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The downside of organizational social capital in group knowledge creation: A study of Chinese high-tech organizations

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This paper develops a measurement of organizational social capital by using three constructs - general trust, density of trust network and network structures. In the empirical testing of 67 separate groups, general trust had a very significant impact on group knowledge creation, while dense trust network had only indirect influence on a group's performance. One of the downsides of organizational social capital (OSC), fragmented structure caused by ganging-up, produced negative effects on general trust, and indirectly influenced knowledge creation, too. On the other hand, the other downside of OSC, the structure of power concentration, is not evidenced to be harmful for knowledge sharing and brainstorming.

Key words: Organizational social capital, network structure, group knowledge creation, trust, Chinese organizations.

INTRODUCTION

Guanxi (the Chinese term for relationship) has been viewed as the key to understand Chinese management (Tsui and Farh, 1997; Farh et al., 1998) and transactional behavior (Granovetter, 1985). In a company, good guanxi helps to control opportunistic behavior and encourages cooperation (Coleman, 1990; Adler and Kwon, 2002), so it is viewed as a positive factor influencing organizational behavior. Outside a company, guanxi helps to generate trust and trust in turn reduces transaction costs (Granovetter, 1985), thereby smoothing the transaction process. In addition, it is partly responsible for generating resources necessary for the survival and expansion of a firm (Lin, 2001; Bian, 2002). As a result, guanxi is seen as an important part of social capital in most of the literature pertaining to management and sociology. However, guanxi is sometimes considered to be a "bad" term in China, linked with privilege exchanges, under-the-table

negotiations and irrational economic behaviors. Why is there such a big difference in how guanxi is perceived in China versus the West? It is precisely this disparity that has led us to focus on the downside of social capital (Chen et al., 2004; Labianca et al., 1998).

Why does social capital at times turn out to be a negative factor in organizational behavior? This paper argues that the phenomenon of "ganging up" marks the point at which this positive force turns in negative. We first examine the positive correlation between organizational social capital and group knowledge creation.

Following this, we discuss the behavioral patterns that are characteristic of Chinese culture in the process of building guanxi, that is, ganging up and tying all personal interests to cliques. Two variables are proposed as part of our group level analysis to measure the downside of organizational social capital, the concentration of informal power and the fragmented structure caused by "ganging up". We find that this downside of social capital has a negative effect on general trust, and therefore indirectly impacts on group knowledge creation.

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LITERATURE REVIEW AND HYPOTHESES

Organizational social capital and group knowledge creation

Knowledge creation is now placed at the center of managerial studies, because knowledge is commonly viewed both as the engine for economic growth (Schumpeter, 1939; Solow, 1957) and as the basis of organizational success in the information society (Drucker, 1993; Senge, 1990). Since the formulation of human capital theory in the 1960s (Schultz, 1963; Becker, 1964), scholars have recognized that knowledge owned by individuals is crucial to organizational survival and development (Nordhaug, 1993). However, more recently, the focus has shifted to another kind of knowledge, possessed by a group, which is more than simply the aggregate of individual knowledge. Nahapiet and Ghoshal (1998: 245) have labeled this knowledge "intellectual capital," and it has also been referred to as "the knowledge and knowing capability of a social collectivity". Organizational learning, defined as a group's acquisition of knowledge, not only trains workers to gain individual human capital, but also provides the whole organization with a collective knowing capability, a capability that depends on the cooperative actions of workers (Senge, 1990).

Moran and Ghoshal (1996) suggested that the creation of new knowledge, whether in the form of improving on existing knowledge or obtaining new ideas and information, occurs by means of two generic processes - exchange and combination. Nahapiet and Ghoshal (1998) further proposed four conditions necessary for knowledge creation, one of which is related to individuals, namely the motivation to combine and exchange. The other three are basically social processes embedded in social relations, and include opportunities for combination or exchange, the chance to raise the expectations of the parties involved that value will be created in the exchange and the power of combination to link different individual's knowledge. Since knowledge creation is a social process, organizational social capital is thus brought in.

What is organizational social capital?

