Preprints of the 19th World Congress
The International Federation of Automatic Control
Cape Town, South Africa. August 24-29, 2014

On Mobilizing Processes of Cyber Movement Organizations

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Abstract—Cyber Movement Organization (CMO) is a special kind of social movement organization on the Web. In this paper, we propose a model to simulate the mobilizing process of CMO, which consists of the individual unit, organization unit, and the mobilizing mechanisms. The mobilizing mechanisms has three sub-mechanisms: the participation mechanism, the choice mechanism, and the inviting mechanism. A dataset of more than two million "*human flesh search*" related microblogs is used to validate the model. Empirical results show that our model can capture the key features of the real-world mobilizing process.

***Index Terms*—Cyber Movement Organizations (CMO), Social Network Analysis, Human Flesh Search (HFS), Simulation, Social Movement Organizations, Resource Mobilization**

1. INTRODUCTION

Cyberspace has become a parallel world, which mirrors and interacts with the real world [1], especially the social media makes it more realistic. Our life is mirrored to the Internet with social media, such as blog, Facebook, Twitter, and etc. Lazer etc. [2] proposed the emerging research area "*computational social science*" in 2009, which pointed out that enormous information on the Internet is the mirror of human and organizational behavior. These data can be used to analyze the behavior patterns of individuals and groups to get a better understanding of people's daily lives, organizations, and the society.

Almost all social phenomena have a presence in the cyberspace. It is particularly true for SMO (Social Movement Organization) [14], a concept coined in sociology by McCarthy and Zald [14] at the worldwide turbulent times. The SMO on the Internet leads to an emerging research field — Cyber Movement Organizations (CMO), or Cyber-enabled Social Movement Organizations (CeSMO) [1]. CMO, as a special type of SMO, was enhanced in cyberspace, where an event could attract a huge amount of Internet users to join, discuss, and act jointly in a short time [1]. The user group of Human Flesh Search (HFS) [3-5], crowdsourcing and rumor propagation [6] involved are typical instances of CMO episodes.

A variety of studies of social movements have been conducted, which can be categorized into four frameworks as Sawyer suggested [7]: resource mobilization theory, frame analysis, political process theory, and new social movement theory. These works mainly focuses on the qualitative aspects of large-scale, coarse-grained macro-social structure and small scale quantitative model, due to the limited social signal data granularity. Web 2.0 takes more and more changes, big data in social media [8-10], and social computing [11, 12] have made many of the non-quantifiable problem become quantifiable nowadays. Sociologists began to pay attention on the Internet as well [13]. For example, resource mobilization theory [14] has been applied in the studies of online social movements [15-17].

We study the mobilizing process of CMO in this paper. The CMO mobilizing process is treated as a resource mobilization process. SMO treated the web etc. technology as one of many potential resources, such as money, time, and materials that a movement can access [18]. In contrast, we treat cyberspace as the main battlefield of a movement instead of simple resources.

In this paper, we first proposed a cyber movement mobilization model in Section II. We validated our model with real data in Section III. At last, we concluded the article with some discussions.

2. MODEL

The influence of social movements depends heavily on the number of supporters. The more people involved, the greater influence it has. Therefore, in order to maximize the influence of a social movement, the initiators usually try to attract more supporters by interesting and impressive theme. This can also

be applied to cyber movement. Initiator draws on their own strength as much as possible to attract Internet users. Therefore, the formation of a CMO can be treated as a process of the initiator and participants mobilizing their social resources. Since there are various types of social resources, human resource is the dominating one among all resources, we limited social resources as human resources in this paper. All the individuals involved in the movement are denoted as a complete set *A*, which can be classified into four groups, namely initiator *I*, participants set *P*, invitees (but not participants yet) set *C*, participants' and initiator' supporters set *S*. The intersection of each set is empty, and form a CMO under the mobilization mechanism *MP*. Thus, the formation of a CMO's mobilization can be described as the following quintuple.

