



## Analysis of social network implementation as a tool for determining the structure of crime networks

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### ABSTRACT

Social network analysis (SNA) is a process of mapping and analyzing interactions between people in social media, including crime. SNA can be used to determine network structure and relationships between criminal network actors through the social media used. After initial investigation, this study used the hashtag "Hayat Tahrir al-Sham" and the phrase in Arabic to crawl the data. Business intelligence is a concept and method of how we can improve the quality of decision-making in a business based on data-based systems. By using SNA terms such as density, centrality, diameter, and reciprocity. Business intelligence can be built. With the combination of SNA and BI, groups affiliated with these groups can be identified. The research also identified 10 accounts that were considered to play an important role in collaborative communication, the flow of funds, and the dissemination of radical propaganda. By finding these 10 accounts, there are many investigations that can be carried out in accordance with standard operating procedures at the authorities.

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### 1. INTRODUCTION

The recent use of SNA in the study of political violence can be attributed to several conceptual and methodological developments. The first is the growing recognition within the academic community of the important associations between group dynamics and social structures and members, motivation and behavior of groups (Utami S, Safitri R, Kuncoroyakti Y., 2021). Sociological and organizational texts began to assess the network perspective in the early, emphasizing the importance of the approach in understanding collective action (Falko von Ameln, 2021). To date, studies of political violence have tended to ignore this group dimension of violence, focusing on two main elements: the individual and the organization. Police resources around the world are becoming increasingly under pressure. Police and government authorities are struggling to meet the increasing demands of the police frontline and the complex financial and social impact of organized crime on society (Sanders C, Lavoie J., 2021). Along with these pressures, the world of intelligence gathering has remained relatively stable and

consistent in the use of human information sources to inform law enforcement authorities about the location and proliferation of organized crime activity in our society (Prieto Curiel R, Patino J, Duque J, O'Clery N., 2021). The research presented in this text demonstrates an alternative evidence-based approach to standard intelligence gathering processes by enhancing law enforcement's deterrence capacity in identifying organized crime groups not previously detected under standard police intelligence gathering techniques (Sweeney J, Tran V., 2022). Research on the Application of AI in Business Intelligence for Predictive Analysis of Criminal Information is a model based on information summarized using SNA (Social network analysis) on Twitter social media and can be applied using Netlytic, NodeXL and GEPHI as well as to facilitate analysis using a data warehouse (Blount K, 2022). The design of research Compositions information begins with preprocessing to map the network structure to prepare data for analysis, namely density, diameter, centralization, reciprocity which focuses more on modulation to identify groups in the network from Twitter social media accounts that share terror study propaganda in space cyber (Senol M, 2022).

Previous research on dealing with organized crime and the threat of terrorism has shown, among other things, the importance of efficiently and effectively analyzing patterns of criminal ties (Musciotto F, Miccichè S., 2022). SNA offers a conceptual framework, techniques and software for measuring and visualizing any empirical network (Goritz A, Kolley N, Jörgens H., 2019). The purpose of this study is to examine, examine and consider the use of SNA as the primary approach for analysis and investigation of criminal and terrorist organizations (Fitriani N, Sembiring I, Hartomo, 2019). Two quasi-experiments were deployed, using a conceptual analytical framework consisting of topology, cohesive subgroups, centrality and size of key players, to see if application of network concepts and techniques could help law enforcement and intelligence services understand and derive meaning from complexes and/or collections big data (Tahalea, S. P., & Azhari, S. N., 2019). The results confirmed the research hypothesis and key conclusions were drawn. It was found that SNA is a fairly effective and reliable approach that gives investigators and analysts the power to know the structure of criminal and terrorist networks. Clearly, SNA can influence new ways of thinking and improve professional practice through intelligence-led application development. This study broadens the understanding of the use of network concepts and techniques for crime analysis and investigation, and can be used to inform decisions about SNA programs and technologies (Kumar A, Rani R, Sharma N, Purohit S., 2020).

## 2. RESEACH METHOD

In this study, an analysis will be carried out to design business intelligence, density, diameter, centralization, crime/criminal reciprocity through a network of social media, namely Twitter, and to support criminal analysis, this case study is only limited to the development of SNA from the Twitter social media terror network to map network structure as in Figure 1.

