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GRAPHIC MODEL OF THE TARGET AUDIENCE OF PSYCHOLOGICAL INFLUENCE IN SOCIAL NETWORKS

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Abstract: In today's armed conflicts, such as the conflict in eastern Ukraine, subdivisions of the psychological operations of special operations forces use social Internet services for psychological impact on the target audience. The fuzzy concept of 'target audience' requires development of a scientifically sound approach to its formal description. One of the important stages of psychological operations is the study of the target audience. In this paper, formalization is reduced to the construction of a graph model of the target audience. Its feature is that it takes into account the characteristics inherent in the actors of social Internet services, in particular social networks. The developed graph model allows to take into account the structure of the target audience and to define separate structural elements. Features of construction of graph model of target audience using the method of Social networks analysis are considered. The connections underlying the graph model in accordance with the Social networks analysis are substantiated. The stages of constructing a graph model are described and the algorithm for constructing a target audience in the social networks is presented. The adequacy of the developed model is proved by a model example.

Keywords: antiterrorist operation, graph model, psychological impact, social networks analysis, actor, target audience.

Introduction

The rapid development of methods and means of psychological impact (PI) is associated with the growing role of social Internet services. For example, the experience of the antiterrorist operation (ATO) in the Donetsk and Luhansk oblasts showed that for the effective dissemination of psycho-social influence (PSI) in social networks (SN) it is necessary to analyse the structure and characteristics of the target audience (TA) behavior in the SN. To facilitate further studies and implementation, such a structure should be described by a certain model. Therefore, the actual task, addressed in this article, is to construct an adequate mathematical model of the TA and its further practical application. In the simulation of social groups, a variety of approaches and mathematical tools are used: cognitive maps,[1] Markov chains with discrete time,[2] simulations and games,[3] optimal control models,[4] etc. In the field of research of social processes, network analysis is widely used for representing social groups represented by SN.[5,6,7] A network approach allows to make a formal description of SN and continue to conduct its mathematical analysis. The mathematical apparatus applied for network analysis includes sections of linear and discrete mathematics, the theory of graphs and its applications in the form of SN analysis. Analysis of social networks—or Social Network Analysis (SNA)—is the application of graph theory for the study of SN in terms of social relationships. From the standpoint of the study of network social structures, this approach has been used, for example, in the simulation of terrorist organizations.[8,9] Other examples of research in this direction ae provided by J. Farley,[10] M. Dombroski and K. Carley,[11] P. Klerks,[12] V. Krebs,[13] S. Sterling,[14] and other researchers. The graph model of the opponent with a strictly justified account of the hierarchy of the group by using a weighted non-oriented graph has been used by Koboseva and Khoroshko.[15] Such a model makes it possible to investigate the structure of the social group and identify the members of the network, which has the greatest number of connections and high impact on others. Guminskyi and Peleshchyshyn proposed to consider the structure of the virtual community in the form of graph.[16]

The purpose of this article is to construct an adequate graph model of the psychological influence on the target audience in social networks.

Formalized Representation of Target Audience in Social Networks

The study of the course of hybrid conflicts in the eastern Ukraine makes it possible to distinguish two TAs onto which the psychological influences should focus in the interests of organizing effective counteraction to the destructive propaganda of the aggressor.[17] These are military personnel directly involved in hostilities and the local population of those areas where hostilities are taking place. For the local population, for example, the object of the study are the actors (nodes) and the associations that characterize the relationships between them (friendship, communication, common interests). Thus, in the broadest sense, a TA is understood as a social group, united in a network, that is, a plurality of subjects and the relations between them. In addition, the SNA allows you to display and measure complex, sometimes hidden, groups of people and organizations, analyze their structures and predict future network members or future relationships between them. SNA is considered as an effective tool for mapping the structure of complex social groups.[18] For example, it can be used to determine: the central node in the network; subgroups that exist on the network; regularities of interaction between subgroups; general structure of the network; channels of distribution of information on the network, etc. Using the SNA method, we will construct a graph model of a defined TA.

Formally, TA from the local population in the combat zone can be submitted as a graph G (N, E), in which N = {1, 2, ..., n} is the set of nodes (actors) and E = {1, 2, ..., k} is the set of edges that represent the relation between actors. Under the link between actors we understand the social ties that arise between members of the TA. Constructing such a representation of the TA actors, we obtain an informational model of the considered social group in the form of a graph.

