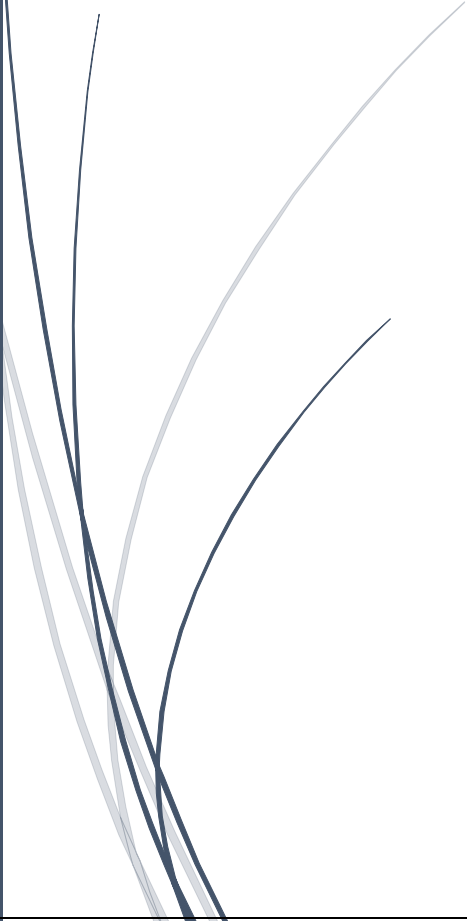




[Date]

# Terrorist Organization Network Analysis

Connecting the dots of the 9/11 attacks



Sanath Acharya  
Sagar Soni  
Aayushi Soni  
Yashkumar Chauhan

TEAM 10  
BIA-658 SPRING 2022

# 1. Introduction



*Figure 1: World Trade Centre before the attack*

The September 11 attacks, known as the 9/11, was a series of 4 co-ordinated suicide attacks carried by a militant Islamic extremist network [Al-Qaeda](#) against the United States. One phrase – “terrorist network” was being constantly used all over the stream of news and was being repeated over the period of time during the time of this attack. After tremendous research of multiple data sources and publicly available information we have gathered some important and relevant data regarding the terrorists who were part of this gruesome attack. The data that

we gathered were segregated into different files based on the information obtained. We had data related to the Association of the different terrorists with each other, the prior contacts of these terrorists, their ties in different attacks and also the records as to who were a part of the Las Vegas meeting. [Las Vegas meeting](#) is one of the well documented meetings of hijackers that took place before the attacks were carried out.

Along with this data, we also got our hands on some other Associates who were a part of this attack and had provided assistance to the terrorists from outside of the attack zone. How were these other associates important in this network and what was their role in these attacks will be the goal of our analysis. We also found some surprising results from our analysis and got an idea as to how these Terrorist organizations operate and plan to carry out the attacks like

these. This analysis can prove to be very helpful to the Intelligence Agencies to study the behaviour of these Militant groups and prevent these attacks in future.

## **2. Data Understanding**

We have 3 files consisting of data related to the attacks.

9\_11\_HIJACKERS\_ASSOCIATES.csv: This file consists of a matrix (61x61) with the Rows and Columns denoting the association of the terrorists with each other during the attacks. The ties are Undirected and Binary and the relations are a mix of prior contacts like the terrorists that have trained together, lived together, financial transactions between them, attended the same school or were on the same flight during the attack.

9\_11\_HIJACKERS\_PRIORCONTACTS.csv: This file consists of a 19x19 matrix of the terrorists who were a part of the 9/11 attacks and were present in the US during the attacks. Both these files will give us the information regarding the ties that were formed during the planning of these kind of attacks.

9\_11\_HIJACKERS\_ATTR.csv: This file will give more information on the Nodes/Terrorists (61 Nodes) in our network diagram. Information like the Network strength, the ties and whether the terrorist was a part of the Las Vegas meeting or not.