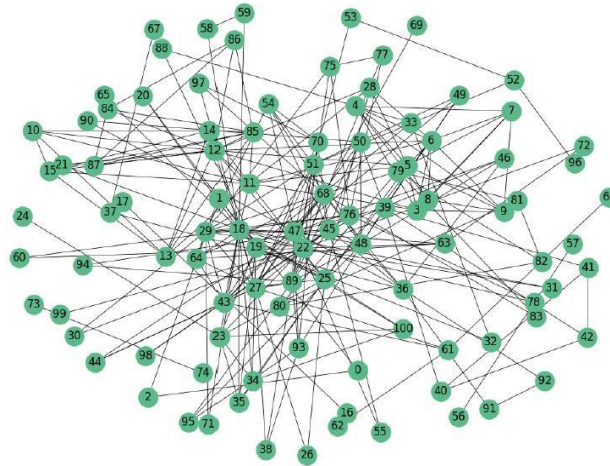


Figure 1. Network structure model

## 2.1 Data Warehouse

Is a system in charge of archiving as well as analyzing historical data to support the information needs of a business or organization. According to Connolly and Begg defines a data warehouse as a collection of subject-oriented, integrated, time-variant and non-volatile data that supports the management decision-making process defines a data warehouse as a collection of data extracted from operational, historical and external databases, which are cleaned, modified and grouped for identification and analysis for business decision making (Saraswat P and Raj S., 2022). Furthermore, describes a data warehouse as a special database whose main task is to provide fast access to data for analysis purposes. But in some cases, it is necessary to use a set of data warehouses to produce complete information. The data cube allows data to be modeled and viewed in various dimensions Meanwhile, the data warehouse functions are (a) easier to make decisions, (b) provide fast data access, (c) provide consistent data, (d) help optimize return on investment (ROI) and (e) provide insight about historical data (Dean G, Moraes J, White J, Deleon R, Jones M, Furlani T., 2022).

### a. Characteristics Data Warehouse

It is fundamentally subject-oriented, integrated, nonvolatile and time-variant these characteristics are interrelated with each other so that all of them must be implemented in order to produce a data warehouse that is useful in decision making. The characteristics of a data warehouse consist of (a) subject-oriented, a data warehouse process that is organized based on the main subject, such as customers, suppliers, products, and sales, (b) integrated, a data warehouse that integrates data from various data sources and stores data. data from various different sources stored in a consistent format which is a unity so that it cannot be separated with integration requirements such as consistency in the physical attributes of the data, (d) time variant, which is a historical data store that is accurate in a certain period , (d) non-volatile, means that the data in the data warehouse cannot be changed by the user (user) cannot change the existing data warehouse, and has a physically separate storage from the operational environment and only requires initial loading of data and access of data (Lokaadinugroho I, Girsang A, Burhanudin B., 2021).

#### b. Data Warehouse Schema

Is a model that is used for multidimensional data and describes the relationship between the dimension table and the fact table and the measure used, so that a collection of real-time transaction data that is read-only and the data will be analyzed for a decision support system, the star schema is a model that Following the star shape, there is a fact table surrounded by several dimension tables. Facts are used to store a measure and dimensions are used to analyze the measure through aggregation operations, such as COUNT, SUM and AVERAGE). Each fact and dimension has a fact table and dimension table. The fact table contains data about a particular topic which is usually associated with a numeric (measurable) value known as a measure and has two or more foreign keys that are connected to the primary key in the dimension table. The dimension table contains perspective data about an entity and is defined by a single primary key (Arora A, Gosain A., 2021).

#### c. ETL (Extract Transform and Load)

Is a data integration process that combines data from various sources into one consistent storage and is loaded into a data warehouse or other system, so it is recommended to store data that is smaller and does not require frequent updates so that data integration is used in real time. In general, the ETL processes are (a) extract, which is the extraction of data from several data sources that will be used in the data warehouse, (b) transform, which is a data transformation process that involves the data cleansing process to obtain accurate, correct, complete, and accurate data. consistent and unambiguous, (c) load, load data that has been extracted and transformed into dimension tables and fact tables in the data warehouse (Andriansyah and Doni, 2022)

#### d. OLAP (Online Analytical Processing)

It is an approach that provides various answers to multidimensional analytical queries quickly to support the design of applications and technologies that can collect, store, and manipulate multidimensional data for analysis purposes. amount of data to provide faster access for further analysis purposes. The function of OLAP is to increase the productivity of end users in the business sector, IT developers and the entire organization, and timely access to strategic information by generating more effective decision making and reducing the application development backlog to allow end users to change schemas and build their own models (Taufik M, Renaldi F, Umbara F., 2021).