Construction of a Contextual Background to Fill the Model

The first step in the analysis of social groups is the construction of a contextual background. It should include information about the actors and the links between them. To obtain this information, it is now convenient to use social Internet services that provide access to relational data of actors, in particular in SNs. The ability to create text and multimedia objects by means of SN makes them a unique source of data about personal life and interests (correspondence, groups, photo albums, videos, musical compositions, etc.) of real actors who will act as a definite TA. All this leads to an interest in the collection and analysis of social data for the distribution of PI to a specific TA. In addition, the extensive capabilities of API methods in SN help to automate the collection of necessary data for research. Also, developing approaches to intelligence at current utilise analysis of data from open sources (Open Source Intelligence, OSINT) in SNs.[19] This facilitates the collection of TA relational data. OSINT in SNs can be used to detect true relationships between actors, that is, real friends, relatives, etc. As a source of information about actors, it is advisable to choose the most popular SNs. Today, there are methods for identifying profiles belonging to one actor in several social networks.[20] Solving this problem affords getting a more complete social graph that can be useful for the analysis of actors.

The following limits apply to constructing the model: the target audience belongs to a group of actors who represent specific population and age groups, i.e. more than 18 years-olds; selection of settlements and collection of relational data for analysis is carried out by experts or units of psychological operations (PSYOP) in accordance with the current military-political situation; information for constructing the TA model is collected only with the SN, which is most used by the TA from the local population.

Algorithm for Constructing a Graph Model for a Target Audience

The algorithm for constructing a TA model based on a graph consists in the successive execution of a number of steps described below.

Stage 1. Selection of TA actors from the entire set of SN actors. Among all actors, only those that match the characteristics of the TA are chosen as the age and place of residence (in accordance with the accepted restrictions)

$$C^A = \left\{ c_i^A \in C \mid P\left(c_i^A\right) \right\} = \left\{ c_i^A \mid P\left(c_i^A\right) \right\}, \tag{1}$$

where C^A is the set of actors TA, C is the set of actors SN and $P(c_i^A)$ − the actor's characteristic, which she or he attributes to the TA.

Stage 2. Construction of an information field for characteristics of TA actors. A set of relational data for constructing a social graph should include data that can be obtained from the most used SNs, such as VKontakte, Fasebook, and Twiter. To determine the relationships between actors, weights of the nodes and edges of the graph—those parameters that are common to the above-mentioned data sources—are chosen, taking into account that the TA actor may have a single profile in one of the SNs. To determine social connections, we use the connections indicated by sociologist Mark Granovetter.[21] Accordingly, we take into account the weak links for the formation of the graph. They appear to be much more effective when certain social processes occur than strong ones. That is, one needs to consider the "force of weak ties." For the formation of the edges of the graph, it is necessary to have information about such social connections between actors in SN: common interests, family ties, friendly relationships, collaborative work.

Common interests can be judged according to the identity of the same communities in SN, a large number of 'reposts' or 'tweets' of each other.

Stage 3. Formation of the link table. The sign of the presence of an edge between the i-th and j-th actors in SN is determined by the formula:

$$\text{Link}_{ij} = \begin{cases} 1, & \text{if one would have one communication characteristic available to the actor} \\ 0, & \text{if the characteristics of the connection are absent in both actors} \end{cases}$$

Stage 4. Construction of the graph. On the basis of the data obtained in the second stage of the process, the graph G (N, E) is constructed, where N is the number of selected actors in Stage 1, and E is the number of links between actors established in Stage 3.

Stage 5. Determination of the weights of the edges of the graph. The weight of the edge of the graph corresponds to the strength of the social ties that exist between members of the social group. In the context of social networks, this means the intensity of the relationship between actors in social networks, a combination of emotional, friendly, and working relationships that arise in social networks.[22] Each of the characteristics of the relationship of actors can take values [0, 1]. Depending on the number of connections available, the weight of the edges will vary, which will be maximal in the presence of all links:

$$V_{reb} = \text{Interest} + \text{Family} + \text{Friends} + \text{Job}, \quad (2)$$

where Interest – common interests, Family – family relationships, Friends – friendly relationships, Job – collaboration. The collected data should be systematized for further formation of the graph.

