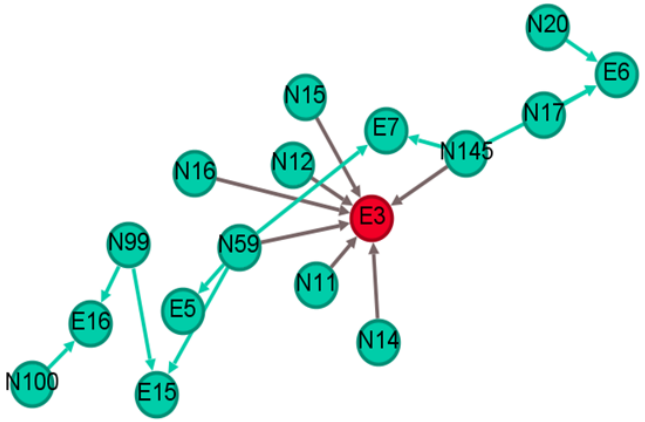


Figure 10 shows Community 6 in the network analysis. This community is characterized by the prominence of target node E3, which attracts the attention of multiple kidnappers. These kidnappers have been involved in either one or more kidnapping events within the network.

Figure 11

Smallest Community in the Network

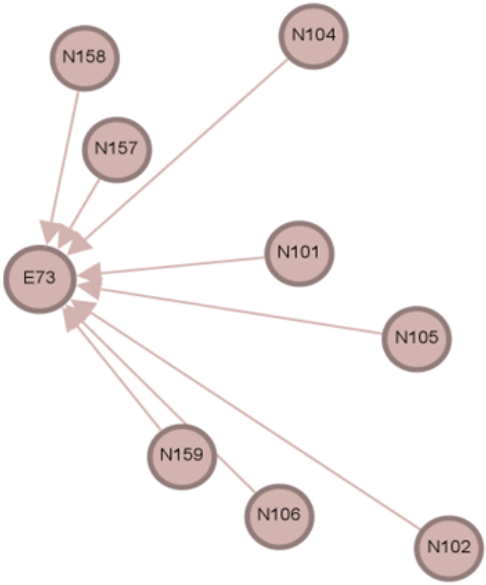


Figure 11 shows the network's smallest community. Within this community, a solitary target is subjected to the involvement of multiple kidnappers.

The Girvan-Newman detection algorithm was utilized in the network to uncover the different communities and their similarities and patterns. There are seven communities in total in the network, each with differences and similarities. From the communities shown in Figures 5 to 11, the kidnapping event nodes have two or more connections to Abu Sayyaf kidnappers, except for Figure 10, which has a connection outside the community. This implies that Abu Sayyaf carries out kidnappings with a partner or group, never alone. Additionally, most kidnapping events are done by different members and different numbers as opposed to a uniform number of people operating in unison. This is most likely due to the ASG's structure and behavior changes throughout the years. O'Brien's (2012) study investigated the fluctuations of the ASG's kidnapping activities, which states that the reason for the changes in their kidnapping activities from having political objectives to kidnapping for ransom is because of the changes of leadership, different subgroups being formed by rogue members, and the discontent objective of ideology, power, and profit that they gain from kidnapping.

Each community has a kidnapping event node that is more prominent than others in terms of their centrality measures. These nodes are also visible in the Eigenvector centrality of the whole network in Figure 2, which shows the transitive influence of nodes connected to other nodes with a higher eigenvector centrality score. Most notably, the nodes with the higher scores are kidnapping event nodes, which shows the higher "importance" of these nodes in the network. These nodes can be defined as the "important" nodes where the event targets individuals of high value for the ASG to kidnap for ransom. This is also held true in other research, such as a studies by O'Brien (2012) and Kalicharan (2019), which states that the ASG in recent times mostly kidnaps individuals for financial reasons, unlike other terrorist groups that kidnap for political or ideological reasons. The more profit

they get from the kidnapping, the more important it is to kidnap individuals. The study by Kalicharan also states that the ASG primarily resorts to executing the kidnapped victim if there are no incentives given to them, which can be a crucial point in the importance of analyzing ASG kidnapping patterns and structures. Moreover, the ASG are more negotiable when it comes to their ransoms compared to other terrorist groups.