### 2.2 SNA (Social Network Analysis)

Social network analysis is a method to visualize activity and connection strength between users on social networks, as well as a step to identify interactions in knowledge sharing. This social network analysis can also map and measure the relationship between people, groups, organizations, computers or information/knowledge bodies and other processing in the network (Singh S, Srivastava V, Kumar A, Tiwari S, Singh D, Lee H., 2022). SNA can be described as a science that studies human relations with the help of graph theory (Guo D, Shao Y, Cui Y, Wang Z, Zhang L, Shen C., 2021). SNA studies the structure of relationships that link individuals or other social units and dependencies in behavior or attitudes related to the arrangement of social relationships. The relationship is described by nodes, or can be called vertices which symbolize actors or users and ties or also called edges, links or connections which symbolize the relationship between actors (Bright D, Brewer R, Morselli C., 2022). To visualize the sociograph, five stages are needed to determine the centralities in a network, namely:

a. Density

Measurement to obtain an explanation of the number of relationships made or relationships received by each actor in a network, by knowing the value (mean) of the connectedness of actors in the network, it can be seen the strength of the relationship that may occur in the whole network (Luna-Pla I, Nicolás-Carlock J., 2020), with the following equation formula:

$$D = \frac{\text{---}}{N(N-1)} \quad (1)$$

b. Eigenvektor Centrality

Measurement to find the most central actor in the network as a whole by looking at the aspect of the distance between the actors, this measure gives a higher weight to nodes that are connected to nodes that also have high connectivity (Oumkaltoum B, Omar E, Loqman C, Aris O., 2021), with the following equation formula:

$$C_i(\beta) = \sum(\alpha + \beta c_j) A_{ji} \quad (2)$$

$$C(\beta) = \alpha(I - \beta A)^{-1} A I \quad (3)$$

c. Degree Centrality

Measurement of the role of an actor in the network as an actor with a high degree of centrality is an actor who has a lot of contact relationships with other actors, this shows that the actor is popular in the network, so it is important to pay attention to where the relationship occurs and how they are connected, and vice versa (Zakimi N, Greer A, Bouchard M, Dhillon A, Ritter A., 2023), with the following equation formula:

$$C_b = \frac{\frac{g_{ij} P_k}{g_{ij}}}{N^2 - 3n + 2} \quad (4)$$

d. Closenes Centrality

Measurement to calculate the geodesic distance, which is the shortest distance between nodes and other actors that are reached. With this path can be a measure of how far an information can be spread from one node to another. The pattern of direct and indirect relationships allows other nodes in the network to be faster than others (Jayashree G, Priya D., 2019), with the following equation formula:

$$C_c = \frac{N-1}{\sum D_{ij}} \quad (5)$$

e. Betweenness Centrality

The measurement is to find out how far the node can control and control the flow of information between other actors, and how well the actor can facilitate communication with other actors, this actor also has a high betweenness centrality, meaning that the actor has a large capacity to facilitate communication. The interaction between actors who are interconnected, this measure shows the role of a node as a bottleneck (Nurrokhman N, Dwi Purnomo H, Dwi Hartomo K., 2020), with the following equation formula:

$$Cb = \frac{gijPk}{\frac{gij}{N2-3n+2}} \tag{6}$$

f. Follower Range

A measurement to determine the popularity value of influential nodes in a network from the number of followers or followers of nodes, while actors connected to other nodes or the degree of centrality have higher means more followers or popular (Lee K, Eoff B, Caverlee J., 2021), with the following equation formulas:

$$Fr = \frac{F1}{F1+F3} \tag{7}$$

3. RESULTS AND DISCUSSION

The general purpose of implementing social network analysis to determine the structure of a crime network is to perform a predictive analysis of criminal information based on information summarized using SNA on Twitter social media using Netlytic, NodeXL and the GEPHI application using a data warehouse as shown in Figure 2.

