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Social network developing process driven by conflict in mass contingency events

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Abstract

Two evolutionary mechanisms of mass contingency events are discussed, which are the cognition structure and the social network structure of the vulnerable groups and also the important problem in public security engineering of developing country. The paper analyzes the developing process of social network driven by conflict. Because the abundant participants share the expensive protest cost, the opinion leaders or sponsors organize the social network in the vulnerable group to maintain their legitimate rights and interests. The theoretical research shows that the protest strategy is feasible as soon as the social network reaches the minimal numbers. The CHAM strike event in 2010 provides an excellent case to explain the three-phase developing process of mass contingency events and the hiberarchy social network driven by the conflict. Lastly, it makes the simulation analysis about the social network of the CHAM strike under the Netlogo platform, where the simulating result is in accordance with the theoretical analysis.

Keywords: mass contingency event; social network analysis; conflict driven; simulation; security engineering

1. Introduction

Mass contingency events is referring to the sudden happening events caused by the contradictions among the people seriously and threatened government management, social order and basic value, where the involving masses varied from tens to thousands, and are organized with some intention, so the clustering masses take the protest behaviors including to blockade or attack state organs, to present a petition with sit-down, traffic congestion, to organize meeting, to gather a crowd and make disturbances, to appeal for help with a big community, and so on [1]. The problem of mass contingency events has played very important role in public security engineering. The relative researches in the developed countries named this problem as “social crisis management”, but there have the larger scope including political convulsion, terrorist attack, besides the contradictions among the people.

After the affair of “911” and SARS crisis in 2003, on one hand, the theoretical researches about mass contingency events apply the interdisciplinary methods including decision-making theory, cognitive dissonance theory, social conflict theory, social risk theory and collective action theory, to build the theoretical model, make the quantitative research and social simulation. For example, Pinker builds the optimal model including early-warning information and resource allocation, when the timing and location of terrorist attack are uncertainty [2]. Zhuang Jun researches the common defense of terrorist attack and natural disaster through the endogenous game model [3]. Fan

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Zemeng and Niu Wenyuan build the control mechanism model of social system stability using the social burning theory [4]. Liu Dehai discusses the information diffusing model of mass emergency using the evolutionary game theory [5]. On the other hand, the emergency management researches put more emphasis on the cooperation between the scholars and the practical departments. The application researches at the level of operation and technology begin to aim at some practical problems such as crisis control approaches, information-based management, emergency system design and building [6, 7]. As a whole, the existing literatures about mass contingency events research the event's characteristics including behavior, information and social structure using the theories of psychological cognation, game theory, information management, and so on. From the viewpoint of game theory, there have two research ideas to explain the developing process of mass contingency events: one is the cognition structure of the vulnerable group [5, 7, 8]; the other is the social network structure of the vulnerable group. But, there is scarce literatures discussed the social network structure of mass contingency events from the viewpoint of Social Network Analysis (SNA).

Since the 1990's, complex network becomes one of hot topics, such as the famous small-world network and scale-free network. Watts and Strogatz construct the small-world WS model through reconnected the original edges in the regular network at a certain probability p [9]; Barabasi and Albert construct the scale-free BA model according with the growth and preferential attachment, where the degree distribution $P(k)$ in these networks decays as a power law, follows $P(k) \sim k^{-\gamma}$ for large k [10]. Barthélemy defines the hierarchical network based the index of clustering-degree correlations [11]. Girvan and Newman put forward the GN algorithm to detect the community structure of network through gradually deleting the edges with the maximum centrality indices [12]. Lubos Buzna builds the disaster diffusing model under the complex network, which the disaster is defined as the external extreme event or internal continuous disturbances [13]. Zachary analyzes a real-world case of social network evolution driven by the conflict target between members, which a Japanese Wushu club divided into two subgroups because of the idea conflict between president and training officer [14]. Generally, the existing literatures on the conflict mechanism of mass contingency events are very few, especially from the viewpoint of social network.