Finally, each community kidnapping event node is tied to at least one kidnapper node with two or more connections with other nodes present in their respective communities, except for Community 7, which only has one kidnapping event node. This shows that there is a consistent pattern where members have already participated in different kidnappings with different members. As stated in a study by Singh and Singh (2019) which focused on the changes of ASG from a band of bandits to a Jihadi Organization, the organization was criminally well-known for being synonymous with kidnap-for-ransom activities.

Conclusion

Kidnapping for ransom is a serious crime threatening security; thus, analyzing its patterns and structure must be performed. From this social network analysis, it has been found that most of the kidnappers were involved in at least one kidnapping event. Abu Sayyaf members who were already experienced in kidnapping were included in the networks involved in the three most prominent kidnapping events. This observation suggests that members of the ASG participate in kidnapping operations more than once for important kidnapping events, indicating that a careful selection of experienced members reveals the ASG's strategies, where they pick kidnappers who are experienced in the operational intricacies.

A 2019 kidnapping of a couple, a Filipina and a British national, where the ASG was involved, provides evidence of this observation of "important" kidnapping events. The couple owned many properties and businesses and thus were always moving from place to place, leading to their kidnapping at a resort (Fonbuena, 2019). The kidnapping demonstrates the ASG's deliberate approach to picking targets, and this knowledge can contribute to the concerned entities' anticipation of the group's weaknesses and take preventive actions on the ASG's approach. Among the kidnapping events, the researchers have termed the "important" communities with a high number of nodes targeting them. Various centrality measurements, such as PageRank, Eigenvector centrality, and In-Degree and Out-Degree centrality, were employed to evaluate the importance and influence of nodes in the kidnapping network associated with Abu Sayyaf. This focused approach, which considers how the network operates, could weaken crucial hubs where operations happen and ultimately limit the group's overall abilities, which can benefit the authorities.

Based on the results, node E35 consistently stood out as the node with the highest influence and significance among different centrality measures. The other nodes' Eigenvector centrality value did not rise higher than 0.396, suggesting that the ASG does not have a uniform number of kidnappers per kidnapping event. Moreover, the application of Girvan-Newman for community detection uncovered the existence of seven communities within the network. Each community displayed unique patterns and traits. Notably, kidnapping event nodes within these communities exhibited multiple connections to Abu Sayyaf kidnappers, signifying that groups rather than solitary individuals typically executed the kidnappings. In all of the identified networks except one (Figure 11), an ASG member is always involved with more than one kidnapping event.

Future work for this study may include an in-depth analysis of the node's survivability by utilizing an updated network dataset with labels of node characteristics such as date and location of the kidnapping event; the gathering of new dataset with node characteristics of specific victims such as

occupation and age; or through the exploration of other methodologies for the analysis. Investigating how these nodes change and continue to exist over time could offer extremely valuable information about how the ASG, and potentially other terrorist groups, develop and change over the years.

Conflict of Interest Statement

We have no conflict of interest to disclose.

AI Disclosure

We declare that this manuscript was prepared without the assistance of artificial intelligence. Hence, the content of this paper is original.

References

Ahmed, A., Khan, M.F., Usman, M., & Saleem, K. (2018). Analysis of coauthorship network in Political Science using centrality measures. *International Journal of Advanced Computer Science and Applications (IJACSA)*, *9*(10), 329–344. https://doi.org/10.14569/IJACSA.2018.091040

Borgatti, S. (2021). Philippine kidnappings. UCINET Software.