For Network Strength:

1 = Trusted Prior Contacts

2 = Other Associates

For Ties:

1 = WTC North

- 2 = Pentagon
- 3 = Pennsylvania
- 4 = WTC South
- 5 = Other Associates

For Las Vegas Meeting:

- 1 = Attended
- 2 = Did not Attend

For the purpose of the [QAP test](#) we had to generate a new file using Prior Contacts csv file so that we get a 61x61 (from the 19x19 matrix) matrix similar to the Associates csv file. This will help us understand how likely is it that the people who have a prior contact will part take in the attacks.

We have used R-studio for the Visualization and the analysis of the network. The association network looks something like this:

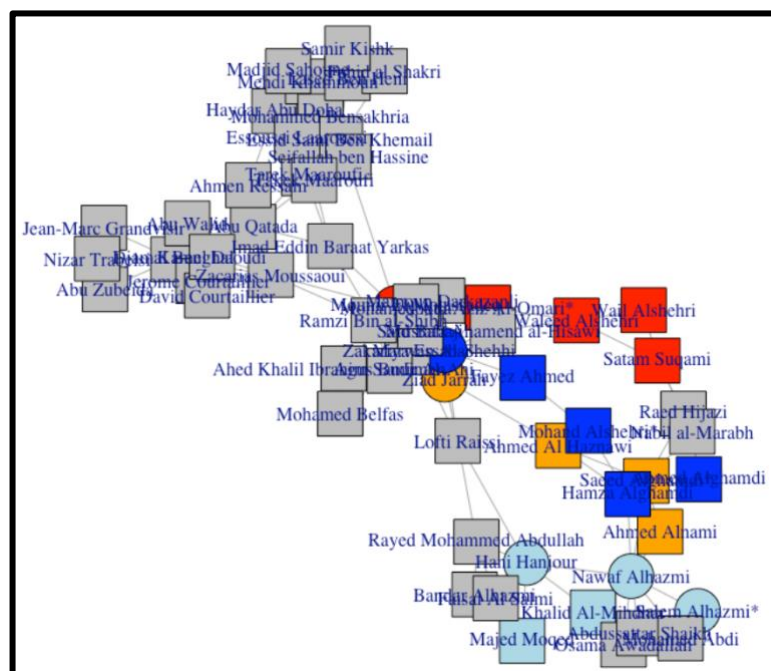


Figure 2: Plot of the Association Matrix

Here:

Nodes represent the terrorists:

Node colour:

Red: WTC North  
LightBlue: Pentagon  
Orange: Pennsylvania  
Blue: WTC South  
Grey: Other Associates

Node Shape:

Circle: Attended Las Vegas Meeting  
Square: Did not attend Las Vegas Meeting

We can see that the other associated who were not directly linked to the attacks had association with the terrorists who were part of different attacks of 9/11.