$$\mathrm{CMOm}: (\mathrm{I}, \mathrm{P}, \mathrm{C}, \mathrm{S}, \mathrm{MP}),$$
$$\mathrm{I} \cap \mathrm{P} \cap \mathrm{C} \cap \mathrm{S} = \emptyset \quad \text{and } \mathrm{I}, \mathrm{P}, \mathrm{C}, \mathrm{S} \subseteq \mathrm{A} \tag{1}$$

Movement initiator *I* first determines event's profile, and then publishes it through social media and/or other channels. He/she will invite someone (C_i) would be helpful for the movement. Initiator's supporters (S_i) are informed when the initiator published related messages. Some or all of the invitees and supporters will become participants (P_i), then participants (P_i) also invite potential individuals (C_j) to participate. Mobilization process continues until the end of the movement.

2.1: Individual Unit

Individual is the cell unit of CMO. In this model, we consider four properties of each individual in (I, P, C, S). They are Mobilizing Ability (*MA*), Costs of Be Mobilized (*CBM*), Invitation Ability (*IA*), and Active Level (*AL*), which signed as a quadruple:

$$\mathbf{Ui}: (\mathrm{MA}, \mathrm{CBM}, \mathrm{IA}, \mathrm{AL}) \tag{2}$$

2.2. Organization Unit

When an individual (*p*) participates a CMO, he or she would invite a few people (*c*) to join, and bring some supporters (*s*). Therefore, we define the triple (*p, c, s*) as the base unit of a CMO. Fig. 1 shows the structure of an organization unit.

$$\mathbf{Uo}: (\mathrm{P}, \mathrm{C}, \mathrm{S}) \tag{3}$$

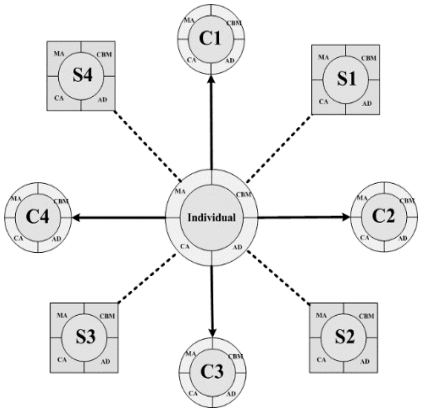

Fig. 1. The Organization Unit

2.3. Mobilizing Mechanism

A potential unit needs to decide whether to participate in the CMO or not at first. If yes, how to participate in is the second issue? This question includes two sub-questions: how to invite new units and which part of organization units to participate. Each potential participant follows this process until the final CMO formatted. Therefore, for each new organizational unit $\mathrm{Uo_i}$ ($\mathrm{P_i}$, [$\mathrm{S_1}$, $\mathrm{S_2}$, …$\mathrm{S_{mi}}$], [$\mathrm{C_1}$, $\mathrm{C_2}$, …$\mathrm{C_{ni}}$]), it joins the CMO under the following three sub-mechanisms: Participation mechanism, choosing mechanism, and inviting mechanism. Their relationships are as Fig. 2:

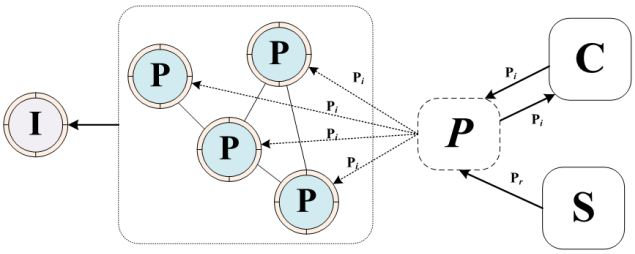

Fig. 2. Mobilizing Process

Two kind of potential user (Supporters and Invitees) would become participants under participation mechanism. When they became the participants, they would choose the one or more old participants to join under the choice mechanism. Another process is executed when one participant invite some other user to join.

