Received 10 August 2019
Revised 29 August 2019
7 September 2019
Accepted 7 September 2019

Identifying key actors in an international crisis using dynamic network analysis

Syrian crisis case study

Amira S.N. Tawadros and Sally Soliman
Department of SocioComputing, Faculty of Economics and Political Science, Cairo University, Giza, Egypt

Abstract

Purpose – The purpose of this study is to examine the extent to which dynamic network analysis (DNA), text mining and natural language processing (NLP) are helpful research tools in identifying the key actors in a complex international crisis. The study uses these tools to identify the key actors in the Syrian crisis as a case study to validate the proposed algorithm.

Design/methodology/approach – To achieve its main purpose, the study uses a collection of three methodologies, namely, DNA, text mining and NLP.

Findings – The results of the analysis show four key actors in the Syrian crisis, namely, Russia, the USA, Turkey and China. The results also reveal changes in their powerful positions from 2012 to 2016, which matches the changes that occurred in the real world. The matching between the findings of the proposed algorithm and the real world events that happened in Syria validate our proposed algorithm and proves that the algorithm can be used in identifying the key actors in complex international crises.

Originality/value – The importance of the study lies in two main points. It proposes a new algorithm that mixes NLP, network extraction from textual unstructured data and DNA to understand and monitor changes occurring in a complex international crisis. It applies the proposed algorithm on the Syrian crisis as a case study to identify the key actors and hence validate the proposed algorithm.

Keywords Dynamic network analysis, Network analysis, Natural language processing, Text analysis, Text mining, Syrian crisis

Paper type Research paper

1. Introduction

Historically, the world has witnessed a countless number of international crises. These crises have shaped the international society in which we live now. An international crisis represents a rise in conflict to a level that threatens to change the nature of international relations between nations (Bell, 1971).

İŞYAR (2008) defined four key elements of any international crisis, i.e. a marked rise in the activities of the armed forces, particularly in the case of crisis management programs; unexpected events at the domestic and international levels, which are difficult to predict

Journal of Humanities and Applied Social Sciences
Vol. 1 No. 2, 2019
pp. 132-145
Emerald Publishing Limited
2632-279X
DOI 10.1108/JHASS-08-2019-0022

because one of the main characteristics of the crisis is the element of surprise and unpredictability; the decision-maker must make a quick decision on these unexpected events and sudden changes; and these events may threaten the real or anticipated interests of the state.

An international crisis is complex in nature because of the multiplicity of actors playing in it, as well as the interconnections between them, and the different and overlapping interests of these actors. This complexity grew even larger in this era, because actors are not confined to states alone, but there are formal and informal organizations and coalitions, in addition to non-state actors such as ISIS, Al-Qaeda, Hamas and Hezbollah.

One example of such very complex international crises is the Syrian crisis that started in 2011 and still exists today. Many countries got involved in the Syrian crisis with different and overlapping political interests. This then produced some mystery in terms of detecting the key actors in this crisis.

2. Literature review

2.1 The outbreak of the Syrian crisis

The Syrian Arab Republic has a total land area of 185.180 km. Syria is located in south-west Asia, at the eastern end of the Mediterranean Sea, with Turkey to the north, Iraq to the east, Jordan to the south, and Israel (Occupied Palestine) and Lebanon to the west. As Syrian history is extending for more than 5,000 years, we will overview only the recent history of Syria.

In 1970, Hafez Al-Assad's government took over the Al-Baath party and formed his government after getting rid of its old leaders. Subsequently, his son Bashar al-Assad took over in 2000 as the leader of the Baath Party. He was then re-elected for a seven-year presidential term (Adeeb, 2012).

In 2011, Syria has witnessed a wave of change. The Syrian people protested because of the political, economic and social problems in Syria. The Syrian government used high levels of violence and minimal levels of concessions such as replacing the Syrian government with a new council of ministers under Bashar Al-Assad's leadership. If these concessions had been done earlier, they might have been enough to ward off the escalation, but protestor's requirements increased and calling for changing the overall regime. From the Syrian government side, the conflict was defined as a foreign conspiracy by terrorists, and the excessive use of force was justified by counter-terrorism (Gifkins, 2012).

The main reason for the Syrian crisis and the beginning of the protests was because of the following factors:

- *Political Factors*: the repression of political and human rights during Bashar al Assad's government, especially the last ten years of government, and the most important aspect of this repression was the Baath Party's control over the authority. In addition to the Emergency Law that has lasted from 1963 until the beginning of the crisis, placing restrictions on the freedom of expression has played a role in the proliferation of multiple political arrests, torture, enforced disappearance and restriction of partisan life (Human Rights Watch, 2010a, 2010b).
- *Economic and Social Factors*: the deterioration of the economic situation and the spread of poverty have led to the disappearance of the middle class. The society was divided into two classes, one of which had everything and included the elements of the Syrian government, and the other class did not have anything. This led to the spread of injustice and inequality.

Describing the current situation is depending on a huge amount of political variables and relations for both regional and international levels. This framing of the situation has fed into debates within the UN Security Council, thus causing a type of division on how to interpret

the situation. Many countries got involved in the Syrian crisis with different and overlapping political interests. This, in turn, produced some mystery in terms of detecting the key actors in this crisis.

