A Case Study of Crime Organization Structure Based on Social Network Method

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ABSTRACT

In this paper, we apply social network approach and analyze the structure of the plurality of criminal organizations, including Pyramid Selling, 911 hijacking organizations, transnational drug trafficking organizations. In the hierarchical organization of MLM, we found that two parameters of network Out2Local, in-Harmonic Closeness difference have huge difference between the different levels of nodes. For relational data of 911 hijacking organization, we use Girvan-Newman algorithm to calculate the number of modules of different societies. When the highest number of associations appears to be four, hijacked planes also happens to be four and we conducted a comparative study based on the result. For structure of cross-border drug crime organization, we summarize Huanghui Xia’s studies. Finally, from the perspective of social network approach, we investigate the efficiency and safety of different types of criminal organizations structure.

KEYWORDS

Structure of criminal networks, Social Network, Examples, Pyramid Selling, 911 terrorists attack.

INTRODUCTION

The real darkness is always hidden behind of the evil on the surface.

To get a closer contact with the darkness of the society, scientists and researchers use data-analyzing to figure out the structures of organized criminal groups.

Dr. Qin Zonggen (2009) mentioned that the original structure of several drug gangs such as “1~15” group arrested in January 2007 and “5:22” group detected in May 2001 can be classified as the combination of many criminal chains which finally be formed as a pyramid. Different layers of the pyramid represent different status and job which make the whole group more stable and organized[1].

Professor Han Jinxia (2003) mainly worked on the structure of gangland, the underworld society. She blend the penal code and criminal law and criminal policy together, inquire into the Concept and character of Underground nature organization;
and finally analyzed the differences among the connected concepts which lead to the real structure of the whole criminal group which seem to be a Metro Rail FIG[2].

Professor Huang Huixia studied the condition of crimes that happened in border defense. This time, she used many examples to get the exact and convincing result. Professor Huang plotted a scatter-plot which can be classified as a new structure[3].

Dr. Ma Fang (2012) figured out a common structure of various kinds of crimes. He found that all of the crimes are related within several networks that exactly showed the close index of the group members. In this way, criminal groups can be classified as star structure, reticular structure and chain structure. The use of several structures is for a better connection and secrecy which will promote the development of the criminal group in various ways[4].

Several foreign researchers also contributed to this topic a lot. The professor groups of College of Computing, Georgia Institute of Technology and Damballa, Inc studied the structure of criminal networks, groups of related malicious infrastructures that can work in correct to provide hosting for criminal activities. They construct graphs to show the relationship which can be finally concluded as the transfer form leaders to followers[5].

In this article, We use our own way to figure out the structure of several different crimes like gangland, hijack political crimes and drug trafficking. We will also find the relationship between the leaders and followers with graphs and tabulations.

SYNOPSIS OF SOCIAL NETWORK

Social network analysis is an approach for sociologist to perform quantitative analysis based on developed mathematical methods and graph theory. In recent years, the method is widely used, in the field of occupational mobility, the impact of urbanization on individual happiness, world political and economic system, international trade, etc. And this method has played an important role. Social network analysis is a relatively mature method of sociology, social scientists can use it to explain some of the intractable problems.

Experts such era—knowledge-economy. When facing so many challenges, they begin to learn thinking about research methods from other disciplines and social network analysis is one of them.

Network refers to various associations, and Social Network can be simply referred to the structure constituted by social relations. Social Network Analysis (SNA) origins in physics adaptive network through studying network can help "macro" structure of relations between individuals, "micro" and the large-scale social network systems be combined up by mathematical methods. graph theory and other quantitative analysis method. It is a new research branch which has developed since the 1970s in fields of sociology, psychology, anthropology, math, science and communication.

Starting from the perspective of social networks, the interaction of people in the social environment can be expressed as a model or rule-based relationship, and this relationship is based on a regular pattern which reflects the social structure. The quantitative analysis of this structure is the beginning point of analysis performed on social network.

Social network analysis is not just a tool, but also a way of thinking on the relationship. It can be used to explain some areas of sociology, economics, management and other issues. In recent years, this method is widely used in the field of
occupational mobility, the impact of urbanization on individual happiness, world political and economic system, international trade, and played an important role.