Leana and Van Buren (1999) coined the term "organizational social capital". They classified social capital as either "private good" or "public good." Private-good social capital brings resources to an individual through that person's social connections. Public-good social capital, on the other hand, belongs to a group and benefits the interests of the whole group. Leana and Van Buren (1999) termed public-good social capital in organizational settings "OSC".

The concept of public-good social capital began to gain currency in the field of sociology in the 1960s. It resulted

in the term "macro-level social capital," which was introduced by a sociologist named Brown (1997). In contrast to micro- and meso-level social capital, which highlight the importance of an individual's social connections and position in a social structure for accessing valuable resources, macro-level studies focus on mutual trust and dense associations in a group, whereby good-will in social interactions brings about cooperative actions beneficial to the whole group. Putnam (1993) found that a lack of macro-level social capital in some regions of Italy resulted in a lack of voluntary participation, which eventually caused the failure of democratic reform. In addition, Fukuyama (1997) argued that social capital in some societies such as America, Japan and Germany is conducive to the formation of large and durable economic organizations, which in turn help to develop modern capitalist economies.

In view of the fact that the conceptual development of organizational social capital is rooted in the notion of macro-level social capital, it is appropriate to review the most commonly cited definition of social capital as stated by Coleman (1990: 302): social capital is defined by its function. It is not a single entity, but a variety of different entities having two characteristics in common: They all consist of some aspect of a social structure and they facilitate certain actions of individuals who are within the structure.

Thus, social capital consists of two characteristics: social relations having certain characteristics, and the resulting cooperative actions that bring resources in. Building on Coleman's definition, this paper defines the concept of organizational social capital (OSC) as follows: "organizational social capital is a kind of social capital found in organizational settings. It is related to certain characteristics of social structure of an organization and eventually brings about results beneficial to the collective."

In the 1990s, this sociological concept was extended to the area of organizational studies. Adler and Kwon (2002) also distinguished internal from external social capital. Internal OSC is based on the internal relations of the group and advances the collective interest of the group, while external OSC is built from external relations accessing to outside resources. Nahapiet and Ghoshal (1998) developed a more complete description of the concept involving three dimensions of social capital in organizations - relational, structural and cognitive dimensions and also found it useful to improve organizational learning theoretically.

A series of empirical studies then followed their work. One of these studies, conducted by Tsai and Ghoshal (1998), developed ways to measure the abstract concept of external OSC and confirmed its effects on group innovative ability. Pennings et al. (1998) proved that OSC helped decrease organizational dissolution rates.

However, in the short history of empirical studies on this topic, various measurements can be found in

different articles. This leads us to define the parameters of the term first.

The conceptual parameters of organizational social capital (OSC)

To define the operational definition of OSC, we must first consider how to construct OSC conceptually. There are two elements of social capital in Coleman's definition, the first of which he refers to as "some characteristics" of the social structure. This social structure can be a social tie or a group of relations, which acts as the carrier of this characteristic. The second element in Coleman's definition is the cooperative actions and resources generated by this characteristic of social structure.

General trust

The first characteristic of social structure affecting organizational social capital and the one most often examined in sociological studies of an empirical nature on macro-level social capital, is general trust. This form of trust can be defined as the "expectation of persistence and fulfillment of the natural and the moral orders" (Barber, 1983). Coleman's three forms of macro-level social capital—norms, appropriable social organizations and intentional organizations, can be viewed as providing a theoretical basis for the notion of general trust. While norms are parts of moral orders—the foundation of general trust, such trust also depends on regulations and enforcement by an authority structure, that is, organizations, in order to function well. Therefore, Coleman's argument requires that we consider both the informal institutional and the organizational factors that contribute to the formation of general trust. The creation of group knowledge requires a group of persons with social relations who show goodwill toward other group members and are willing to share information and knowledge. These trust relations eventually facilitate the cooperative actions that make exchange and combination possible. On the basis of these arguments, we have formulated the following hypothesis:

H₁: A group with a high level of general trust will show strong performance in knowledge creation.