2.3.1 Participation Mechanism

Participants come from two sources: the invitees set *C* and the supporters set *S*. For the participant p_i in *S*, we suppose they join the CMO randomly. But it is not true for the participant p_i in *C*, three factors would influence their decisions: the frequency of invitation, the mobilizing cost, and their activity level, which can be represented as follow:

$$p_c = \begin{cases} \alpha_{ci} \frac{MS_{ci}}{MA_{ci}}, & MS_{ci} < MA_{ci} \\ 1, & \alpha_{ci} MS_{ci} \geq MA_{ci} \end{cases} \tag{4}$$

In which α_{ci} is the activity level of individual ci, $\alpha_{ci} \in [0,1]$. $\mathrm{MS_{ci}}$ is the strength of ci be mobilized, $\mathrm{MA_{ci}}$ is the damping strength of ci.

2.3.2 Choice Mechanism

The supporters and invitees of initiator joined to the initiator directly. However, the supporters and invitees of participator p_i have two choices: to join the initiator directly, or to join his or her master p_i. Specifically speaking, the preference probability of p_i and *I* who are connected is:

$$p_{mk} = \beta_k \frac{MA_m}{\sum_{k=0}^{i} MA_k} \tag{5}$$

In which MA represents the mobilizing ability, and the β_k represents the preference index of m_k .

The only difference between supporters and invitees is the scope of p_i they prefer to connect. For the supporters, they are

free to connect any p_i or I, while the invitees just choose one or more individuals who invited them before.

2.3.3 Inviting Mechanism

Inviting mechanism answers whether each participant would invite someone or not, and how many persons to invite each time. Another question is under what condition one could be invited more than once.

The person who can be invited is limited. Some invitees may have been invited already. The probability of one who have been invited is:

$$p_{ci} = \frac{1}{|A-C|+1} \quad (6)$$

In which A is the complete set of people who can be invited, C is the subset who have been invited. $|A\text{-}C|$ is the amount of people not invited, which means if all the possible invitees have been invited at least once, the next invitee must be have been invited, p_{ci} is directly proportional with the amount people who have been invited.

If one invitee has actually been invited before, then the next question is who the invitee is in the set of invitees. It has strong coupling with specific data.

2.4. Organization Network

The network paradigm is used to model the mobilizing process in CMO, in which there are three types of nodes, and two types of links. The vertices I stand for the initial organizer. P represents the person who participated the movement. C represents the person who is invited by the people in I or P. If p_i participate the movement, he or she would links to I or p_j ($i \neq j$, namely no self-loops) with participating links. One participant (or the initiator) will link some potential participants (namely c) with inviting links. Fig. 3 visualized a typical organization network topology. Different organization units have different color.

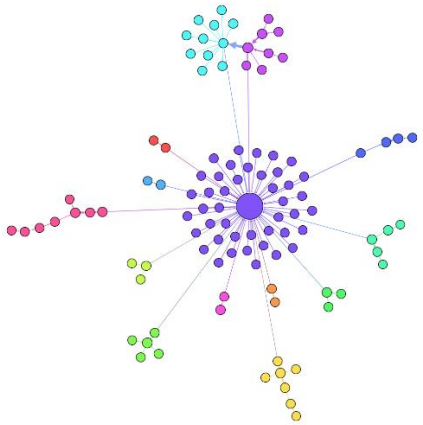

Fig. 3. A typical Organization Network of CMO

3. EMPIRICAL ANALYSIS

In this section, we present the data collection, and mapped the attributes etc. into our model. Three metrics were used to evaluate our model. The results performed well which demonstrate that our model can regenerate the mobilizing process.

3.1 Data collection

For the purpose of this study, corresponding to the mobilization model, we use social media to validate it. Microblogging about HFS can simulate this process well.