ANALYSIS TOOLS NETDRAW

Our primary analysis tool is NetDraw[6]. Developed by the professors from American College of Business and Economics University of Kentucky Department of Management, Gatton and Steve Borgatti, NetDraw is very representative of a social network analysis software, image NetDraw its intuitive graphical display, simple and easy maneuverability, excellent open compatibility to our social network analysis has injected new vitality, it has been widely used in social networks study. NetDraw is free, that’s another reason for us to choose, you can download from http://www.analytictech.com/

ANALYSIS OF CASEES

Then, we will analyze several criminal organizations, including Pyramid selling, 911 hijacking organizations and transnational drug trafficking organizations.

Structural Analysis of Pyramid Selling

Pyramid selling refers to the organizer or operator development officers, was developed by its staff or the number of personnel directly or indirectly from sales and development as the basis for calculating remuneration and development or require the person to pay a fee to obtain qualifications to join conditions and obtain benefits. April 21, 1998, the Chinese government announced a total ban on pyramid schemes, issued "Notice on the prohibition of marketing and business activities of pyramid selling."

In document[7], the author provides an example of pyramid selling, shown in figure 1.

![Diagram of Pyramid Selling](image)

Figure 1. Typical example of pyramid selling.

This example of this pyramid is divided into four layers, the first layer is only one node; layer 2 has five nodes connected to the node 1; Layer 3 is the number of connected nodes 7-17, connecting respectively with the second layer node; such as the nodes 12, 13 which are connected to the node 4; layer 4 is the reference numerals 18 to 44 nodes, respectively, up to the third layer is connected to a node. NetDraw with network analysis and found that the two parameters Out2Local four networks,
in-Harmonic Closeness difference is relatively large, the specific data are shown in Table 1.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Node number</th>
<th>Out2Local</th>
<th>In-Harmonic Closeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>First layer</td>
<td>1</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Second layer</td>
<td>2-6</td>
<td>8, 2, 7, 2, 8</td>
<td>1</td>
</tr>
<tr>
<td>Third layer</td>
<td>7-17</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>Forth layer</td>
<td>18-44</td>
<td>0</td>
<td>1.833</td>
</tr>
</tbody>
</table>

Out2Local is a parameter which represents the sum of number of all neighbors’ neighbors and can also be understood as the total number of nodes which is 2 distance away from each other. In Figure 1, choosing Node 3 as an example, we consider a directed graph with node 3 from the node 2 is only 26 and 27, the node Out2Local 3 to 2. As what can be seen from Table 1, the first layer Out2Local is maximum and Out2Local of layer 3, 4 is zero.

Closeness, tightness of Closeness is mainly related with the concept of center which is measured by the distance between the vertices of each figure. When number of closeness becomes greater, the apex lives nearer the center of the network, indicating a more important role. By considering a directed graph, we can calculate the In-Closeness and Out-Closeness of the model.

Harmonic Closeness is a similar index as Closeness. In-Harmonic Closeness is defined as: sum of reciprocals of lengths of incoming geodesic paths.

Choosing the node 14 in Figure 1 as an example, there are two paths to the node 14, one arrives directly from node 5, the length is one; the other one starts from node 1 to node 5 then arrives node 14, the length is 2. Finally, we calculate the reciprocal number of the two lengths and put them together and get 1.5. From Table 1, we found that the in-Harmonic Closeness of first layer is 0, the second layer is 1, layer 3 is 1.5, 4th floor is 1.833.

Structural Analysis of 911 Hijacking Organization

September 11, 2001 morning, two hijacked airliners rammed first and second building of the World Trade Center in New York, two buildings collapsed one after another after the attack in the World Trade Center while the remaining five buildings are also destroyed by the collapse; 9 pm, another hijacked airliner crashed into the US Department of Defense in Washington the Pentagon, Pentagon localized structural damage and collapse. 10:02:23, United Airlines Flight 93 crashed at 580 miles an hour on the Pennsylvania Shanks Weir an open space, away from Washington, DC, only about 20 minutes of flight time.