Stage 6. Determination of the weights of the vertices of the graph. It is not known in advance what role SN plays for the actor. Weights of nodes are proposed to be formed by calculating the authority of each node. This will ensure the hierarchy of TA actors. The authority in the social graph can be analyzed using the PageRank criterion that uses Google's search system. It is calculated by accidentally wandering around the graph. The random marker moves in a graph and occasionally moves to a random node and starts moving again. In analytical form, the PageRank weight $PR(A)$ of node A (the weight you want to calculate) is defined as [23]:

$$PR(A) = (1-d) + d\left(PR(T_1)/C(T_1) + \ldots + PR(T_n)/C(T_n)\right), \quad (3)$$

where d is the constant factor d = 0.85, $C(T_n)$ – the pageRank weight of the node pointing to node *A*; $PR(T_n)/C(T_n)$ – number of transitions from each node pointing to node A. The larger the PageRank, more authoritative is the node. Unlike other approaches to determining the weight of a participant in the SN, this approach does not require the introduction of facts about the management of members of certain organizations or movements, is not based on the actor's activity in the network, does not take into account the level of education and the position defined in social networks. may be false. Also, this algorithm does not require expert evaluation, which takes a lot of time and resources. That is not possible, since the amount of TA in the SN is very large and takes a long time to evaluate it, as well as the hybrid conflict is very fast, and the analysis of the TA may be inappropriate.

In contrast to other approaches to determining the actor's weight in SN, such an approach does not require the input of the leaders of certain organizations or movements. It does not rely on actors in the network providing content, nor does it take into account the level of their education.

Stage 7. Formalization of the graph model. Let's formalize the graph model and present it with a mathematical model, a matrix of adjacency. The adjacency matrix $S = \{a_{mn}\}$ in SNA is a square matrix with the number of rows and columns corresponding to the number of nodes. The diagonal of the matrix characterizes the node itself, therefore, the diagonal elements correspond to the weights of the vertices of the graph. If the actor has a connection with another actor, then the weight of this connection is written to the matrix at the intersection of the associated actors. If the actors do not have connection to the matrix write 0. The matrix is symmetric, since the graph is not directed, which greatly reduces the number of mathematical operations for further study.[15] Such a matrix allows us to depict a complete graph, and, therefore, characterizes the TA.[15]

$$S = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots a_{ij} & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix} \quad (4)$$

where a_{ij} is the weight coefficient of the edge, which binds the i-th and j-th actors, the elements of the matrix, where $i = j$ corresponds to the weighted coefficients of the nodes, respectively, and n is the number of nodes.

Stage 8. Definition of the hierarchy in the graph model TA. Using a weighted graph allows to take into account the hierarchy of actors in the network. Since the links between the actors are not directed, the transition to the oriented graph is impossible. From the initial graph, we pass to its root structure with the root in the node that has the greatest weight. Let there exist several nodes with the maximum weight; then, when building a hierarchical structure, the role of 'root' will be played not by one node: all the vertices of the graph with a maximum weight will belong to the zero level in the hierarchical structure of the graph. All chains of the hierarchy are the graphs of the graph which come from the zero level of the root structure and end with either a node whose weight is the smallest among others in this chain or the node lying in the last level of the hierarchy; if v_k, v_m are two consecutive nodes of such a chain, the number of the level of the hierarchy that contains v_k is not higher than the number of the level in which the node v_m is.

Exploring the characteristics of actors at each level of the hierarchy allows to allocate the most influential of them at each of the levels. This will provide for a detailed study and use of the data obtained when planning the PI. This will also reduce the number of people included for analysis in the TA and will save time.

Algorithmization of the above-mentioned stages allows us to submit a block diagram of constructing a graph model TA (Figure 1). The practical application of the developed algorithm allows us to construct graph models of other TAs, not only TAs from the local population in the conflict zone. In this case, only the physical content of the values that are responsible for the connection and its weight change.