Several resolutions of the UN Security Council have stipulated the need to stop fighting and starting a political process, but the nature of Syrian crisis is characterized by the intransigence and refusal to make serious concessions, in addition to the multiplicity of regional, international and local key players in the Syrian affairs.

There are some other factors led to the current conflict, such as the fragmentation of the opposition forces and armed groups, the divergence of their objectives and finally the prolonging of the Syrian crisis with social divisions, tragedies and atrocities between components and segments of Syrian society because of violence and counter-violence (Human Rights Watch, 2010a, 2010b).

Because of these factors, the Syrian crisis has entered its eighth year. There is a lack of full understanding the Syrian crisis; therefore, our objective is to propose a tool or a technique that can be able to identify key actors that hold powerful positions in Syrian crisis as a case of a complex international crisis.

2.2 Dynamic network analysis

The methodology used starts by revealing a social structure from the textual content of Security Council Meeting Verbatim Records (Network Extraction Phase), and then detecting the key actors in the crisis using a dynamic network analysis.

Network extraction depends on the assumption that texts can be coded and analyzed as networks of concepts. The first step in handling textual resources is applying natural language processing (NLP). NLP techniques can be decomposed into several sub-tasks, such as tokenization, part of speech tagging (Madnani, 2007) and named entity recognition (Sun, 2010).

Extracting network from texts involves the conversion of words into concepts (nodes), and the creation of linkages between pairs of those concepts (links) (Carley, 2003).

A network is a complex graph that consists of nodes and links; nodes are the actors in the network and links, which could be binary or weighted, are the relationships between those nodes, (Denny, 2014). There are two types of networks: static and dynamic.

Network analysis is a method of analysis with increasing application in the social sciences and has been applied in scientific fields as diverse as psychology, health, business organization, economics, political science and electronic communications. It represents an approach that uses mathematics, graph theory and visualization tools to represent the structure of relationships between people, organizations, goals, interests and other entities within a larger system (Hoppe and Reinelt, 2010).

Social network analysis has several practical applications across an array of domains; it was applied in retrieving meaningful information from social media platforms (Mincer and Niewiadomska-Szynkiewicz, 2012) and describing the complex interrelations, both formal and informal, between individuals and groups (Renfro and Deckro, 2001).

Social network analysis was also applied in e-commerce (Kumar and Zhang, 2007), as well as to study inter-country export patterns of EU member states (Rašković *et al.*, 2015).

Most of researches in social network analysis use static networks. However, a number of recent studies have shown that the incorporation of temporal evolution into network analysis significantly improves the quality of the results. Therefore, a significantly amount of work has to be done on the dynamic analysis of social networks, which has evolved over time.

DNA is the study of change occurring in networks with the passage of time (Moody *et al.*, 2005). It requires methods that can satisfy the temporal dimension of these networks. A common method is the discretization of dynamic network, in which a temporal network N in

a time period T_1 to T_m is broken into m sub-networks N_1, $_{N2}$. . .,$_{Nm}$ such that N_i represents the network in time-period T_i.

Visualization methods for dynamic networks help to visualize dynamic processes, which in turn help to build a dynamic model. Moreover, using animated visualization, in which the transition between time-steps is animated, facilitates the analysis and understanding of dynamic processes taking place in a network (Zaidi *et al.*, 2014).

DNA has many practical applications such as studying counter-terrorism, which focuses on key measures for identifying network elites, network vulnerabilities, and tools for reasoning about the possible impact of exploiting such vulnerabilities on terrorist networks. (Carley, 2007). DNA is also used to identify weaknesses and strengths in any social group and suggests ways of overcoming them. DNA was used in studying human socio-cultural behaviour (Carley and Pfeffer, 2012), this study tried to forecast the space of future possibilities.

Networks are well suited to represent many interacting components, which is a key feature of complex systems and processes. Complex Dynamical Network combines structural and dynamical complexity because it can dynamically change their structure because of both external and internal factors (Pestov, 2009).

3. Methodology

The main methodology used in this study is DNA. However, DNA requires structured data to perform. In addition, similar to any other way of analysis, it may provide incorrect or misleading results if the raw data is inadequate or contain irrelevant information.

Since our raw data are textual and unstructured, it is important to process this unstructured data first and transform them into a structured form. We applied a NLP algorithm on our raw data to produce a structured output in the form of a network. Afterwards, we visualized this network and applied a DNA on it.

To summarize, the two main steps were performed after selecting our research data: network extraction from texts and DNA.

3.1 Research data

It was practically impossible to gather and apply NLP on all documents, reports, articles, speeches, books and other resources that are relevant to the Syrian Crisis. Therefore, we selected a sample of documents that gather all international actors' situations as much as possible with characteristics such as reliability and availability.

Our sample includes Security Council Meetings Verbatim Records of Syrian crisis in 2012 and 2016. Security Council Meeting Verbatim Records are statements made during UN meetings and contain the detailed speeches and reports presented from the members toward Syrian Crisis in both mentioned years. There were seven Meeting Verbatim Records of the Security Council in 2012 and 23 Meeting Verbatim Records of the Security Council in 2016. Therefore, we have a total sample of 30 Meeting Verbatim Records with the presence of each meeting member and representatives who may vary from one meeting to another (See Appendix). The Presidency of the Council also rotates on a monthly basis, according to the English alphabetical listing of its member states.

We selected these two years to compare the situation from the intensification of the crisis in 2012 until the end of 2016. We selected these two years for reasons that will be discussed in the following paragraphs.