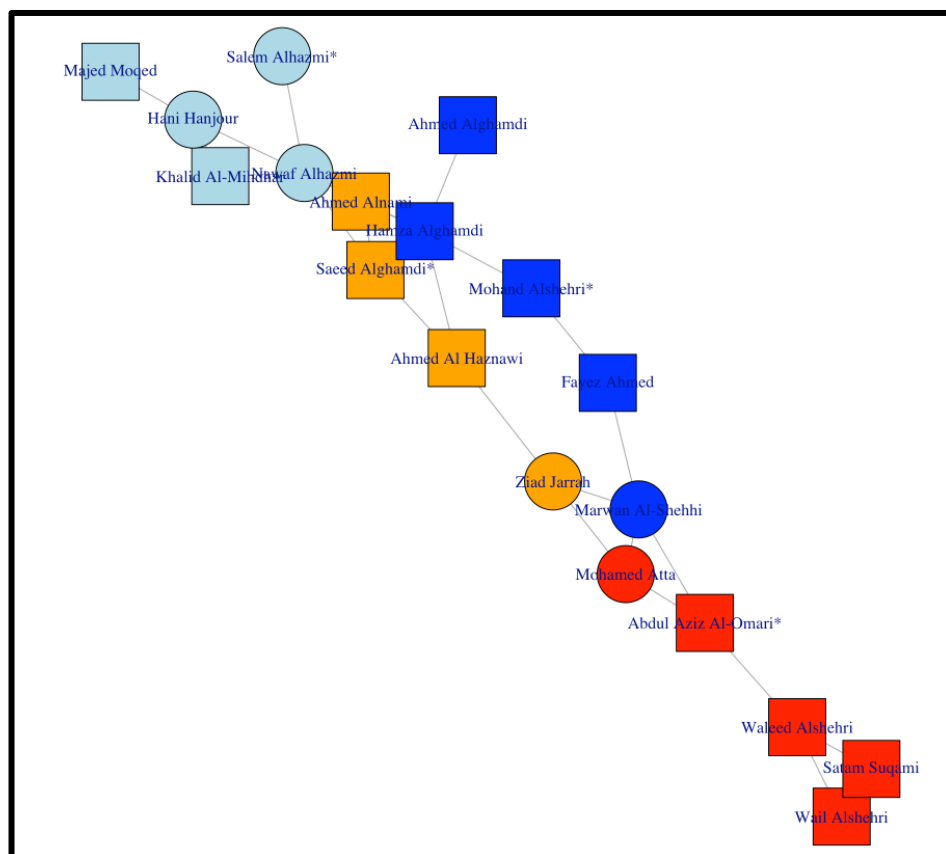


Figure 3: Plot of the Association Matrix without other associates

Similarly the plot for the Prior contacts looks like:

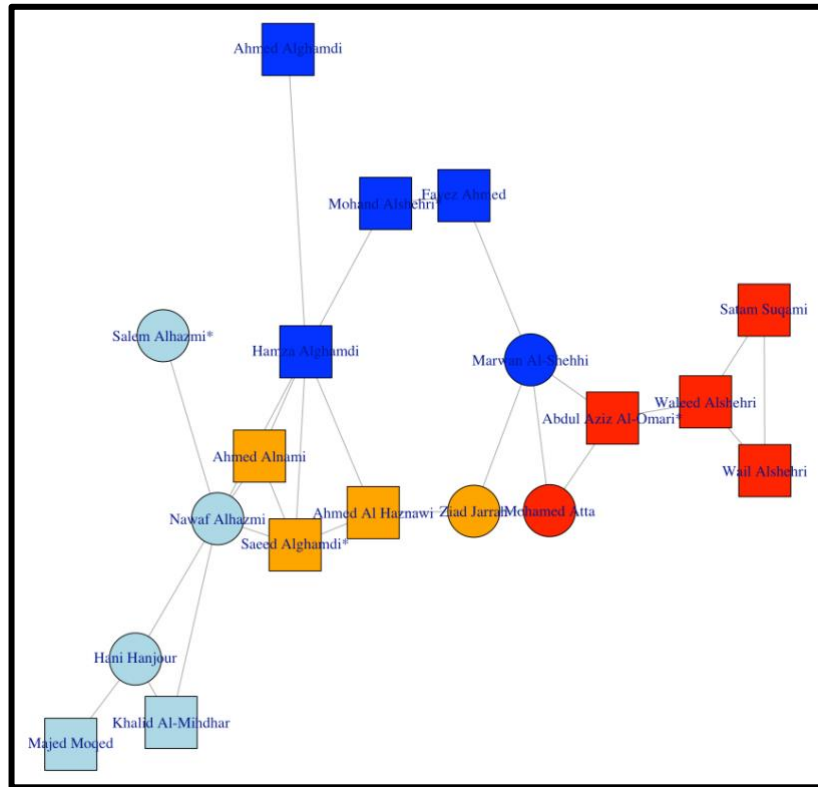


Figure 4: Plot of the Prior Contacts Matrix

We also performed community detection on this data and also performed a QAP analysis to test how these terrorists were like to carry out the attacks and how the intelligence agencies can prevent such attacks in future. We also did a centrality analysis to find out who was the most central node and who was the main protagonist of this attack. The analysis of the same can be found in the Methodology and Analysis section.