Our data come from the literature[8]. The definition of a network of community structure has not yet been widely recognized and the one that more commonly used is based on the definition of the relative frequency of connections: a network of vertices can be divided into groups, the group connection between dense and sparse group connection. We, use Girvan-Newman algorithm to module number of different societies (Q-value), when the community is 4, the module is highest.

We organize the data in Table 2. Through line 1 to 4 are the names of the terrorists, community number, degree, where the aircraft. Table marked only four Leader (pilot) degree.
Table 2. 911 hijacking members of the network packet, the degree and location Flights.

<table>
<thead>
<tr>
<th>Name</th>
<th>Group</th>
<th>Degree</th>
<th>Flight</th>
<th>Name</th>
<th>Group</th>
<th>Degree</th>
<th>Flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>aalghamdi</td>
<td>2</td>
<td>175</td>
<td></td>
<td>halghamdi</td>
<td>2</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>alhaznawi</td>
<td>2</td>
<td>93</td>
<td></td>
<td>hanjour</td>
<td>4</td>
<td>10</td>
<td>77</td>
</tr>
<tr>
<td>almihdhar</td>
<td>4</td>
<td>77</td>
<td></td>
<td>jarrah</td>
<td>1</td>
<td>7</td>
<td>93</td>
</tr>
<tr>
<td>alnami</td>
<td>2</td>
<td>93</td>
<td></td>
<td>malshehri</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>alomari</td>
<td>3</td>
<td>11</td>
<td></td>
<td>moqed</td>
<td>4</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>al-shehhi</td>
<td>1</td>
<td>12</td>
<td>175</td>
<td>nalhazmi</td>
<td>4</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>alshehri</td>
<td>3</td>
<td>11</td>
<td></td>
<td>salghamdi</td>
<td>2</td>
<td></td>
<td>93</td>
</tr>
<tr>
<td>alsuqami</td>
<td>3</td>
<td>11</td>
<td></td>
<td>salhazmi</td>
<td>4</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>atta</td>
<td>1</td>
<td>14</td>
<td>11</td>
<td>walshehri</td>
<td>3</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>banihammad</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>175</td>
</tr>
</tbody>
</table>

We found that degree of four leaders among the total 19 people are located in position 1, 2, 3, 5, and partitioned in four flights. We also found that the number of communities where the aircraft is not a one to one correspondence between the two which is shown in table 3.

Table 3. Associations number and location of aircraft correspondence table.

<table>
<thead>
<tr>
<th></th>
<th>F175</th>
<th>F93</th>
<th>F77</th>
<th>F11</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>G2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>2</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

From the perspective of a criminal organization, the F93 can be considered not complete the task. Compared with several other flights, this aircraft allocated only four people, the other three flights are equipped with five people. Also consider parameters Degree. Degree is the degree of vertex refers to the number of edges and vertices associated. Leader jarrah's Degree is the lowest of four leaders, if this is also a factor. The center of Atta HAS the highest degree, approximately at the center which confirmed Mohamed Atta was a leader figure.

**Structural Analysis of Cross-border Drug Trafficking Organizations**

Drug crime is an anti-narcotics legislation and undermine anti-drug control activities, should be subject to criminal law punishment. The cross-border drug crime refers to drug-related crime happen between state and country. Cross-border drug-related crimes is one of the prominent factors which destroyed national security and stability of the border.

Huanghui Xia has studied cross-border drug crime organization structure for a long period [3] [9], we briefly describe her results here. Source is a typical case of Chinese Public Security Border Defense Criminal Investigative Selected from 1999 to 2006 data. Software tools are UCINET.

When Huanghui Xia analyzed data of border drug trafficking organizations in recent years, she also found that the characteristics of a criminal organization has a network structure. Through the study of cross-border drug crime, she got2 the following conclusions:
1) In a network of cross-border drug-related crimes, the majority of cross-border drug crime network is similar to the small-world networks. Most of the cross-border drug crime cases are available to run the group through operating crimes and attracting new members. Small average distance also showed a weak relationship between their widespread network which connects different small groups. For each internal relatively homogeneous, small groups can provide and expand the channels of communication.