Particularistic trust and trust networks

Particularistic trust is the second characteristic of social structure tied to organizational social capital (Luo, 2005). It may be defined as trust generated by dyadic relationships, and thus differs from general trust, which is based on institutions and norms. Most scholars agree that Chinese culture is relationship-oriented (Ho, 1993), and

that consequently, dyadic relationships provide a stronger motivation to share than general trust. As a result, public-good social capital in Chinese organizations is based primarily on a dense network of dyadic relationships. The greater the density of trust relationships, the more sharing there will be among members of an organization. When many individuals in a group have a high degree of trust relationship with one another, it may be said that the group is characterized by a dense trust network (Cook, 2004). Given the importance of dyadic relationships to Chinese organizations, particularistic trust should constitute the main focus in Chinese management studies (Luo, 2005).

Some scholars see dense relationships as significantly facilitating exchange. For example, the research of Sparrowe et al. (2001) deployed a whole-network questionnaire to survey 38 groups in several organizational settings. They were mainly concerned with the correlation of group density and degree of advice network centralization on a group's performance. Regarding the first concern, network density is understood as the mean of network ties possessed by each member, but it has no significant impact on performance in their empirical test.

Reagans and Zuckerman (2001) used second-hand data from 224 groups to test the relationship between group density and group performance. Their hypothesis was supported by the data, thus establishing group density as a significant factor. Inquiring into the same subject, Krackhardt (1996) designed an experiment to simulate the social process of diffusion. However, contrary to traditional viewpoints, Krackhardt demonstrated that very tight or loose social networks are not necessarily effective in diffusing new knowledge. A curve-linear relationship between group density and group performance is thus hypothesized. A tight network makes the small number of innovation adopters influenced by the majority of non-adopters. A very loose network provides too few interactive opportunities to diffuse new innovations.

In this study, most of the groups involved were small and knowledge creation was a central part of their mission. Since it is not necessary to have a comparatively isolated environment in order to foster an innovative idea for the small number of innovation adopters, a linear relationship between group density and knowledge diffusion is hypothesized, rather than one characterized by curve-linearity. Knowledge diffusion is crucial to the exchange process in knowledge creation, so we therefore posit our second hypothesis:

H_{2a}: A group with high-density trust network will show a strong performance in knowledge creation.

One's experience in dyadic relations should generalize to people in general. Successful accumulation of experiences of trustworthy interactions in dyadic relations raises his or her confidence in the return of goodwill by

others in general. The density of a person's trust relations gives him (or her) access to critical help and reduces uncertainty within the working environment, which has the effect of encouraging a general tendency to trust others. When many members of a group have dense trust relations, it raises the average level of general trust for the group as a whole. The hypothesis thus follows:

H_{2b}: A group with high-density trust network will show a high level of general trust.

The down side of organizational social capital

The third characteristic of social structure influencing OSC is network structure, which has been termed "structural configuration" by Nahapiet and Ghoshal (1998). Some types of network structure are beneficial to information sharing and brain storming, while others are not. The question post challenge to us is what these unbeneficial structures are.

Social capital theory generally states the bright side of social ties, but the term "guanxi" can evoke negative associations for many Chinese. This leads us to ask whether or not there is a difference between the Chinese term "guanxi" and the concept of social ties. In my viewpoint, there are a number of distinctions between the terms, but two are particularly important. First, unlike social ties, guanxi is not a unified concept for Chinese. There are at least three types of guanxi - weak ties, familiar ties and familial ties (Hwang, 1987; Luo, 2005). Different behavioral and moral standards are applied for each of these different guanxi, in what sociologist Fei (1948) called a "framework of differential order" (in Chinese, *cha xu ge ju*). Secondly, there is a special type of guanxi named after the "familiar tie" (Hwang, 1987), which forms the most important part of a Chinese ego-centered social network. Sometimes when Chinese person use the general term "guanxi", they mean only this category, so we can take it as narrowly defined "guanxi" (Yang, 1994; Chen et al., 2004).

In weak ties, or instrumental exchange relations, trust can be bred from trustworthy behaviors in repeated exchanges based on mutual self-interest (Hardin, 2001). In other words, trust is the result of fair exchanges, in which both sides demonstrate honest, consistent and competent behavior, and this makes it possible to continue the exchange relationship (Mishra, 1996). Hwang calls this "the rule of equity," and it represents the behavioral standard for weak ties. However, trust based on weak ties is insufficient for obtaining certain valuable resources in Chinese society, such as gaining introduction to a key person, passing on vital information, cutting a risky deal, and so on. That is why Chinese often work to shift reliable and frequent exchange relations into the category of familiar ties. Familiar ties are the key to obtaining important resources through economic

transactions for Chinese, especially since they are strong enough to be a bridge to other guanxi for the focal actor. Building an ego-centered network of familiar ties is the key to establishing a successful career.