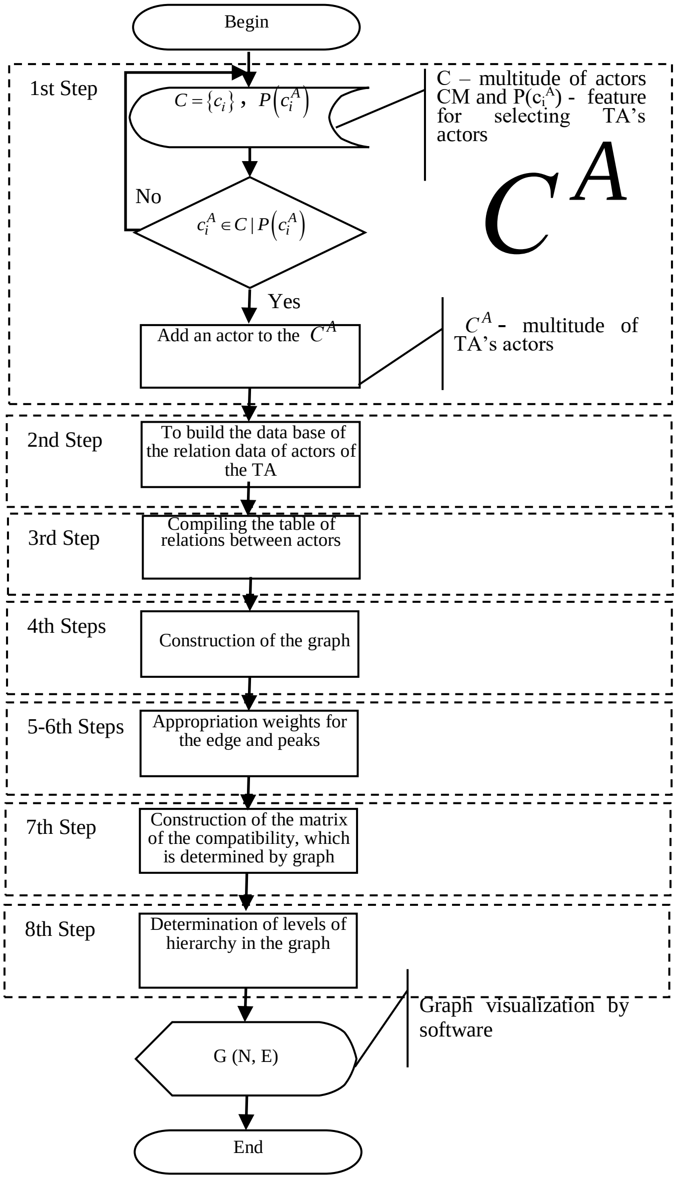

Figure 1: Block diagram of the algorithm for constructing a graph model TA in SN.

Model Example

Prove the adequacy of the constructed model. To do this, consider a model example, the source data for which is collected in the conflict zone. The data collection was conducted for a model example only with SN VKontakte, which are the most popular in the conflict zone.

Stage 1. We choose among SN actors those who meet the characteristics of the target audience, for example, they live in the city of Volnovaha and are older than 18 years (Figure 2). For example, we confine the set to ten from all TA actors.

8	ИМЯ	ФАМИЛИ	ПОЛ	ЛЕТ
9	Михаил	Гвоздик	М	33
10	Павел	Второй	М	31
11	Евгений	Ворошилі	М	29
12	Александ	Агафонов	М	25
13	Сергей	Голубенк	М	46
14	Ольга	Путиенко	Ж	31
15	Юлия	Беседа	Ж	28
16	Владимир	Ефименкс	М	28
17	Виталий	Шептура	М	19
18	Владисла	Ермоленк	Ж	22

Figure 2: An item in the TA list, located in the Volnovak settlement of the Donetsk region, Ukraine.

Stage 2. We construct a field of characteristics for each actor (Figure 3), included in the TA.