### 3. Methodology

Obtaining the network of the terrorists in R was done using the [Fruchterman Reingold](#) layout and Sugiyama layout present within the R [igraph](#) package and the ggplot2 package. The other packages used for the analysis and visualization were [tidyverse](#), [sna](#) and [ergm](#).

We first imported the Associates file and then linked the attributes file to obtain the data enough for the Visualization. Similar steps were followed for the Prior Contacts file as well. On the other hand, for the QAP test we had to generate a new file as the existing matrix files were of different dimensions (61x61 vs 19x19). Hence, we had to make additions to the Prior contacts file to be similar to the Associates files.

The length of the longest geoside (diameter) of the network for associates was found to be 8/61. This means that it will take around 8 people for a message to be communicated from one point to another.

Further, we performed Community detection on the data and found the following network:

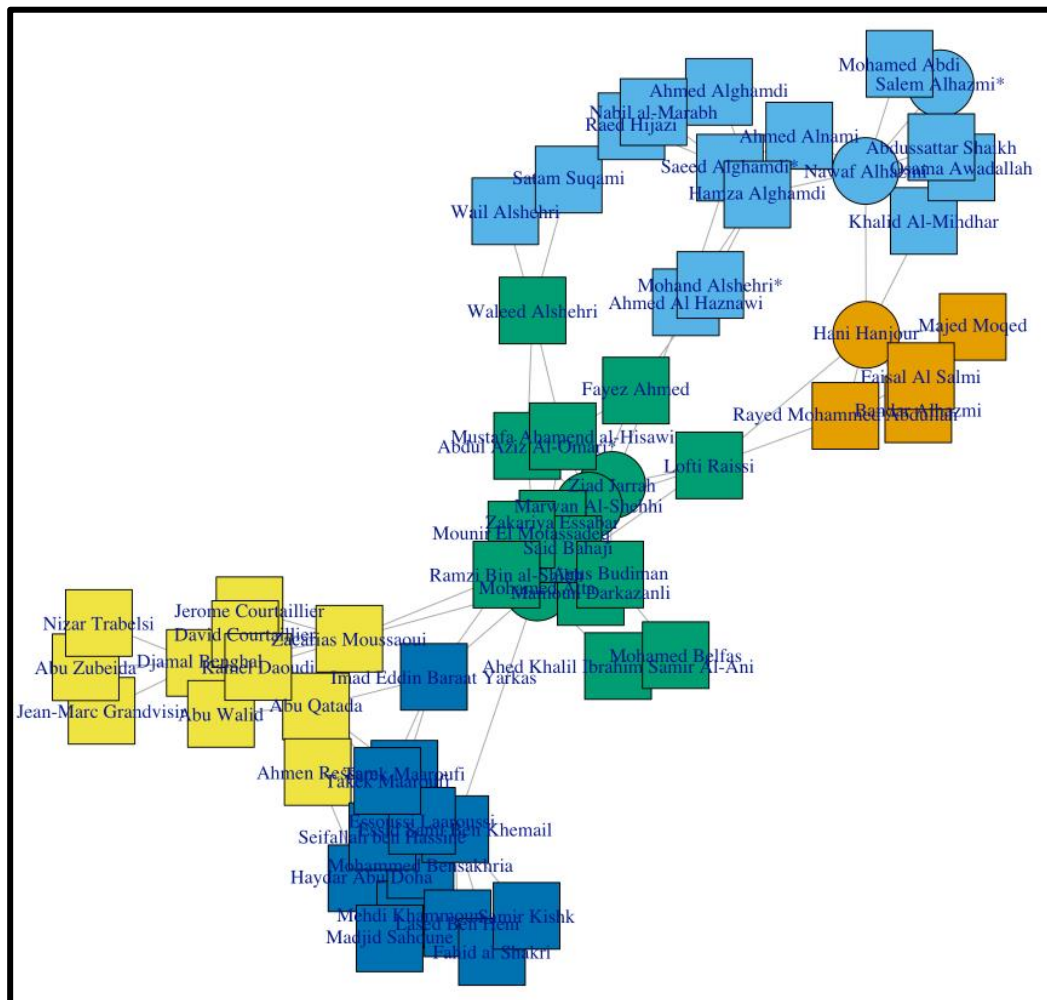


Figure 5: Community Detection Network

Here, we found 5 communities with the following sizes.