Although the crisis began in March 2011, The Syrian National Council, formed in Istanbul, claimed to be the official representative of the Syrian opposition on August 23, 2011.

In addition, in November 2011, the Free Syrian Army (FSA), formed four months earlier, was strong enough to launch attacks on government intelligence offices in Damascus and Aleppo. In January 2012, Abu Mohammed al-Julani, originally a member of al-Qaida in Iraq, announced the formation of the Nusra Front in Syria.

Therefore, the year 2012 witnessed the beginning of a new phase in the Syrian Crisis, in which an armed insurgency began and Syria descended into *full-scale civil war*. An array of poorly organized opposition groups had formed rebel brigades that seized key cities in the north, including parts of Aleppo, Syria's largest city.

On September 30, 2015, Russia launched its first airstrikes in Syria, thus deepening its involvement in the war with a claim to target ISIS. On October 30, 2015, the US announced that it was sending almost 50 special operations troops to northern Syria for an open-ended mission to advise groups fighting ISIS.

Therefore, the year 2016 also witnessed the beginning of a new phase in the Syrian Crisis, in which *international military intervention* began on the Syrian land, and the roles of US, Russia, Hezbollah, Turkey, and Iran increased.

The research toolset contains (See Appendix):

- AutoMap (v3.0.10.42, 2017) – a text mining tool developed by CASOS at Carnegie Mellon – for extracting networks from texts; and
- ORA software for analyzing the extracted networks.

3.2 Network extraction

Network extraction from text rises from the assumption that language and knowledge can be modelled as networks of words and relations by encoding links among words. This method analyses the existence, frequencies and covariance of terms.

In this area, previous research has provided us with a set of computer-supported solutions that enable analysts to gain a window into social structure and meaning as represented in texts. Collectively, these approaches enable the analyst to extract networks of concepts and the connections between them from the texts.

3.2.1 Text processing. Text Processing, based on NLP, is used to clean text and to extract the networks from it.

Step 1: Text Cleaning. To get rid of extra whitespace, fix common typos, convert British to American spelling and expand contractions and common abbreviations.

Step 2: Text Pre-processing. A semi-automated, iterative process that:

- *Generate N-Gram Thesauri*. N-Gram thesaurus creates single concepts from multi-word n-grams. It transforms specific words into more general concepts by applying lists of all corresponding higher-level concepts that represent the text-level concepts in a generalized way (Carley *et al.*, 2013). For instance, a thesaurus can unify all the three concepts, US, United States, and USA, to the concept: "United States of America".
- *Generate Part-of-Speech Tagging Thesaurus*. This is the process of assigning grammatical tags to words; a word can be classified into one or more of a set of lexical or part-of-speech categories such as Nouns or Verbs (Carley *et al.*, 2013).
- *Generate Context-Stemming Thesaurus*. This eliminates plurals forms and consequently reduces the verbs or nouns to its basic form and deletes non-content bearing words.

- *Generate Suggested Meta-Network Thesaurus (The Project Thesaurus)*. This assigns an ontological class for each individual concept. It tells whether this concept is an agent, location, source or any other category.

In this step, we replaced all cities into their states, e.g. Moscow was replaced by Russian Federation, whereas Damascus, Duma, and Aleppo were replaced by Syrian Arab Republic. Two main reasons behind this are some representatives use the capital city expression in mentioning the state itself, and we are concerned with state-to-state relation and are dealing with the whole state regardless to its cities:

- *Apply Delete List*. This removes all concepts already in the Delete List and generates a Filtered List of concepts.
- *Generate Dynamic Network Model (DyNetML)*. This is an xml-based interchange language for relational data including nodes, ties and the attributes of nodes and ties. DyNetML is a universal data interchange format to enable exchange of rich social network data and improve compatibility of analysis and visualization tools (Carley *et al.*, 2013).

3.2.2 Extracted networks. Using the previously discussed text-processing algorithm, we extracted 30 DyNetML .xml files, which represent 30 networks from the 30 Security Council Meeting Verbatim Records (the research data). Each network is considered a time-step and is represented by meeting date and number.

Because we are concerned with the states that constitute the key actors in the crisis, the nodes of our networks are states.

The networks we used are Weighted Networks, in which weighted links represent the strength of the linkage between nodes. The weight given to a specific link between two nodes represents how many times these two nodes were mentioned together in the Meeting Verbatim Record.

Afterwards, ORA software visualizes these networks (DyNetML .xml files) over time. For each network, there is a meeting date mentioned by month/year to study the evolution of interactions within the year and between the two years in the study.

3.3 Dynamic network analysis

Our dynamic network is divided into two discrete periods: the beginning period represents 2012 networks and the end period represents 2016 networks (Table I).

To detect key actors (states), we used eigenvector centrality measure that measures who are leaders of strong cliques and shows the states that hold powerful positions in the network because they are mainly connected to other well-connected states (Landherr *et al.*, 2010).

Most of centrality measures just focus on the node connectedness, but do not consider the node community membership and the powerful of clique to which it belongs. Thus, we used eigenvector centrality measure, which is the most important measure according to the study

Period	No. of networks	Year
Beginning	7	2012
End	23	2016
Overall	30	

Table I. Networks determined by year

purpose. Eigenvector centrality measure was separately calculated on all components (values are scaled according to the component size), and combines them into a single result vector (Bonacich, 1972).