In this paper, we analyze the developing process of social network driven by the conflict in mass contingency events to maintain legal rights. In second section, we build the static and dynamic game models to reveal the evolutionary mechanism of mass contingency events considering the cognitive structure of the vulnerable group. In third section, we theoretically analyze the developing course of social network driven by the conflict in mass contingency events, discuss the case of the CHAM strike in 2010, and then make the simulation analysis on the platform of NetLogo. The fourth section is conclusion.

2. Game models of mass contingency event

2.1. Hawk-Dove game model of mass contingency events

Supposed there have the scarce social resources competed between the dominant group i and the vulnerable group j, which the value of social resources is V. If the dominant group i takes the toughness strategy T and the vulnerable group j takes the concession strategy B, the dominant group i should obtain all of resources V, and vice versa. If both of sides take the cooperative strategy, the dominant group i should get the greater sharing proportion in the total social resources, $V/2 < a < V$. If both sides take the toughness or protest strategy, the outcome of game is losses for all competitors, where the protest cost is defined as C, $C > V$.

Tab. 1. Hawk-Dove static game model of mass contingency events

		Vulnerable group j	
		Concession B	Protest P
Dominant group i	Cooperation C	a, V-a	0, V
	Toughness T	V, 0	a-C, V- a- C

The above static game model of mass contingency events is the famous Hawk-Dove game (see to Table 1), where

the Evolutionary Stable Strategy (ESS) is the mixed strategies Nash equilibrium.

Considering the asymmetry of capacity for action between the dominant group and the vulnerable group, the dominant group possesses the pioneer advantage because of the extensive social relationship. So the former static game model is changed into the dynamic game as Figure 1, where the only Sub-game Perfect Equilibrium (SPE) is {Toughness, Concession}, and the evolutionary path of mass contingency events {Toughness, Protest} is in out of sub-game perfect equilibrium. Obviously, under the framework of traditional game theory with perfect rationality, the phenomenon of mass contingency events with the irrational behavior couldn't be explained.

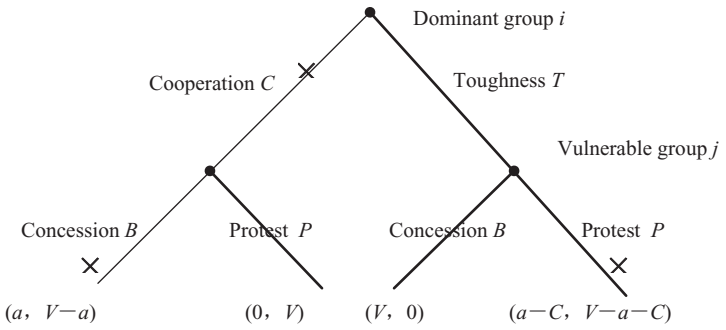

Fig. 1. Dynamic game model of mass contingency events

2.2. Cognition structure of vulnerable group in mass contingency events

Many results about experience games, for example, finitely repeated Prisoner Dilemma game and ultimatum game, reveal the real-world human behaviors, which include the bounded rational behavior and irrational behavior. Bethwaite and Tompkinson put forward the non-selfish utility functions according to the outcome of the ultimatum game [15]. Further, Liu Dehai puts forward the vulnerable group's utility function considering the equity factor in the mass contingency events as following [8, 16]:

$$u_j = p_j + \beta_j (p_j - p_i) \quad (1)$$

where p_j is the absolute income of the vulnerable group that is the payoff in the dynamic game model (seen to Figure 1); $\beta_j (p_j - p_i)$ is the relative income of the vulnerable group; β_j is the coefficient of relative income which reflects the sensitive degree of the vulnerable group for the income gap.

Considering the equity factor in the utility function (1), the utility of vulnerable group j taken the protest strategy P may be larger than the concession strategy B:

$$u_j (P, T) > u_j (B, T) \text{ , where } u_j (P, T) = V - a - C + \beta_j (V - 2a),\ u_j (B, T) = -\beta_j V \quad (2)$$

So we get the critical condition that the vulnerable group j takes the protest strategy P, i.e. the mass contingency event breaks out:

$$\beta_j > (a + C - V) / 2(V - a) \quad (3)$$

Obviously, when the sharing social resources (V-a) of the vulnerable group j increases, the protest cost C declines, and the sensitive degree β_j of the vulnerable group increases, the vulnerable group will be more inclined to take the protest strategy P, that's to say, the mass contingency events should be break out in the larger probability.