Familiar ties in Chinese society are not the same as the "strong ties" of Western society, since the moral standards that Chinese apply to familiar ties differ from those pertaining to weak ties, whereas in a Western context they are the same. Rather, familiar ties operate according to "the rule of favor exchange" (Hwang, 1987; Luo, 2005). The distinction between strong and weak ties in Western society can be measured by four factors - duration, interaction frequency, intimacy and reciprocity. The higher a relationship scores in these four areas, the stronger it is. To put this in another way, we may say that "friendship" is the main factor distinguishing strong ties from weak ties. In this sense, familiar ties are like strong ties, since they involve intimacy and emotional support. However, Chinese particularistic thinking introduces a different dynamic into these relationships. In universalistic societies, an actor will not operate by a different moral code according to tie strength, but in Chinese society, "the rule of favor exchange" that guides familiar ties introduces a kind of quasi-collective behavior not true of weak ties. That is, members of such a group tend to imitate family ties by meeting each other's needs without asking anything in return, yet unlike family ties, both parties understand that repayment is required. This sort of brotherhood ethic is called "Yi," and was a moral code highly appreciated by the Confucian literati of traditional China. Thus, "the rule of favor exchange" helps to balance both collective and particularistic concerns (Hwang, 1987). For this reason, it is called the art of *quanxi*, or "*quanxi xue*" (Yang, 1994).

Bringing valuable exchange relations into an inner circle of familiar ties is a central part of Chinese culture. This dynamic can enhance organizational social capital by strengthening the trust among firm employees. However, once certain colleagues become associated as a network of familiar ties, different moral standards apply. Though the skillful use of favor exchanges is not harmful to the larger group, illegal use of favor exchanges to benefit one's inner circle may ruin procedural justice (Chen et al., 2004). In addition, a small group bound by familiar ties may block the flow of information and resources to benefit itself and thereby decrease working efficiency. Phenomena such as these reveal the downside of organizational social capital.

The formation of gangs

As argued previously, bringing friendship into instrumental exchange relations signals the establishing of familiar ties. Therefore, the formation of disconnected friendship cliques has the effect of creating small groups of people who treat "insiders" differently. Closure and procedural

injustice begin from this point (Chen et al., 2004).

The concept of “gangs” can be defined as “tightly closed cliques of friendship networks where resource flows are kept within the boundaries of the group.” In Chinese society, if there is commonly a wide disparity between how insiders and outsiders are treated in an organization, then individual cliques within the organization tend to develop a strong sense of “we-group” and tend to vigorously protect the interests of the group, such as struggling to gain higher positions for group members, keeping key resources within the group, and so on. If a department or project team contains only one gang, then power usually concentrates in the hands of the gang members. The negative effects of this concentration of power are considerable, not least of which is that non-gang members lose their motivation to contribute to the group. The situation is even worse, though, when there are more than two gangs in a group, since then conflict is practically inevitable. A member of one gang may feel ashamed to ask advice from another gang because of the importance of “keeping the face of we-group.” Given such a mentality, in an organization with many gangs, knowledge sharing and advice consulting generally stop at the boundaries of the gangs.

Two main indicators point to the emergence of this downside: one is the concentration of informal power in a small group of people; the other is the fragmented structure caused by “ganging-up.”

The concentration of informal power in a small group

Since a clique is bound together tightly by familiar ties, it naturally becomes the dominant force in a group, and excludes the participation of outsiders. Thus, informal power centralizes in the hands of the small group of people. Based on the studies of communication patterns and group performance in the 1950s (Shaw, 1964), Sparrowe et al. (2001) argued that group centrality is negatively correlated to team performance. As they defined it, group centrality consists of the variation in number of connections held by individual group members. High group centrality indicates that a small minority of the members has relationships with most of the group, while the majority has relatively little interaction with one another. This type of structure is a barrier to knowledge exchange, since a centralized group makes members dependent on the central figures, whereas a decentralized network makes group members dependent on one another. This provides us with a third hypothesis:

H_{3a}: A group with a high level of informal power concentration will show weak performance in knowledge creation.