4. Results and discussion

Figures 1 and 2 present the highest eigenvector centrality values of states changing over time in the beginning period (2012) and the end period (2016), respectively. In both figures, the Y-Axis represents the eigenvector centrality values, and the X-Axis represents the network of the Security Council Meeting Verbatim Report ordered by the meeting date. Each meeting represents a time step to monitor the changes over time.

Eigenvector centrality values reflect the power of the position that each State holds at that time with respect to the crisis. In other words, the higher the eigenvector centrality value for a state, the more central it is, and the more powerful position it holds in the Syrian Crisis, according to the Security Council Meeting Verbatim Records.

4.1 Results of 2012

The results show that the states holding the highest eigenvector centrality values are Russian Federation, the USA, China and Turkey.

In 2012, Russia and China had strategic interests in Syria; therefore, they have taken an unusually active role in leading resolutions and statements on Syria, which is a powerful role because of their ability to frame an issue according to their preferences and set the terms of debate. The USA got involved using international pressure on the Security Council, especially in the case of chemical attacks against civilians. In addition, the USA continued issuing a series of sanctions against the Assad regime. These sanctions were then modified later for the USA to begin providing non-lethal assistance to rebel-controlled areas. Turkey played a critical role in receiving the refugees who are flocking across the border.

These four countries proved to have the four most powerful positions in the networks under study; however, their ranks change with time.

China and Russia share almost the same trend, i.e. their ranks increase and decrease together. The Security Council created a draft resolution in supporting the Arab League request, which called for a political transition; however, it was vetoed by both Russia and

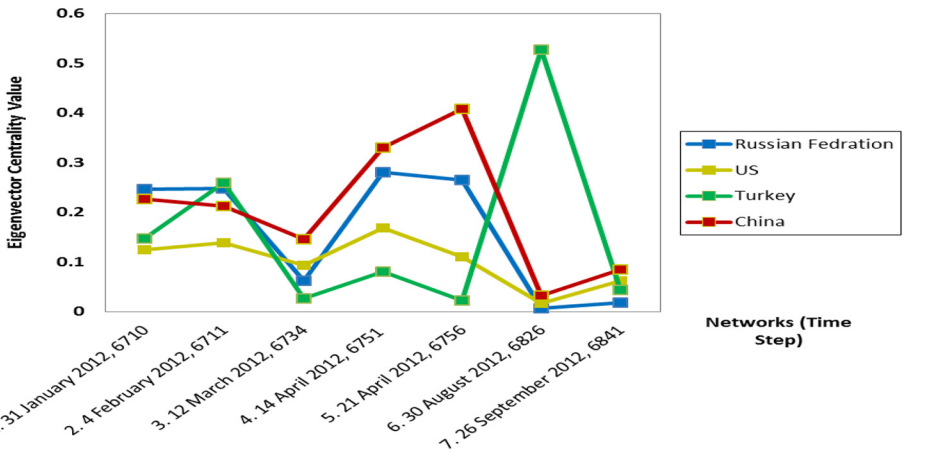

Figure 1.
Eigenvector centrality values for the key States within 2012

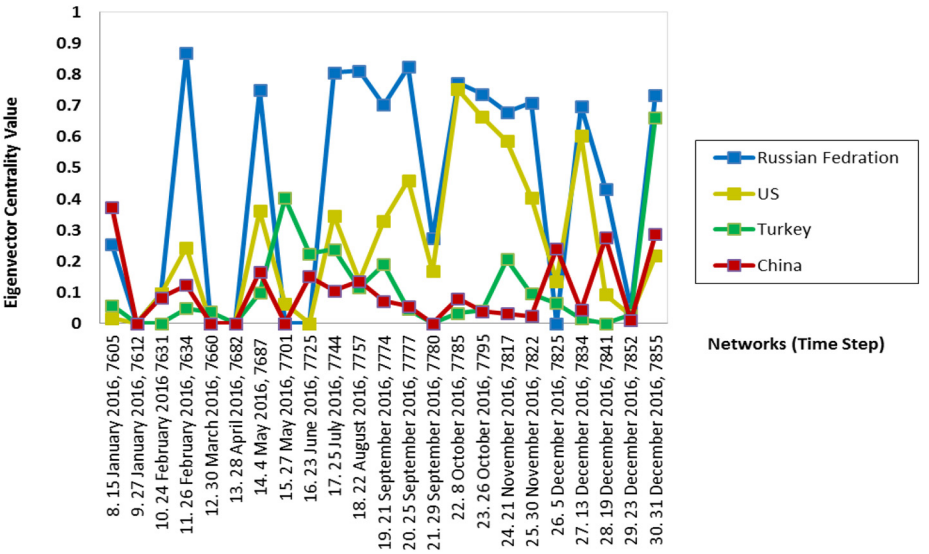

Figure 2.
Eigenvector centrality values for key States within 2016

China on February 2012, which is clarifies why they have a convergent eigenvector centrality values in the February 4, 2012 network. There was another resolution issued at the same time from the UK and France for the same purpose, but included a threat to adopt sanctions if Syria did not comply with Resolution 2042. Both Russia and China continued to reject issuing sanctions against Syria if they did not comply with resolutions 2042 and 2043, which led to the escalation of violence to the extent that United Nations Supervision Mission in Syria had been suspended because observers were being targeting by June 2012 (Gifkins, 2012).