3. Social network developing process driven by the conflict of mass contingency events

3.1. Theoretical model of social network developing process in mass contingency events

Besides the explanation of the cognizing structure in mass contingency events in the Second Section, there has the other evolutionary mechanism of mass contingency events from the viewpoint of social network. According to the definition of mass contingency events, the number of participating protest is varied from tens to thousands, and the protest behavior is organized with some intention. So the mass contingency events, especially the mass emergency to maintain legal rights, are not the so-called "the crowd" by Gustave Le Bon [17], which conceals some special social network structure.

As to the concrete analysis, the social network developing process driven by conflict in mass contingency events includes the follow three phases:

- Firstly, if the social resources could be fairly distributed between the vulnerable group and the dominant group, the vulnerable group should accept the distribution project.
- Secondly, when the vulnerable group faces the unfair distributing outcome, such as the dominant group grabs the most social resources V utilizing their pioneer advantage, some nongovernmental opinion leaders should take the protest behavior P to maitain their legitimate rights and interests. The dominant group possesses so extensive social capital as to take the toughness strategy T, when they face the protest action taken by a few opinion leaders.
- Thirdly, the opinion leaders have to arouse and organize the other masses to take part in the protest action. The social network of the vulnerable group driven by the conflict comes into being.

Supposed all of the members of the vulnerable group are N_s, where the members taken the concession strategy or opportunistic hitchhike behavior are ε, and the people taken the protest strategy are N. The more members participating protest action, the more probability to get the success. Let the successful probability p is proportion of members taken the pretest strategy accounted for the total members:

$$p = N / (N_s - \varepsilon) \tag{4}$$

When the nongovernmental opinion leader organizes an opportunistic member to take part in the social network and take the protest behavior, the organizing cost is defined as c. In the same time, the expensive protest cost C should be shared equally among all of protesting members. Because psychologists advice that the factors comparing each other in the same hiberarchy could not exceed to nine usually [18], we analyze the hiberarchy structure of social network, where every core member could only connect with up to the nine new members. Let the number of the new members connected with a core old member is n, i.e. the degree of points, where $n \leqslant 9$.

Considering the hiberarchy structure of social network, the utility function of the members taken the protest strategy is shown as following:

$$u_j = [N / (N_s - \varepsilon)](V - a) - C / N - nc \tag{5}$$

Comparing the utility function taken the protest strategy (5) with the utility function taken the concession strategy, i.e. zero, we can obtain the minimum members taken the protesting action in the vulnerable group to ensure success.

3.2. Case analysis of social network evolutionary mechanism in mass contingency events

In the May 17th 2010, a big strike broke out at Honda Auto Parts Manufacturing Co. Ltd. (CHAM) in Chinese Guangdong Province. This company mainly products the automobile gearbox, automobile engine and the relative component parts supplied for Guangqi Honda, Dongfeng Honda. The company was established in 2005, and has about1, 800 employees now.

The evolutionary course of the CHAM strike event experiences three phases:

- Firstly, there has the huge income gap between Chinese workers and Japanese workers. The total income of Chinese workers is 1510 RMB Yuan, where the obtainable wage is only 1211 RMB Yuan. However, the wage of Japanese workers is 50 thousand RMB Yuan [19]. Because of the wage gap between Chinese workers and Japanese workers is close to 50 times, the Chinese workers require remarkable increase their slender wage. In the afternoon of May 27th, Guangqi Honda and Dongfeng Honda have to cease product because of the labor-capital conflict in the CHAM.
- Secondly, the capital and the local labor union take the toughness countermeasures. For example, the capital rapidly retired the strike sponsors, the local labor union staffs of approximately 100 enclosed the strikers and beat their up in the afternoon of May 31th [20].
- Thirdly, the bodily conflict incident spurs the strikers much more determined, even if the strikers intended to

return to work tentatively. Now hundreds of workers take part in the strike, and they put forward three requirements: deal with the incident, further increase the wage 200-300 RMB Yuan, and rebuild the labor union. At last, the capital agreed to increase the wage of worker at the production line 611 RMB Yuan per month, which is increasing 32% than the former 1921 RMB Yuan. In the June 2nd, the company was restored to full working order [20].