8	ИМЯ	ФАМИЛИ	ПОЛ	ЛЕТ	РОДНОЙ	СЕМЕЙНОЕ ПОЛОЖЕНИЕ	VK ID ПАРТНЁРА	ССЫЛКА НА ПА	УНИВЕРСИТЕТ	ГОД ОКОНЧАНИЯ	МЕСТО РАБОТЫ	ДОЛЖНОСТЬ	ПОДПИСЧИК
9	Михаил	Гвоздик	М	33	с.Василье	женат	https://vk.com/id13148651	Светлана Гвозд	УИПА	2011	Промтех	Инженер-элек	55
10	Павел	Второй	М	31		женат							117
11	Евгений	Ворошилі	М	29	Волновах	женат			ЛНАУ	2011	https://vk.com/club60102778		26
12	Сергей	Агафонов	М	25		женат							241
13	Ольга	Голубенк	М	46	Енакиево	женат					Шахта"Южнодо	солист культур	10
14	Игорь	Ефименкс	М	28	Ивановка	не женат			ДонГМУ им. Горького				143
15	Владисла	Шептура	М	19	БЛАГА	влюблён				2010	Донбасскерамика		7
16	Татьяна	Ермоленк	Ж	22	Валерьян	в активном поиске				2014			181

Figure 3: Information about each actor was obtained from the social network *Vkontakte*.

In addition, we get tables with the lists of friends, which includes only friends corresponding to the requirements of selecting the TA (Figure 4).

1	Актор	З ким дружить
2	https://vk.com/id183701614	https://vk.com/id366560893
3	https://vk.com/id183701614	https://vk.com/id113786963
4	https://vk.com/id183701614	https://vk.com/id138432365
5	https://vk.com/id183701614	https://vk.com/id249946492
6	https://vk.com/id183701614	https://vk.com/id416366165
7	https://vk.com/id183701614	https://vk.com/id414593205
8	https://vk.com/id183701614	https://vk.com/id407818163
9	https://vk.com/id183701614	https://vk.com/id300872559
10	https://vk.com/id183701614	https://vk.com/id400085592
11	https://vk.com/id183701614	https://vk.com/id400349573
12	https://vk.com/id183701614	https://vk.com/id290358722
13	https://vk.com/id183701614	https://vk.com/id383025732
14	https://vk.com/r.kerbenyova	https://vk.com/id9681399
15	https://vk.com/r.kerbenyova	https://vk.com/id13130015

Figure 4: A table of friends among the target audience.

Stage 3. The collected data are systematized for further determination of links (Table 1).

Table 1: Data about connections between nodes.

The node from which the edge is directed	Node to which the edge is directed	Available connections for the collected characteristics			
		common interests	family ties	friendly ties	joint work
Actor 1	Actor 2	0	0	1	0
Actor 1	Actor 4	0	1	0	0
Actor 1	Actor 8	1	0	0	1
Actor 3	Actor 5	0	0	1	0
Actor 3	Actor 7	1	0	1	1
Actor 4	Actor 5	1	1	1	1
Actor 5	Actor 6	1	0	1	0
Actor 6	Actor 8	0	1	0	0

Step 4. Form the graph according to the collected information in the previous steps (Figure 5).

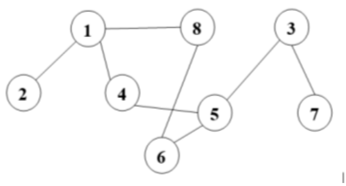

Figure 5: A graph of the target audience.

Step 5. Form the weights of the edges by the formula Vreb1 = 0 + 0 + 1 + 0 = 1. The calculation results for each edge of the graph are given in Table 2.

Table 2: The scales of the edges of the social graph.

№ edge	The node from which the edge is directed	Node to which the edge is directed	Available connections for the collected characteristics				Weight edges
			common interests	family ties	friendly ties	joint work	
1	Actor 1	Actor 2	0	0	1	0	1
2	Actor 1	Actor 4	0	1	0	0	1
3	Actor 1	Actor 8	1	0	0	1	2
4	Actor 3	Actor 5	0	0	1	0	1
5	Actor 3	Actor 7	1	0	1	1	3
6	Actor 4	Actor 5	1	1	1	1	4
7	Actor 5	Actor 6	1	0	1	0	2
8	Actor 6	Actor 8	0	1	0	0	1

Step 6. Form the weights of the vertices of the graph by the formula (3). The calculations are given in Table 3.

Table 3: The value of PageRank for the nodes of the social graph.

Nodes	PageRank nodes (weight)
Actor 1	0.2
Actor 2	0.1
Actor 3	0.2
Actor 4	0.3
Actor 5	0.4
Actor 6	0.2
Actor 7	0.1
Actor 8	0.3

An example of a weighted graph model is shown in Figure 6 (numbering in the middle of the node is the number of the actor, next to the node in blue – its weight, corresponding to the hierarchy of the network actors, next to the edge in red color – the weight of the edge).