In addition, the USA and Turkey share almost the same pattern too, except for the meeting on August30, in which Turkey had the top rank. This result is very reasonable because the main topic discussed in this meeting was the problem of Syrian refugees. Because Turkey is one of the most affected countries that received Syrian refugees, it makes sense that Turkey ranked up in this meeting. However, in general, Turkey's policy towards Russia complies with that of the USA in that both countries support the Syrian opposition and oppose al-Assad's regime.

4.2 Results of 2016

In 2016, however, Russia's power obviously increased and it held the highest rank comparing to the other states because of its military intervention. The ranks of the USA increased as well because of the US-led coalition targeting ISIS in northern Syria.

The nature of Russia's involvement in the Syrian crisis underwent a change because the Russian air force attacked rebels and ISIS targets. This military engagement highlighted the change that has occurred in Russian foreign policy in the international arena in general and in the Middle East in particular. Hence, Russia's power is not limited only to drafting resolutions and statements on Syria but also reflected by its frank military intervention in Syria. This was not the case for China, which usually sticks to the diplomatic solutions, although it agreed with Russia's military intervention in Syria (Kaczmarski and Jakóbowski, 2016).

However, the USA led a coalition that conducted airstrikes in Iraq and Syria against the ISIS and other extremist groups. The coalition comprises more than 60 countries who are contributing in various ways to the joint effort. Turkey provided support to Syrian opposition; it has permitted supplies to flow across its territory to Syrian groups, allowed some groups to take refuge on its land, and cooperated with the Syrian opposition in military interventions.

It is obvious from Figure 2 that the great transformation in Russia's position happened in February 2016, when both Russia and the USA agreed on cease fire between the regime and the opposition; moreover, Russia warned Bashar Al-Assad about breaching the cease fire agreement as per Security Council's 7634th Meeting (Casagrande, 2016).

In June, Russia broadcasted footage of incendiary weapons, specifically RBK-500 ZAB-2.5SM bombs, being mounted on a Russian Su-34 fighter-ground attack aircraft at a Syrian airbase (Human Rights Watch, 2016). Russian warplanes continued to concentrate airstrikes against opposition targets on the northern and western outskirts of Aleppo until August. It aimed at shaping the terms of a potential end-state to the Syrian Civil War in accordance with its strategic objectives.

In September, both Russia and the USA agreed on a cessation of hostilities, including the grounding of Syrian air assets and humanitarian access. The Russian Federation and Syrian regime then opened corridors for civilians to leave, as per Security Council's 7774th Meeting.

In October 2016, Russia vetoed a United Nations Security Council resolution, tabled by France and Spain, which would have demanded an immediate end to air strikes and military flights over Aleppo. It also called for a truce and humanitarian aid access throughout Syria, as per Security Council's 7785th Meeting. This was the fifth time Russia has vetoed a United Nations resolution on Syria during the conflict at that time. The previous four times Russia was backed by China; however, this last time China abstained from voting. In the same month, Russia announced the ceasefire in Aleppo to allow civilians to escape and for militants to leave the city; moreover, it expressed its readiness to extend it for as long as needed provided that the rebels would not use it for launching new attacks (Mignon, 2016).

In the beginning of December 2016, Russia and China vetoed a UN Security Council resolution seeking a humanitarian pause for 7 days in Aleppo city, as per Security Council's 7825th Meeting (Rainsford, 2016).

In late December 2016, we noticed that Turkey and Russia eigenvector values (ranks) are quite close and because of the joint agreement between Turkey and Russia; moreover, they agreed on ceasefire and a plan to convene political talks in Kazakhstan's capital, Astana, between the Syrian regime and opposition groups, in January 2017. The ceasefire plan was then presented to the warring sides of the conflict ahead of planned peace talks in the Kazakhstan, as per Security Council's 7855th Meeting. Based on this agreement, Russia and Turkey would act as guarantors of the ceasefire; thus, they represented a powerful position at that time.

The year of 2016 was full of military attacks, especially on Aleppo. These attacks were held on one side by Russia, which targeted ISIS and the Syrian opposition. The USA targeted ISIS in northern Syria, and Turkey conducted strikes to support the Syrian opposition.

At the beginning of 2016, Turkey bombed Kurdish positions, which led Bashar al-Assad to ask for immediate intervention from the Security Council against Turkish bombing (Perchoc, 2017).

China played an active role in lead drafting resolutions and statements on Syria and using the veto right many times in a coherent manner with Russia.

4.3 Average centrality

Figure 3 shows the average eigenvector centrality of each of the four key states in both years, i.e. 2012 and 2016. Although Figure 1 shows changes in the centrality value of each state changes over time in 2012 because of changes in the course of events in the crisis. However, on an average, China was the most central in the Syrian Crisis throughout 2012, followed by Russia and Turkey, while the USA was the least. Taking Russia and China as one side, we find that both countries together were the most central in the Syrian crisis in 2012.

In 2016, however, China was the least central in the crisis, while Russia was the most central state followed by the USA. The involvement of China and Turkey decreased from 2012 to 2016, while that of Russia and USA increased. This is reasonable because both Russia and the USA made military interventions on Syrian land in 2016.

Figure 4 shows the average overall eigenvector centrality of each of the four key states. We can observe that, on an average, Russia held the most central position in the Syrian crisis from 2012 to 2016, followed by the USA, while Russia and China held less central and equivalent positions.