Chiang, J. (2021, October). Girvan–Newman - The clustering technique in network analysis. *Medium*. https://tinyurl.com/2e8fvvwc

Columbia University Irving Medical Center. (2023). *Social network analysis*. https://tinyurl.com/kcd45bbn

Derpanopoulos, G. (2018, May). *Modeling inter-rebel group conflict with network analysis: The case of Lebanon's civil war*. https://tinyurl.com/4x4zz55k

Disney, A. (2020, January). *PageRank centrality & EigenCentrality*. https://tinyurl.com/32fxhk84

Disney, A. (2022). Social network analysis: Understanding centrality measures. *Cambridge Intelligence*. https://tinyurl.com/mrx4ydef

Eaton, T. (2021, June). *A network analysis of Haftar's military alliance (4)*. https://tinyurl.com/5b2hd4km

Ficara, A., Cavallaro, L., Curreri, F., Fiumara, G., De Meo, P., Bagdasar, O., Song, W., & Liotta, A. (2021). Criminal networks analysis in missing data scenarios through graph distances. *PLOS ONE*, *16*(8). https://doi.org/10.1371/journal.pone.0255067

Fonbuena, C. (2019). British national and his wife kidnapped in Southern Philippines. *The Guardian*. https://tinyurl.com/mr7af2r3

Gephi (2022). Gephi Features. *Gephi*. https://gephi.org/features

Hansen, D. L., Shneiderman, B., Smith, M. A., & Himelboim, I. (2020). Social network analysis: Measuring, mapping, and modeling collections of connections. *Analyzing Social Media Networks with NodeXL (Second Edition)*, 31–51. https://doi.org/10.1016/B978-0-12-817756-3.00003-0

International Crisis Group. (2022, March). *Addressing islamist militancy in the Southern Philippines*. https://tinyurl.com/mpkw4eet

Johnson, E. M., & Chew, R. (2021). Social network analysis methods for international development. *RTI Press*. https://doi.org/10.3768/rtipress.2021.rb.0026.2105

Kalicharan, V. S. (2019). An evaluation of the Islamic State's influence over the Abu Sayyaf. *Perspectives on Terrorism*, *13*(5), 90–101. https://tinyurl.com/5n9beshj

Katagiri, N. (2019). Organized insurgency, lethality, and target selection: Abu Sayyaf Group and Jemaah Islamiyah. *Small Wars & Insurgencies*, *30*(3), 518–542. https://doi.org/10.1080/09592318.2019.1601838

Margiati, T., Halkis, M., & Sutanto, R. (2023). Indonesia's defense strategy against transnational crimes of the Abu Sayyaf Group in the Sulu Archipelago. *International Journal Of Humanities Education and Social Sciences (IJHESS)*, *2*(6), 1930–1942. https://doi.org/10.55227/ijhess.v2i6.516

Nagdive, A.S., Tugnayat, R., & Peshkar, A. (2020). Social network analysis of terrorist networks. *International Journal of Engineering and Advanced Technology (IJEAT)*, *9*(3), 2553–2559. https://doi.org/10.35940/ijeat.C5431.029320

National Counterterrorism Center (2022, October). Abu Sayyaf Group (ASG). *Counter terrorism guide*. https://tinyurl.com/2f2uz7cd

O'Brien, M. (2012). Fluctuations between crime and terror: The case of Abu Sayyaf's kidnapping activities. *Terrorism and Political Violence*, *24*(2), 320–336. https://doi.org/10.1080/09546553.2011.648679

Rödder, W., Dellnitz, A., & Litzinger, S. (2021). Analysing terrorist networks—An entropy-driven method. *Expert Systems*, *39*(10). https://doi.org/10.1111/exsy.12720

Saqr, M., & López-Pernas, S. (2022). The curious case of centrality measures: A large-scale empirical investigation. *Journal of Learning Analytics*, *9*(1), 13–31. https://doi.org/10.18608/jla.2022.7415

Satriawan, I., & Mustofa, M. (2023). A genealogical study of the history of Philippine terrorism. *Journal of Social and Political Sciences*, *6*(2), 162–171. https://doi.org/10.31014/aior.1991.06.02.417

Singh, B., & Singh, J. (2019). From "bandit" to "Amir"—The rise of the Abu Sayyaf Group as a Jihadi organization in the Philippines. *Asian Politics & Policy*, *11*(3), 399–416. https://doi.org/10.1111/aspp.12480

Umadevi, V. (2013). Case study— Centrality measure analysis on co-authorship network. *Journal of Global Research in Computer Science*, *4*(1), 67–70. https://tinyurl.com/yr4x44kr