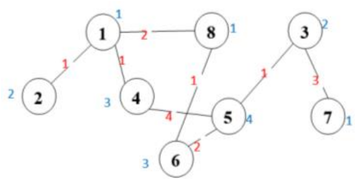

Figure 6: An example of a weighted graph, with weights of vertices in accordance with the PageRank algorithm and the indicated weights of the edges.

Stage 7. Go to the mathematical representation of the graph in the form of a matrix of adjacency for further mathematical operations over the graph for TA analysis.

$$S = \begin{pmatrix} 0{,}2 & 1 & 0 & 1 & 0 & 0 & 0 & 2 \\ 1 & 0{,}1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0{,}2 & 0 & 1 & 0 & 3 & 0 \\ 1 & 0 & 0 & 0{,}3 & 4 & 0 & 0 & 0 \\ 0 & 0 & 1 & 4 & 0{,}4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & 0{,}2 & 0 & 1 \\ 0 & 0 & 3 & 0 & 0 & 0 & 0{,}1 & 0 \\ 2 & 0 & 0 & 0 & 0 & 1 & 0 & 0{,}3 \end{pmatrix}$$

Step 8. Submitting the graph in the form of a hierarchical structure.[15]

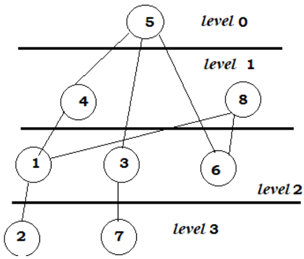

Figure 7: Hierarchical structure of the graph.

This representation (see Figure 7) provides the opportunity to visually highlight the most influential actors and explore possible chains of dissemination of information from these actors. Further detailed analysis can only be carried out for those actors belonging to higher levels of the hierarchy, thus we determine the most important actors among the large volumes of TP. Thus, one can allocate the levels of the hierarchy by specifying the vertices of the summit of any characteristics according to the SNA theory, which is more expedient for use to solve a particular task.

Conclusion

The proposed approach to the construction of the graph model of TA to the modeling of social groups and social processes, in contrast to other models, allows to take into account the structure of the TA, which in the future will allow the identification of opinion leaders, information dissemination mediators, and to predict new relationships that may arise between actors. The graph model allows to simulate the processes of dissemination of information, taking into account all existing channels (social relations) for the dissemination of information. Unlike existing graphic models describing terrorist groups, the model does not require prior intelligence for group leaders and does not rely on expert estimates that may require a large amount of time at large scales, since the weight model of the actor calculates the algorithm. Some of their social connections are chosen as links between actors, which accurately defines communicative chains different from hyperlinks and comments. The mathematical basis of the model is flexible and can be applied to any TA. The hierarchical representation of the graph model is proposed, which allows studying the levels of TA, and not of each actor separately, which saves time and resources considerably. A promising area of uture research is the construction of a graph of interests based on the social graph representation of the TA. Another one is the development of algorithms for generating content with hidden PI for TA actors with particular interests. Also of relevance is the development of algorithms for predicting future connections between influential persons in SNs based on the recommendations of friends' algorithms.

Notes

1 Andrey Ivaschenko and Dmitry Novikov, *Modeling and Methods of Organizational Management of the Innovative Development of the Firm* (Moscow: Lenand, 2006).

2 Dong Zhang, Daniel Gatica-perez, Samy Bengio, and Deb Roy, "Learning Influence among Interacting Markov Chains," *Neural Information Processing Systems (NIPS)* 3 (2005): 132-141.

3 Dmitry Novikov, "Cognitive Games: Linear Impulse Model," *Management Problems* 3 (2008): 14-22.

4 Fred Roberts, *Discrete Mathematical Models with Applications to Social, Biological and Ecological Problems,* Translated by A. Rappoport, S. Travkina (Moscow: Science, 1986).

5 Ruslan Hryshchuk, "Startup of Virtual Communities in Social Networks on the Principle of Critical Mass," *Information protection*, Special issue (2015): 19-25.