5. Conclusion and future research

The presence of many interacting components is a key feature of complex systems and processes, and networks are well suited to represent this feature. There is a variety of network models to choose from, but dynamic networks proved to stand out because of the combination of both structural and dynamical complexity. Note that these networks can dynamically change their structure because of both external and internal factors. From this point of view, the models based on dynamical networks give a rich and flexible representation of many real systems and processes of interest to social sciences.

International multi-lateral crisis can be considered as a dynamic complex system because it witnesses the interplay of multiple heterogeneous components with differing interests and

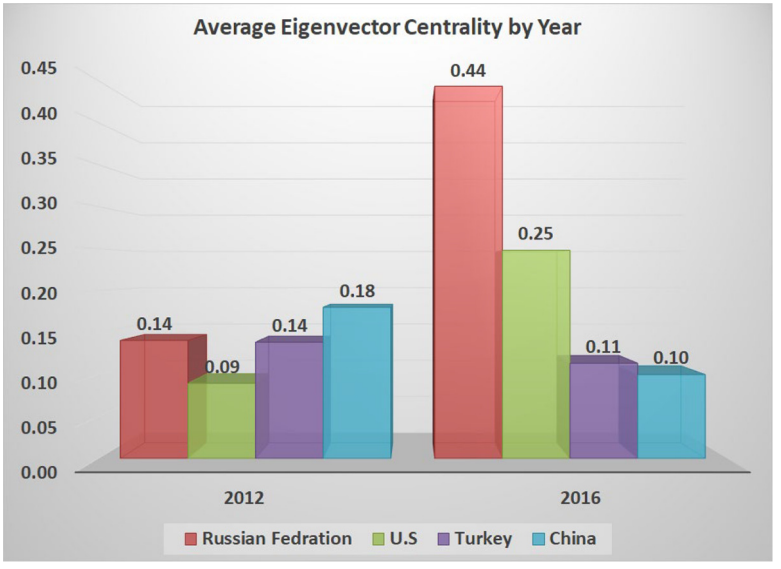

Figure 3.
Average eigenvector centrality values for the key States in both years

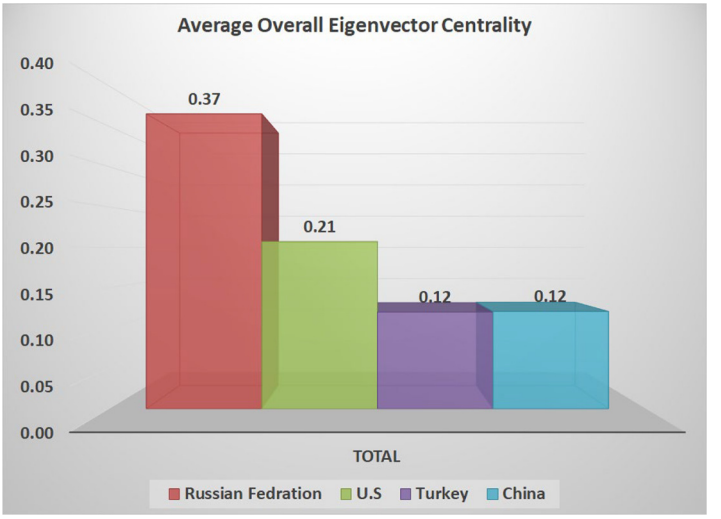

Figure 4.
Average overall eigenvector centrality values for the key States

goals. Therefore, there is a need for an innovative approach that goes beyond the limitations of the classical approaches and brings network techniques to the level of the complex systems thinking. DNA attempts to address this need.

Based on the meta-network concept, DNA proves to be the most suitable approach to study complex systems in general and complex international multi-lateral crises in particular. In addition, the graph measures that DNA provides are valuable additions to the analysts' toolkit, especially when dealing with complex networks that change with time.

DNA captures Structural Dynamics by representing complex systems as a time series of metanetworks and by incorporating a range of social, cognitive and political processes that govern the system's evolution. In this way, DNA provides a framework for modelling the system evolution and informs the agent-based model development (Pestov, 2009).

An illustrative case study of a potential application of DNA in identifying key actors in an international crisis has been considered in this study. The study shows how the meta-network representation can be used to gain insight into the Syrian Crisis complexity. It also shows how the unstructured data extracted from Security Council Reports can be extracted, analyzed and transformed into a network form that changes over time to create a dynamic network of different interacting players.

The proposed approach in this study can then be extended to accommodate the full scope dimensions of an international crisis, using other resources, in addition to Security Council reports, such as media coverage and social media discussions.

DNA together with text-mining helps researchers and analysts in the political field with new tools, insights and capabilities that are needed to understand the complexity of social and political phenomena.

The human capability of analyzing huge number of reports, blogs, news, media coverage, events and data is very limited in comparison with the ability of computers. Because of the advancement of artificial intelligence tools like text mining, text analysis and NLP, machines can now reveal social structure from unstructured huge textual data in seconds.

In addition, computerized temporal network analysis used in this study proved to significantly improve the quality of the results because it gives the researcher a tool to monitor

the evolution of a specific phenomenon over time. Hence, this type of analysis promotes the research in social sciences with more depth in analysis and better understanding.