We employ data from the largest microblogging website in China (*Sina Weibo*), which has more than 500 million users as of Dec 2012[19]. About 100 million messages are posted each day [20]. In this paper, we collected a complete set of posts, comments, and all of the user information about 308 HFS cyber movement cases, ranging from 2010 to 2013. It involves more than 2 million messages and 1.3 million users. More than 6,000 users are involved in one case on average. The most influential case involved more than 230,000 users. The detail of the data is listed as Table 1.

Table 1. Data collection profile

Participants Size	Cases Count	Average Size of Participants
0 and 500	144	221
500 and 1000	50	739
1000 and 5000	66	2199
5000 and 10000	14	7248
10000 and 50000	25	21728
50000 and 150000	8	75957
150000 and 250000	2	197589
Total	308	6061

3.2 Mapping

We make the following mapping between our data set and model's concepts, such as four attributes of each individual in the organization unit etc., as follow:

Movement: the discussion topic.

Movement Initiator: the first person who proposed the topic.

Participating Processes: the reposts or comments to the discussion topic. Commenting or forwarding original topic is treated as direct participation behavior; the others are treated as indirect participation through brokers.

Individual Unit: registered users in Sina Weibo.

Organizational Unit: the users involved in one comment or repost.

Mobilizing Ability: the amount of followers one user own.

Costs of Be Mobilized: the ratio of one's followers to friends.

Invitation Ability: the amount of invitees one invited.

Active Level: the relative amount of one's microblogs.

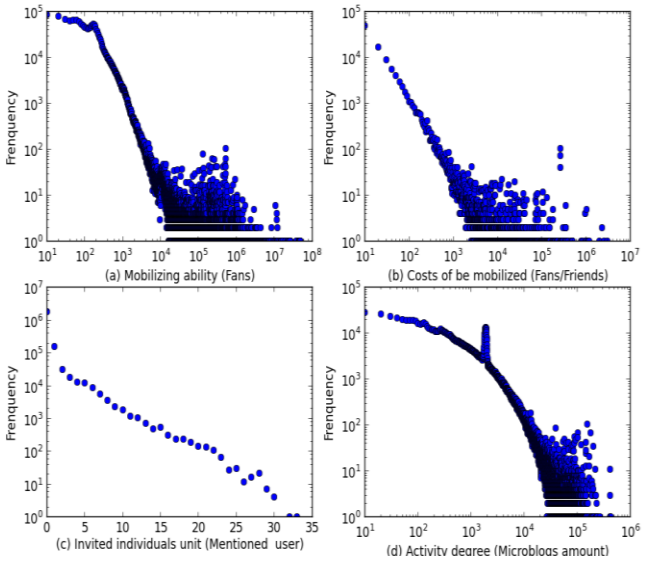

Fig. 4. Distribution of the individual's attributes in real data

Fig. 4 shows the distribution of the individual's attributes in our data set. Mobilizing ability, the costs of being mobilized, and the individual activity level have long tails, which indicates that few people are superheroes. Most of them are not very active, invited few people to join the organization, and their mobilizing abilities are poor. Very few people invite more than 20 other persons one time.

Based on the mapping of model and dataset, some parameters about the three sub-mechanisms in mobilizing mechanisms should be studied from our data, which includes the activity level α_{ci} for participation mechanism; the preference index β_k for choice mechanism, and the probability p_{cij} of two invitees are the same one.

Parameters in Participation Mechanism: α_{ci} is the activity level. The absolute activity level is indicated in figure 4(d), while we generated a sequence ranged from 0 to 1 followed power law distribution to simulate this parameter approximately. For the participants from C, the strength of ci be mobilized is actually the mentioned times ci received, MA_{ci} is the damping strength of ci, which is related with user's influence and helpfulness. It is harder to mobilize a user with higher influence than the one with lower influence. Similarly, it is harder to mobilize a user with less helpfulness. So we use the ratio of these two factors as the damping strength of ci shown as follow:

$$MA_{ci} = F_{ci}/E_{ci} \tag{7}$$

In which F_{ci} represents the influence (broadcast ability: fans amount), and E_{ci} represents its helpfulness (acceptance ability: friends amount).