Analyzed the case of CHAM strike, the sharing social resources of the strike workers is $V\text{-}a$ = 611 RMB Yuan, and the total employees could participate the strike is $N_s - \varepsilon$ = 1800. The protest costs undertaken by the strike sponsors include the retired loss and the cost of medical care caused by the blow. Supposed the strike sponsors may be waiting for employment in the next year, and the cost of medical care is 20,000 RMB Yuan, the total protest costs are shown as following:

$$C = 1510 \times 12 + 20000 = 38{,}120 \text{ RMB Yuan} \quad (6)$$

Put the above data into formula (5), and omitted the organizing cost c because of the voluntary behavior in the most of strikers, the minimum number of the striker workers ensured strike to succeed is:

$$N_{min} = 335 \quad (7)$$

3.3. Simulation analysis of social network evolutionary mechanism in mass contingency events

We make the simulation analysis of the CHAM strike event under the NetLogo platform (the simulating program is omitted), where the simulating result is shown in Figure 2. The impression drawing (a) shows the hiberarchy of the strikers' social network, where the most of members participating the protest action are the end points and only a few members become the core points. The total members in the social network are 335. The degree distribution of social network varies from 9 (there is only one point) to 131 (there are 131 points), which is approximately obeys the power law distribution.

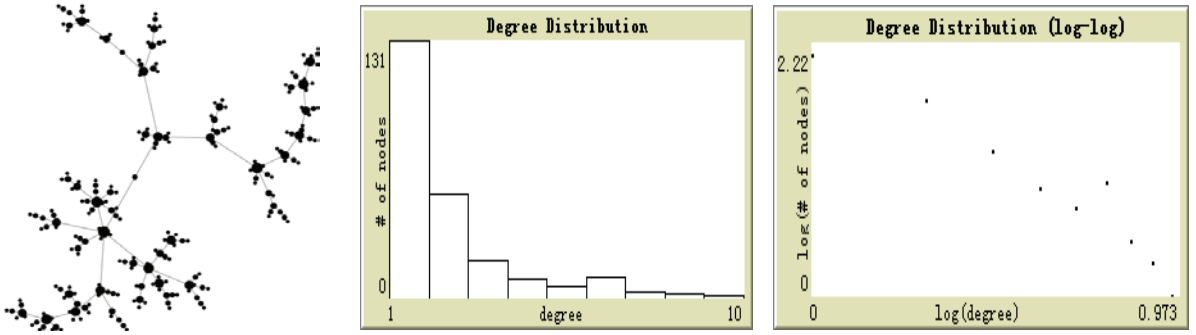

Fig. 2. (a) Hiberarchy of strikers' social network; (b) Degree distribution of social network; (c) Approximate power law distribution

4. Conclusion

The phenomenon of mass contingency events brings the huge challenge for the traditional management theory because of the irrational behavior and complex social network structure in the vulnerable group. This paper puts forward two evolutionary mechanisms of mass contingency events: firstly, considering the cognition structure of the vulnerable groups; secondly, considering the social network of the vulnerable groups. Because the abundant participants share the expensive protest cost, the protest action could succeed so long as there have the enough numbers of social network. The CHAM strike event in 2010 provides an excellent case to explain the three-phase evolutionary course of mass contingency events and the hiberarchy social network driven by the conflict. Considering the relative data of dynamics on social network is too scarce, we have to take the simulation analysis under the Netlogo platform, and the simulating result is in accordance with the theoretical analysis.

The paper discussed the social network developing process in mass contingency events to maintain legal rights, where the participant's behavior is in accordance with the rational hypothesis. For the mass contingency events to vent their resentment, the social network structure and behavior manner belong to the different types. Those problems should be further researched in the future.

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