To summarize, DNA proved to be a suitable tool and technique for detecting key actors in any international Crisis in which there are many actors with different, overlapping and – to some extent – interconnected targets and interests.

Applying the proposed methodology to the Syrian crisis has proved to be very helpful because the results were very reasonable and validated by the real incidents and events occurring in the real world. Therefore, we can conclude that DNA and text mining can be used to study and monitor complex international crises that humans cannot be manually analyzed using traditional content analysis or discourse analysis.

Therefore, this study is significant in two aspects. First, it shows the significance of using text-mining, text-analysis, network extraction from text and DNA in identifying key actors in international multi-lateral crises. Second, it paves the road for other future studies that can use this approach in analyzing and understanding other crises.

References

Adeeb, K. (2012), *Recent History of Syria from French Occupation to Summer 2011*, Al-Nahar, Beirut.

Bell, C. (1971), *The Conventions of Crisis: A Study in Diplomatic Management*, Oxford University Press for the Royal Institute of International Affairs London.

Bonacich, P. (1972), "Factoring and weighting approaches to status scores and clique detection", *The Journal of Mathematical Sociology*, Vol. 2 No. 1, pp. 113-120.

Carley, K.M. (2003), *Dynamic Network Analysis for Counter-Terrorism*, National Academies Press, Pittsburgh pp. 169-187.

Carley, K.M. (2007), *Dynamic Network Analysis in Counterterrorism Research. Proceedings of a Workshop on Statistics on Networks (CD-ROM)*, National Academies Press, Washington, DC.

Carley, K.M. and Pfeffer, J. (2012), "Dynamic network analysis and ORA", Paper Presented at Advances in Design for Cross-Cultural Activities Part I. pp. 265-274.

Carley, K.M., Columbus, D. and Landwehr, P. (2013), *Automap User's Guide 2013*, Institute for Software Research, School of Computer Science, Carnegie Mellon University, available at: www.casos.cs.cmu.edu/projects/automap/CMU-ISR-13-105.pdf

Casagrande, G. (2016), "Russian airstrikes in Syria: February 29 - March 15", Institute for the Study of War, available at: www.understandingwar.org/map/russian-airstrikes-syria-february-29-march-15-2016 (accessed 8 May 2018).

Denny, M. (2014), "Social network analysis", *Institute for Social Science Research*, Vol. 10, pp. 1-20.

Gifkins, J. (2012), "The UN security council divided: Syria in crisis", *Global Responsibility to Protect*, Vol. 4 No. 3, pp. 377-393.

Hoppe, B. and Reinelt, C. (2010), "Social network analysis and the evaluation of leadership networks", *The Leadership Quarterly*, Vol. 21 No. 4, pp. 600-619.

Human Rights Watch (2010a), "Human rights watch world report 2017", available at: www.hrw.org/sites/default/files/world_report_download/wr2010-web.pdf (accessed 25 October 2017).

Human Rights Watch (2010b), *A Wasted Decade: Human Rights in Syria During Bashar al-Assad's first ten years in power*, Human Rights Watch, New York, NY, available at: www.hrw.org/en/reports/2010/07/16/wasted-decade-0 (accessed 7 May 2018).

İşyar, Ö.G. (2008), "Definition and management of international crises", Perceptions, XIII.

Kaczmarski, M. and Jakóbowski, J. (2016), "China on Russia's intervention in Syria", Center for Eastern Studies, 193, available at: www.osw.waw.pl/sites/default/files/commentary_193_0.pdf.

Kumar, P. and Zhang, K. (2007), "Social network analysis of online marketplaces", Paper Presented at IEEE International Conference on E-Business Engineering (ICEBE'07). IEEE, Hong Kong, pp. 363-367.

Landherr, A., Friedl, B. and Heidemann, J. (2010), "A critical review of centrality measures in social networks", *Business and Information Systems Engineering*, Vol. 2 No. 6, pp. 371-385.

Madnani, N. (2007), "Getting started on natural language processing with python", *Crossroads*, Vol. 13 No. 4.

Mignon, J. (2016), "The situation in Aleppo", Report of the Committee on Political Affairs and Democracy. available at, http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=23218&lang=en

Mincer, M. and Niewiadomska-Szynkiewicz, E. (2012), "Application of social network analysis to the investigation of interpersonal connections", *Journal of Telecommunications and Information Technology*, Vol. 2, pp. 81-89.

Moody, J., McFarland, D. and Bender-deMoll, S. (2005), "Dynamic network visualization", *American Journal of Sociology*, Vol. 110 No. 4, pp. 1206-1241, available at: www.journals.uchicago.edu/doi/10.1086/421509

Perchoc, P. (2017), "Syrian crisis: Impact on Turkey from mediation to crisis management", European Parliament Res Serv, available at: www.europarl.europa.eu/RegData/etudes/BRIE/2017/599389/EPRS_BRI(2017)599389_EN.pdf

Pestov, I. (2009), "Dynamic network analysis for understanding complex systems and processes", Defence R&D Canada, Center for Operational Research and Analysis, Report: DRDC CORA TM 2009-020, available at: https://pdfs.semanticscholar.org/03b4/1b73167753878d1f59b9d130c4091428a7aa.pdf

Rainsford, S. (2016), "Aleppo Syria: Russia hails "victory over terrorism", BBC News, Moscow available at: www.bbc.co.uk/news/world-europe-38335970 (accessed 8 January 2018).