Parameters in Choice Mechanism: The empirical studies demonstrated that the supporters and invitees of initiator preferred to involve directly. More than eighty percent individuals joined the movement directly on average in our dataset. About eight percent of individuals join the movement through one broker, less than four percent of individuals joined the movement through more than two brokers. Based on the results, we define the preference index as follow:

$$\beta_k = 10^{-distance(m_k,\ I)} \tag{8}$$

$distance(m_k,\ I)$ is the distance between the individual m_k and initiator I in the organization network.

Parameters in Inviting Mechanism: Empirical results in figure 4(c) shown that most people participated the movement without invitees. The amount of individuals invited decreased logarithmically. More critical, more invited times. As this phenomena, we supposed the probability of invitee ci and *cj* are the same one is proportional with *cj*'s invited times:

$$p_{cij} = \frac{MT_{cj}}{\sum_{k=0}^{n} MT_{ck}} \tag{9}$$

In which *MT* is the times of been invited of all n inviters.

3.3 Evaluation Measures and results

For validating our model, three metrics of organization's network profile are presented as follows: the clustering coefficient, the diameter and average shortest path length, which indicated the organization hierarchy. Clustering coefficient of the organization network can characterize organization at microscopic scale. The last two can characterize the organization network at macroscopic scale. Fig. 5 shows the distribution of these three metrics in our cases. It indicates that the simulated organization network based on our model can regenerate the real cases in some sense.

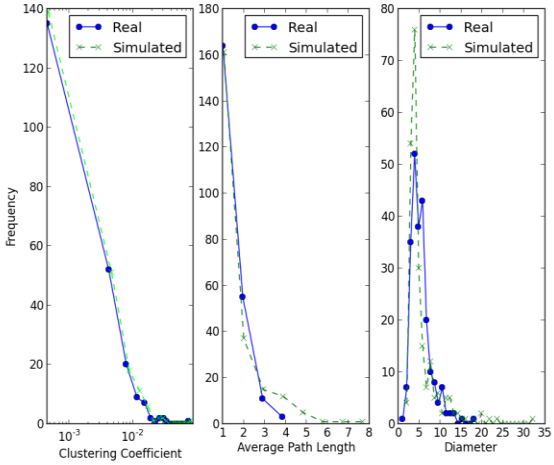

Fig. 5. Distribution of metrics between real organization networks and simulated organization networks.

The clustering coefficient fits the real data perfectly. The average shortest path length has a good fit in most cases. There is no case beyond 4 in real data, while there are 6 cases in the generated organization network. This situation applies diameter as well. Most of real organization networks' (53 cases) diameter is 5, which have 20 more cases in generated organization network. The real cases have no long tail; the longest one is 17, while the generated cases have a few cases beyond 17.

IV. CONCLUSION AND DISCUSSION

We present a model to simulate the mobilizing process of CMO. The process contains three mechanisms: the join mechanism, the choice mechanism, and the inviting mechanism. First, the participation mechanism explains how the individuals joined the CMO. Second, the choice mechanism explains which unit the individual would join. Third, the inviting mechanism explains when two individuals would invite the same one.

Although the current model performed well in our dataset, there are a number of interesting future research topics based on our research. First, time is critical for the CMO. How to simulate the growth speed is another topic we should focus on. Second, our model assumes that supporters have no overlap with inviting persons, which is different from the real world. The mechanisms study in this paper is a first step for an in-depth understanding of the CMO mobilizing process. A number of other unique characteristics of CMO mobilizing process and other behaviors also need to be studied, and will be our future research.

ACKNOWLEDGE: The authors would like to thank Dr. Wenli Liu, and Qingpeng Zhang for their help in this research. This work is partly supported by Hunan Provincial Innovation Foundation for Postgraduate, the National Natural Science Foundation of China though grants No. 91024006, No. 61201328, and the Early Career Development Award of SKLMCCS.

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