## Community sizes

1	2	3	4	5
5	16	16	11	13

The modularity score of this network was found to be **0.6284307**. This is a pretty good modularity score which also represents that the communities formed have a better structure and connectivity.

The Node with the highest degree was found to be **Mohamed Atta**. This terrorist had a degree of **15** which is the highest among the others in the network. Not just a highest degree, but Mohamed Atta had the highest closeness and betweenness. This means that he was one of the most prominent person in the network.

Since the associated were not directly linked to the attack, we found the path length of the network with and without them. With the other associated in the network the path length was 8 (8/61) and without them the path length was 10 (10/19).

The QAP test was performed between the Prior contacts file and the association file. This was done to check the likelihood of the terrorist to form an association for an attack if they have prior contacts in the past. The output of the QAP test were as follows:

```
QAP Test Results

Estimated p-values:
  p(f(perm) >= f(d)): 0
  p(f(perm) <= f(d)): 1

Test Diagnostics:
  Test Value (f(d)): 0.482034
  Replications: 1000
  Distribution Summary:
    Min: -0.02756867
    1stQ: -0.01695195
    Med: -0.006335225
    Mean: 0.000491328
    3rdQ: 0.01489822
    Max: 0.099832
```

Figure 6: QAP test results performed in R-Studio



We see that the P-value here is larger than **0.05 i.e.:**  $(f(d): 0.482034 > 0.05)$  hence we do not reject the [H0 hypothesis](#). This proves that the associates and the Prior Contacts networks are significantly related to each other. People who have a prior contacts before the planning of the attacks are most probably to be working as an associate in future.

The Final model to predict the formation of the terrorist network is as follows:

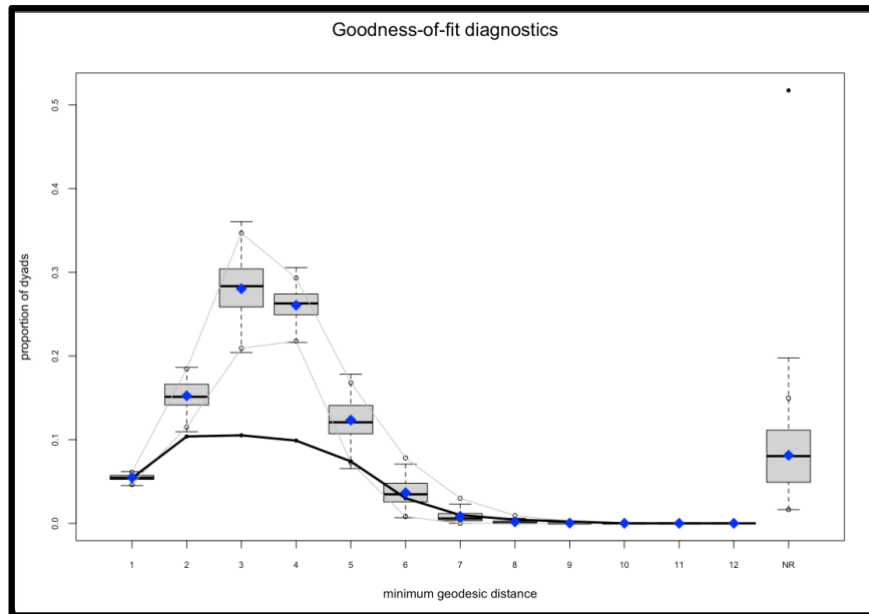


Figure 7: Final Model for prediction

## 4. Analysis

	Degree		Closeness		Betweenness
15	Mohamed Atta	0.007407407	Mohamed Atta	899.1655844	Mohamed Atta
12	Marwan Al-Shehhi	0.006329114	Marwan Al-Shehhi	454.5714286	Essid Sami Ben Khemais
12	Essid Sami Ben Khemais	0.006097561	Ramzi Bin al-Shibh	389.6214286	Zacarias Moussaoui
7	Hani Hanjour	0.005376344	Hani Hanjour	250.2429293	Nawaf Alhazmi
9	Nawaf Alhazmi	0.004672897	Nawaf Alhazmi	370.8762626	Hani Hanjour