Rašković, M., Udovič, B. and Žnidaršič, A. (2015), "Network analysis of inter-country export patterns in the EU: Implications for small states", *Teorija in Praksa*, Vol. 52, pp. 150-174.

Renfro, R. and Deckro, R.F. (2001), "Social network analysis of the Iranian government", Paper Presented at 69th Military Operations Research Society Symposium. USA: National Security Agency.

Sun, B. (2010), "Named entity recognition evaluation of existing systems", "Master thesis in information systems", Norwegian University of Science and Technology.

World Report (2017), "World report 2017: Syria | human rights watch", available at: www.hrw.org/news/2016/06/21/dispatches-incendiary-weapons-pose-civilian-threat-syria. (accessed 7 January 2018).

Zaidi, F., Muelder, C. and Sallaberry, A. (2014), "Analysis and visualization of dynamic networks", available at: https://arxiv.org/pdf/1409.5034.pdf

Further reading

Bamberger, L. (2017), "Shay Har-Zvi: the return of the Russian bear to the Middle east 2016", *SIRIUS - Zeitschrift Für Strateg. Anal*, Vol. 1, pp. 1-39.

Baur, M., Brandes, U., Lerner, J. and Wagner, D. (2009), Group-Level Analysis and Visualization of Social Networks, in Lerner J., Wagner D. and Zweig, K.A. (Eds), *Algorithmics of Large and Complex Networks, Lecture Notes in Computer Science, Springer*, Berlin, Heidelberg, 330-358, available at: https://link.springer.com/content/pdf/10.1007%2F978-3-642-02094-0.pdf

BBC (2015), "Islamic state: Where key countries stand", available at: www.bbc.com/news/world-middle-east-29074514 (accessed 8 January 2018).

Bodansky, Y. (2012), "Explosion on the Syrian-Turkish border", *Inst. Strateg. Polit. Secur. Econ. Consult*, Vol. 49, pp. 1-8.

Carley, K.M. and Diesner, J. (2005), "AutoMap: Software for network text analysis", Center for Computational Analysis of Social and Organizational Systems, ISRI Carnegie Mellon University.

Czuperski, B.M., Herbst, J., Higgins, E., Hof, F. and Nimmo, B. (2016), ("Rep.) distract deceive destroy. Putin at war in Syria. Atlantic council", available at, www.jstor.org/stable/resrep03651

Daniel, J. and Martin, J.H. (2016), "Part-of-Speech tagging", available at: https://web.stanford.edu/~jurafsky/slp3/8.pdf

Diesner, J. and Carley, K.M. (2005), "Revealing social structure from texts: Meta-Matrix text analysis as a novel method for network text analysis", in Narayanan, V.K. and Armstrong, D.J. (Eds), *Causal Mapping for Information Systems and Technology Research: Approaches, Advances, and Illustrations*, Idea Group Publishing, Harrisburg, PA, pp. 81-108.

Harmer, C. (2012), *Syrian Air Defense Force Attack on Turkish Reconnaissance Aircraft*, Institute for the Study of War, available at: www.understandingwar.org/sites/default/files/Backgrounder_SyrianAirDefenseForceAttack.pdf

Jusoor for Studies (2016), "Euphrates shield operation an extra impetus for Turkish policy options", available at: https://jusoor.co/details/Euphrates-shield-operation-an-extra-impetus-for-Turkish-policy-options/189/en (accessed 10 January 2018).

McInnis, K.J. (2016), "Coalition contributions to countering the Islamic state", *Congressional Research Service Report*, available at: https://fas.org/sgp/crs/natsec/R44135.pdf

Salamy, G. (2017), "Turkish policy towards Syrian crisis 2011-2017", Arabic Democratic Center. available at: https://democraticac.de/?p=47298 (accessed 8 January 2018).

Sharp, J.M. and Blanchard, C.M. (2013), "Armed conflict in syria : background and US Response", Congressional Research Service, CRS Report (RL33487), available at: https://fas.org/sgp/crs/mideast/RL33487.pdf.

Stent, A. (2015), "Putin's power play in Syria", Council of Foreign Relations. available at: www.foreignaffairs.com/articles/united-states/2015-12-14/putins-power-play-syria (accessed 8 January 2018).

UNHCR (2014), "Registered Syrian refugees in Turkey, 2012-2013", available at: https://data2.unhcr.org/en/documents/details/39309 (accessed 8 January 2018).

Zanotti, J. (2012), "Turkey : background and U. S. Relations", Congressional Research Services, Report (R41368), available at: https://fas.org/sgp/crs/mideast/R41368.pdf

Appendix. Data and tools

Security Council Meeting Verbatim Records, United Nation Security Council, 2012-2016, available at: www.securitycouncilreport.org/un-documents/syria/

Carley, K.M. and Diesner, J. (2005), "AutoMap: Software for Network Text Analysis", CASOS (Center for Computational Analysis of Social and Organizational Systems), ISRI, CMU, available at: www.casos.cs.cmu.edu/projects/automap/

Carley, K.M. and Diesner, J. (2005), "ORA: Software for Dynamic Network Analysis", CASOS (Center for Computational Analysis of Social and Organizational Systems), ISRI, CMU, available at: www.casos.cs.cmu.edu/projects/ora/

Corresponding author
Amira S.N. Tawadros can be contacted at: amira.tawadros@gmail.com