2) The number of cross-border network of small groups is proportional to that of drug-related crime; cross-border criminal networks of drug groups and intermediary network size also showed a positive correlation. A smaller network has lower possibility to keep information and make it be monopolized by few people. While a larger network has higher possibility to keep information among a small group of members. That is, more complex networks are more likely to maintain the presence of an intermediary link between small groups than a simple network.

3) After the study, authors found that when public security combat cross-border drug-related crimes in the network, the organization is more likely to develop a certain degree of elasticity of the network of anti-strike. Thus, in the case of the investigation cannot be limited to operations associated with a greater degree of criminal suspects, and to simultaneously focus on those larger intermediary, that play an important role in the maintenance of the suspects on the association of the network.

4) The main point of cross-border drug crime network to maintain network resiliency is that crime keeps an important basic role/position, and cross-border drug crime networks remain an important role/position or not, and their advantageous position in the network has a policy network with close relationship.

DISCUSSION

Compared with three former examples in this article, we find that different types of criminal organizations don’t have the same structures. The main reason for this difference is due to two factors: criminal organizations efficiency and safety, which is a contradiction of factors.

Evan. W. M. (2001) believes that the typical criminal networks have topology chain, star and mesh structure[10], which we acknowledge, let each of the three previous example of the structure and efficiency of safety discussion.

Pyramid Selling Organization

Pyramid selling organization belongs to close networks with significant hierarchy, high efficiency and low security. The crime summit is the central figure in the network, like the sun surrounded by the planets and members of the network only get contact with the central figure. However, the members rarely have contact with each other, any one point to another point is associated with the occurrence of all through the central node. Such an organization has a clear structure, simple operation mode, high working-efficiency, but it is very risky. Once the core member is exposed, the entire criminal organizations can easily collapse.

Terrorist Organizations

Terrorist organizations generally have a long period of planning, organization and implementation of terrorist activities, so its consequences are very serious such as a
large number of casualties and economic losses. Therefore, this type of criminal organizations has a very high security requirements in the planning of terrorist activities of the organization and even one single mistake will lead to the destruction of the whole group. In these terrorist organizations, members are connected by the strong relationship, with a clear goal. But if once the network has been identified, each of grassroots organizations is relatively easy to be monitored and destructed when the entire terrorist network remains sound. A high degree of cohesiveness and lower degree of separation is not just to ensure the efficient transfer of information and other resources, even network members are in the event of large-scale change, it will not destroy the structure of the entire network. Thus, the random destruction of each member does not make any sense.

Terrorist criminal organizations belong to a distributed network with significant network structure. Figure 2 is a network diagram of 911 hijacking which is depicted by us.

From this figure we can find that the network is very sparse, even among members of the same team are far apart and the spacing of many team members beyond the critical value of the observation. If the distance between the two terrorists is no more than two steps, keeping constant distance between team members and between teams, terrorists can minimize damage caused by the arrest of other network members. As Osama bin Laden in his famous videotape said: "The Training of hijacking another person does not know, members of one team do not know the situation of the other teams."

Drug Trafficking Organizations

Drug trafficking organization has a clear chain structure which is constituted by different interrelated groups. This network should be run by several gang leaders working together and be implemented. Each gang leader is responsible for the management and control of the gang members, and his or her control over the gang members is unique and exclusive. The network does not have a central figure who leads
authority decision, but as an important "middleman" or "gatekeepers", to get contact among several groups, coordination, communication, in order to maintain balance and operation of the network.

CONCLUSION

This paper reviews the research of criminal networks using social networking methods and the study of a number of scholars before. Then we briefly introduce the social network approach. Then we have three different types of criminal organizations structure of social network analysis, examples of 911 hijacking organization and direct sales organization. We carried out our own analysis and the analysis of drug-trafficking organizations is related with two papers of Professor Huanghui Xia. Finally, we discuss the efficiency and safety of different types of criminal organizations structure.

Through the study of examples, we found that social network methods can get some accurate and interesting results.

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