As Molm (1994) has argued, interdependence encourages cooperation, which in turn improves mutual trust. But power concentration reduces the degree of

interdependence, and one more hypothesis follows:

H_{3b}: A group with a high level of informal power concentration will reduce the general trust.

The fragmented structure caused by ganging-up

The formation of gangs is damaging to group knowledge creation in both direct and indirect ways. Both ways stem from the fragmented structure produced by the process of gang formation. Once certain members of a department, or project team, form gangs, other members may be excluded from these active “cores.” In the cliques based on familiar ties, people treat each according to the rule of favor exchange, but outsiders are denied such warm treatment.

As with friendship networks, the formation of gangs limits the opportunities that members have to build up a broader range of trust relationships, while at the same time isolating outsiders. These negative effects are exacerbated when there are conflicts among several gangs within an organization. Self-protection and an irrational struggle for resources make it difficult for gang members to cooperate with outsiders. Therefore, outsiders often feel isolated and unable to contribute their ideas. If these members lose the motivation to join in and contribute to the group, then the process of knowledge exchange and brainstorming will be negatively affected. This leads to a fourth hypothesis:

H_{4a}: A group containing fragmented structure caused by ganging-up will show poor performance in knowledge creation.

The indirect negative effects of gangs on knowledge creation are caused by the damage they do to mutual trust. As suggested by “the strength of strong ties” theory (Krackhardt, 1992; Uzzi, 1996), friendship constitutes the primary basis of dyadic trust. The structural factor of friendship networks has been shown to be influential in building up particularistic trust in Chinese organizations (Luo, 2005). The formation of friendship cliques undermines mutual trust in two ways. First, insiders in a clique tend to associate and enter into exchanges only with other clique members, so the scope of their friendships is narrow, thus reducing their opportunities for building up general trust. Second, outsiders will tend to lose organizational commitment and feel frustrated by their lack of access to closed cliques, resulting in fewer social connections and more limited mutual trust. Thus, the climate within a group containing gangs is characterized by suspicion, making it even more difficult people within the organization to develop mutual trust. Consequently, general trust is reduced:

H_{4b}: A group containing fragmented structure will reduce general trust.

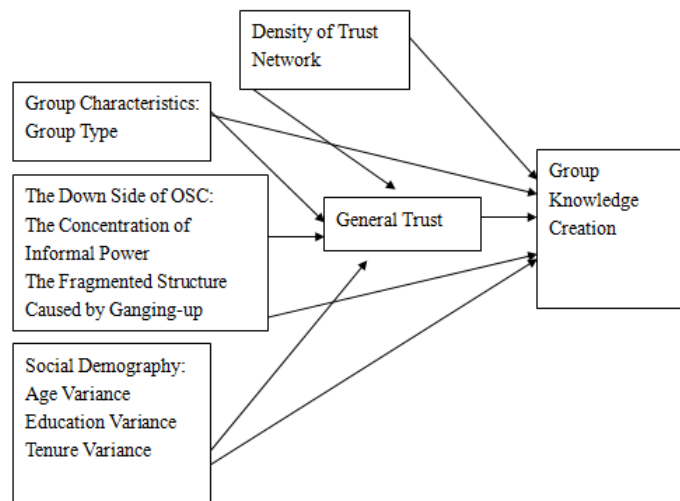


Figure 1. The theoretical framework of group knowledge creation.

Controls

Given that group knowledge creation is a social process, group factors have been used to analyze it. Commonly, group size, the task of a group and R&D experience are mentioned in the studies of innovation performance (Reagans and Zuckerman, 2001; Ancona and Caldwell, 1992).

Among group factors, though, social demography is undoubtedly the most important (Tsui and Farh, 1997). Bantel and Jackson (1989) found that variations in age, sex, and education affected technological and administrative innovation in 199 banks. Simons (1995) studied 57 groups in high-tech industries and found that the variations in educational background influenced group performance. Zenger and Lawrence (1989) confirmed that the combination of different age groups influences the efficiency of communication, indirectly impacting the exchange processes. Reagans and Zuckerman (2001) pointed out that departmental and tenure variation is significantly related to the performance of knowledge management.