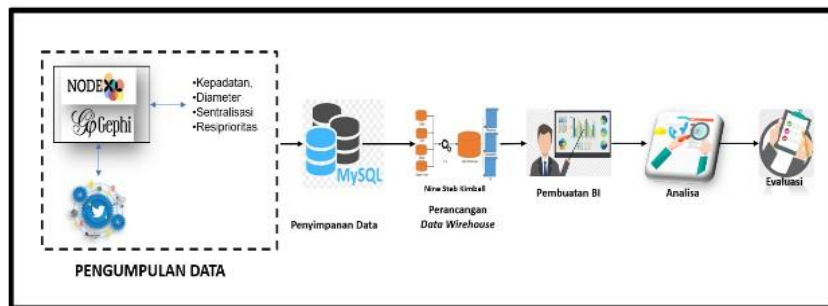


Figure 2. Process analysis using SNA

3.1 Collection Data

The data used comes from Twitter which explains to take hashtag data from the account of the creator who creates, shares hashtag information containing radical propaganda content on verified social media. The list of hashtag data studied is as described in Table 1.

Table 1. Analyzed hashtags

#AlQaeda	#Khilafah	#KhilafahIna
#Taliban	#terorisme	#IS
#Jihad	#Daesh	#1515
#khillafah	#AfghanTaliban	#Islamic_State
#ISIS	#JAD	#HizbutTahrir
#BenderaTauhid	#jamaahislamiyah	#AlQaidah
#Terorisme	#JAK	#dais
#tauhid	#ShareNewsOk	#percumalaporpolisi
#ISIL	#NII	#ISIS
#mujahidin	#Amshar_Production	#ShareNewsOk
#isil	#islamic_state	

Hastag Data collected from January-July 2022. Hashtag history data is collected from each tweet data on each Twitter account. The data collected will be divided into two,

namely network structure data and detecting groups in the network. Twitter's data collection is referred to as Twitter crawling. Twitter crawling is done using NodeXL. The data collected is limited to tweets in English only.

### 3.2 Analysis Results

The results of crawling data using XL nodes can be saved to the MySQL data warehouse database, Crawling data. Data Crawling is a stage in research that aims to collect or download data from a database. Data collection from this study is the data downloaded from the twitter server in the form of users and tweets and their attributes. Twitter API or twitter Application Programming Interface (API) is a program or application provided by twitter to make it easier for other developers to access information on the twitter website. Registration as a twitter app developer to use the twitter API can be done in the old <https://dev.twitter.com>. after registering the developer will get a consumer key, consumer access, access token and access token secret which will be used as a condition of authentication of the application that we will build. Purpose from authentication is for developer access rights in downloading data on twitter. MySQL Programming Language. MySql is a SQL database management system software that has an interface (interface) to various applications and Programming Languages by using API functions. crawling data on twitter with APIs that consist of two, namely REST-API and API for streaming. REST-API uses HTTP in downloading data supported various kinds of queries in URL with various kinds of information. While the API for streaming to mangakses data from tweet activity in real time, as in Table 2.

Table 2. Crawling data results

No	Hastag Name
1	#AlQaeda
2	#AlQaedah
3	#dais
4	#ISIS
5	#Jihad
6	#Khilafah2
7	#khilafah
8	#Taliban
9	ال سوري_الإسلامي_المجلس#
10	@Abubaseer123

Table 3. Result analysis actor

ID Actor/User	Actor	Tweet	Nodes	Edges
#Taliban	671	1785	2803	8030

The process of crawling the tweet data produces 13.951 tweets containing the hashtag #Taliban by involving 671 actors. The number of nodes collected is 2.803 and the edges are 8.030 In the formation process, it can be seen in Figure 2 which is the initial graph of the #Taliban hashtag which was carried out by cleaning the data to see more specifically the community formed by using the ForceAtlas2 Algorithm provided by the Gephi software.

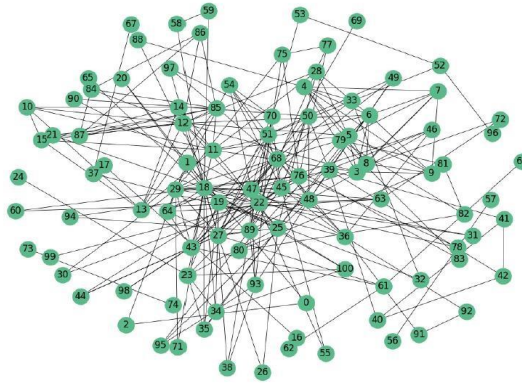


Figure 3. The initial graph of the hashtag #Taliban

To analyze using a filter degree range = 6 to the initial data, with the results as shown in Figure 4.