Figure 8: Values for the different analysis performed

### a. Degree, Closeness and Betweenness analysis

A **highest degree** of 15 for Mohamed Atta in the network says that he was the most active person in the network. Also, his **highest closeness** measures his ability to access others in the network and monitor what is happening. His **highest betweenness** shows his control over the network. We can say that he plays a role similar to that of a broker in the network. He was likely to be involved in any kind of exchange within the network, be it financial or from a communication point of view. He was always involved in almost everything. We can say that he was like a ring leader for this terrorist network. He was also one of the emerging local leader.

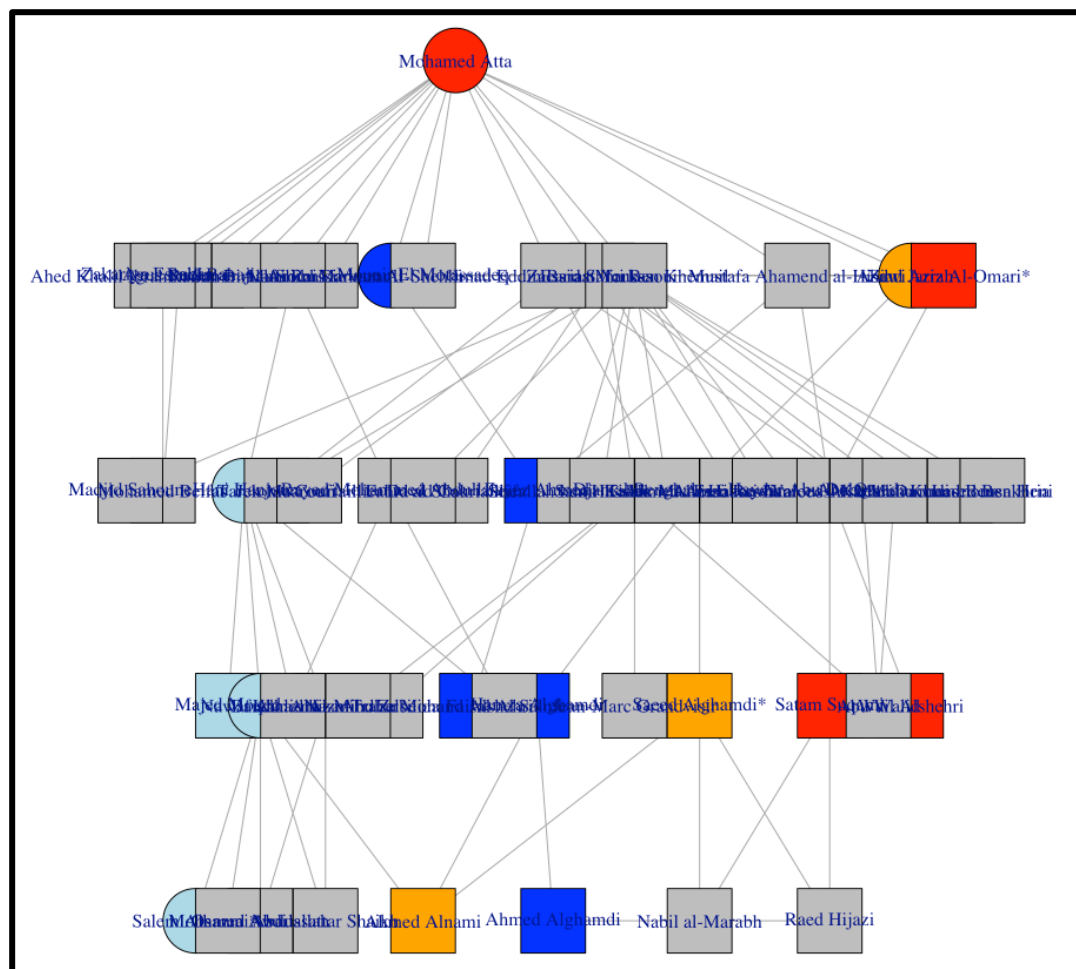


Figure 9: Sugiyama layout for the network

### **b. Importance of Other Associates in the network**

We also observed that the behaviour of the network is different in the presence and absence of the other associated in the network. One such observation is that the numbers of members that are needed when a message is passed from one terrorist to another varies significantly. With the presence of the other associates in the network less members are required for the message to pass on; whereas, if the other associates are not present then the message travels through some additional members in the network. This is harmful for the secrecy of the message and hence the presence of the other associates in the network is important.

### **c. How prior contacts influence the attacks**

The hijacker's network had a hidden strength – massive redundancy through trusted prior contacts. These ties made the network very resilient. These ties were solidly placed as the hijackers made their way into America. One additional observation made in the network was that eliminating the boundary-spanning ties reduces the visibility into the network, and chance of leaks out of the network. Hence, the associates play an important role in speeding up the system in the network from both Financial and Communication point of view.

### **d. Relation between the Associates and their Prior Contacts**

From the QAP test analysis we found that the people who had prior contacts before the planning were most likely to work together as associates with each other to carry out the attacks. This information can be highly useful for the Intelligence agencies who can monitor their activities.