6 Alexander Bikkulov and Andrey Chugunov, *Network Approach in Social Computer Science: Modeling of Socioeconomic Processes and Research in Social Networks. Tutorial* (Moscow: ROS, 2013).

7 Andrei Snarsky and Dmitry Lande, *Simulation of complex networks: A manual* (Kyiv: NTTU "KPI," 2015).

8 Stuart Koschade, "A Social Network Analysis of Jemaah Islamiyah: The Applications to Counter-Terrorism and Intelligence," *Studies in Conflict and Terrorism* 29, no. 6 (2006): 559-575, http://eprints.qut.edu.au/6074/1/6074.pdf (accessed Octouber 24, 2017).

9 Pankaj Choudhary and Upasna Singh, "Ranking Terrorist Nodes of 26/11 Mumbai Attack using Analytical Hierarchy Process with Social Network Analysis," 11th Annual Simposium on Information Assurance (Asia'16), June 8-9, 2016, Albany, NY, http://www.albany.edu/iasymposium/proceedings/2016/12_Choudhary_Singh_ASIA2016.pdf (accessed November 21, 2017).

10 See, for example, Jonathan David Farley, "Breaking Al Qaeda Cells: A Mathematical Analysis of Counterterrorism Operations (A guide for Risk Assessment and Decision Making)," *Studies in Conflict & Terrorism* 26, no. 6 (2003): 399–411; and, by the same author, "Two Theoretical Research Questions Concerning the Structure of the Perfect Terrorist Cell," in

Mathematical Methods in Counterterrorism, ed. Nasrullah Memon, Jonathan David Farley, David L. Hicks, and Torben Rosenorn (New York, NY: Springer, 2009), 91–103.

[11] Matthew Dombroski, Paul Fischbeck, and Kathleen M. Carley, "Estimating the Shape of Covert Networks," in *Proceedings of the 8th International Command and Control Research and Technology Symposium*, Washington, D.C., June 17-19, 2003, www.casos.cs.cmu.edu/publications/papers/dombroski_2003_estimatingshape.pdf (accessed August 6, 2018).

[12] Peter Klerks, "The Network Paradigm Applied to Criminal Organisations: Theoretical Nitpicking or a Relevant Doctrine for Investigators? Recent Developments in the Netherlands," in Transnational Organised Crime: Perspectives on Global Security, ed. Adam Edwards and Peter Gill (London: Routledge, 2003), 97-113.

[13] Valdis E. Krebs, "Uncloaking Terrorist Networks," *First Monday* 7, no. 4 (2002), http://firstmonday.org/ojs/index.php/fm/article/view/941/863%22%3B%3E%3BNetwork; Krebs, "Mapping Networks of Terrorist Cells," *Connections* 24, no. 3 (2002): 43-52.

[14] Sara E. Sterling, *Aggregation Techniques to Characterize Social Networks*, Thesis (Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 2004).

[15] Alla Koboseva, Igor Machalin, and Vitaliy Khoroshko, *Analysis of the Security of Information Systems* (Kyiv: View. DUPST, 2010), p.316.

[16] Ruslan Guminskyi and Andrei Peleshchyshyn, "Definition of Discussion Pages of the Virtual Community for Informational Influence," Master's thesis, *Information, communication society in Ukraine* (2017): 32-33.

[17] Georgii Pocheptsov, *Modern Information Wars* (Kyiv: Kyiv-Mohyla Academy, 2016).

[18] Matthew O. Jackson, *Social and Economic Networks* (Princeton: Princeton University Press, 2008).

[19] Benjamin Robert Holland, *Enabling Open Source Intelligence (OSINT) in Private Social Networks* (Ames, Iowa: Iowa State University, 2012).

[20] Dmitry Gubanov and Aleksandr Chkhartishvili, "Conceptual approach to the analysis of online social networks," *Management of large systems* 45 (2013): 222-236.

[21] Mark Granovetter, "The Strength of Weak Ties," *American Journal of Sociology* 78, no. 6 (1973): 1360–1380.

[22] Granovetter, "The Strength of Weak Ties."

[23] JaewonYang and Jure Leskovec, "Structure and overlaps of communities in networks," ACM SIGKDD Conference on Knowledge Discovery and Data Mining, Ukraine, 2012.

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