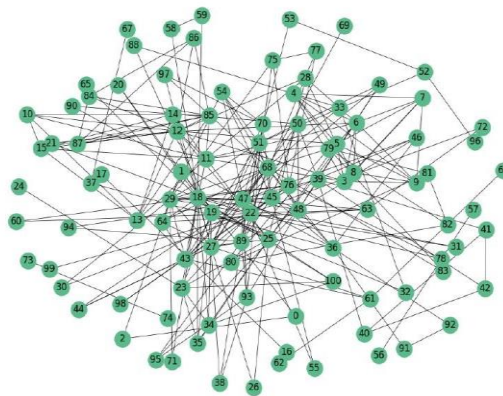


Figure 4. Graph degree range 6 hashtags #Taliban

After the filter process with degree range=6, we get nodes and edges, on the remaining nodes and edges, observations are made and the results of the network overview process are shown in Table 2.

Table 4. Network overview result

ID Actor/User	Avarage Density	Network Diameter	Graph Density	Modularity
#Taliban	6,859	8	0,013	0,092

The average degree shows the the number 6,859 in Table 4, which means that the average of a node is related to 6 other nodes. The network diameter shows the number 8 which means that the longest distance between nodes is 8 nodes. In the density graph, we get 8 which is where the numbers obtained make this network not dense and not close because the density scale must be on a scale of 0 to 1, while for modularity it gets 0,013 Furthermore, in the calculation of degree centrality against 0,092 accounts to get 10 accounts with degree centrality values highest. The results of the calculation of degree centrality can be seen in Table 5.

Table 5. Hasil follower range tagar #Taliban

ID Actor/User	Degree centrality	In Degree	Out Degree
@sarah07909750	265	3	263

Table 6. The results of the #Taliban hashtag range follower

ID Actor/User	Follower	Following	FollowerRange
@iivugl9yu4ikn7y	6	5	0.491362764

And the last step in analyzing tweet data is analyzing the tweet data profile based on 10 actors with the largest degree centrality value. The results of the profile analysis can be seen in Table 7.

Table 7. Main actor profile

ID Actor/User	Aktif Date	Status
@sarah07909750	20 Agustus 2022	Aktif
@iivugl9yu4ikn7y	1 November 2022	Aktif

Based on Table 5, the results of profile analysis of 10 actors with the largest degree centrality value show that of the 10 main actors, 8 active actors, 1 inactive actor and 1 actor are suspended by Twitter due to violating Twitter rules. And if you look at the time of account creation, @iivugl9yu4ikn7y which is categorized as new but already has a lot of followers.

#### 4 CONCLUSION

This study shows that by using the degree centrality method, influential actors can be identified and the follower rank method of popular actors can be identified. find influential actors and with the rank follower method can identify popular actors. The results of data analysis of tweets with the hashtag actor producing #Taliban @sarah07909750 are actors who are in position 1 with the highest degree centrality score of 265, InDegree = 3, and OutDegree = 262, and @iivugl9yu4ikn7y is in position 10 with the lowest popularity value or follower ranking is 0.491362764. While the actor @natiqmalikzada is the actor who is in position 1 with the highest popularity value or follower rank, namely 0.988081224. Based on the results of the SNA analysis, the network structure associated with the Al-Qaeda group can be found in the network structure of both. that links between group members and the network organizational structure of the group being analyzed. Based on the results of the SNA analysis, analysts can assist in understanding the pattern of relationships between group members and finding relationships that were not seen before (finding groups in the network) related to the Al-Qaeda network. Utilization of SNA groups associated with the Al-Qaida network This helps in understanding the level of influence (dominant actor) of members and allows to identify the strengths and weaknesses of organizations established in cyberspace. That way, crime analysts can easily identify the structure of the network formed and the dominant actors spreading radical and intolerant views in cyberspace, so that they can easily carry out law enforcement efforts to break the chain of the spread of radical and intolerant views in cyberspace for the sake of creating national security.

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