## 5. Conclusion

In this paper we have proposed a way to analyse the attacks of the 9/11 incident and prove on who was the leader and how they formed their network and maintained their secrecy. We also found the key players in the network and visualized on as to who communicated with them. [Mohamed Atta](#) was one of the most prominent members of this team of terrorists who carried out the attacks. [Nawaf Alhazmi](#) and [Hamza Alghamdi](#) were very active before the plannings of the attacks.

We also performed QAP and ERGM testing and analysis to prove that the terrorists who had a prior contacts were mostly associated with the attacks and had strong ties with each other. As the network structure emerges, a key dynamic that needs to be closely monitored is the activity within the network. The agencies can use this analysis to compare it with the other attacks that happened in the past and predict the working of such organization and prevent such attacks in the suture. Our network had 61 nodes with 131 edges, but an addition of one or removal of one node may change the dynamics of the network in place. Hence it was very important for the terrorists to maintain the secrecy of the attack and avoid spanning out of their network so as to prevent information leakage.

By sharing the information and knowledge, a more complete picture of possible danger can be draw. To win this war against terrorism, good people seem to need to build a better information and knowledge sharing network than bad people. This analysis was done with all the information and data that was available to us online. If we had access to more information we could have known some more insights as to how these networks usually form and what measures can be taken to weaken and break the network.

## 6. Acknowledgements

The authors of this paper would like to thank and express their deep gratitude to [Professor Bei Yan](#) for their patient guidance, enthusiastic encouragement and useful critiques on this research and analysis work. We would also like to thank the sources from where we able to obtain the data and perform our analysis.

## 7. References

- [https://www.albany.edu/~ravi/pdfs/talk\\_papers.d/husslage\\_etal\\_2015.pdf](https://www.albany.edu/~ravi/pdfs/talk_papers.d/husslage_etal_2015.pdf)
- <https://sites.google.com/site/ucinetsoftware/datasets/covert-networks/911-hijackers>
- <http://orgnet.com/tnet.html>
- <https://ieee-dataport.org/documents/911-hijackers>
- <https://firstmonday.org/ojs/index.php/fm/article/view/941/863#fig4>
- Data can be found here: <https://www.kaggle.com/datasets/sanathacharya/911-attacks-social-network-analysis>