However, the question of whether variation is good or bad for exchange and combination processes is still disputed. Pfeffer (1983) posited that homogeneity of a group helps the group members to communicate with each other. O'Reilly et al. (1989), following the same line of reasoning, argued that lack of variation positively influences the integration of a group. In other words, variation hinders mutual communication in exchange processes and raises the possibility of conflict in brainstorming processes. According to these arguments, social differences exert a negative influence on the internal connections of a group, and indirectly reduce group performance in knowledge creation.

Ancona and Caldwell (1992) on the other hand, proposed an opposite view that social variation can bring

different perspectives into the brainstorming process, thus sparking the invention of new ideas. A great innovation often results from the combining of different lines of thinking. Exchange of homogenous ideas may not be conducive to stimulating new thinking. Baker (1992) suggested that creating a pool that allows for the exchange of different ways of thinking is the best way to manage innovation. Reagans and Zuckerman (2001) reached the same conclusion from a different angle. They argued that variation in a group helps it to access different outside resources, so that various types of information can be brought into the group. These arguments suggested that social variance is a direct and positive factor for group knowledge creation. Summary from the afore-stated hypotheses and group factors is presented in a theoretical framework of group knowledge creation as shown in Figure 1.

MATERIALS AND METHODS

Data collection

The data used for this study was collected from both Taiwanese and Mainland Chinese organizational settings. We distributed 1012 questionnaires to 95 groups. These 95 groups were conveniently sampled, and scattered among 11 organizations. Most of these organizations can be classified as high-tech firms or research institutes, including for instance TSMC, BenQ, an IBM agent in Taiwan and Industrial Technology Research Institute. Given that we needed to collect whole-network data to compute the influence of structural factors, any group with more than 20% of the data missing was automatically excluded. In the end, we received valid data from a total of 82 groups representing some 876 persons. The return rate was 86.5%. 15 groups were eventually excluded, since their network size was too small to form a meaningful network structure. A total of 67 groups were included in our analysis.

For the questionnaire design, we drew on existing questions from other sources, including Cummings and Bromiley (1996) survey on trust inventory, Krackhardt's whole-network questionnaire about

consultative and information networks (Krackhardt 1992; Krackhardt and Hanson 1993), Mishra (1996) inquiry on trustworthiness and a survey on team outcome made by Denison et al. (1996). After this, 60 employees from a Mainland Chinese firm were selected to conduct the pretest in August of 2002. After several cycles of factor analysis, the questionnaire was shortened to contain 6 questions on general trust, eight whole-network questions related to particularistic trust and network structure (four trust questions, three friendship questions and one resource-exchange question) (Table 1), and six questions designed to evaluate performance in the area of group knowledge creation. Then, three assistants were asked to survey 95 groups directly, rather than by mail, in order to achieve a return rate of 80% for each group. We found that having social relationships with group supervisors was the key to successfully conducting a survey. It was necessary to establish a connection first before a given group agreed to participate in the study.

Measurement of variables

Density of trust network

The questions related to trust networks are based on Mishra (1996) four dimensions of trustworthiness: (a) competent, (b) open, (c) concerned and (d) reliable". We replaced the competence question with the statement "overall, I think I trust him/her," since the factor loading of the former was too low. These questions were all in whole-network format, so the resulting data provided a basis for analyzing four trust networks.

We first computed the network density for every trust question. In the end, the average of the four indexes was used to form a single indicator of the density of trust networks.

General trust

Six seven-point Likert scale questions adopted from Cummings and Bromiley's trust inventory were used to analyze the variable of general trust. These six questions were included in a confirmatory factor analysis.

The results showed that composite reliability of general trust was as high as 0.94. We then averaged the six general trust questions to obtain a single index.

The down side of organizational social capital (OSC)

The concentration of informal power

Informal power concentration was represented by the average group centrality of the three friendship networks (Table 1). According to Freeman (1979), group centrality measures the average power difference between general members and the most powerful person. The greater is the value, the higher is the concentration of power. Then, the three indexes of group centrality were averaged together.

The fragmented structure caused by ganging-up

We used the number of isolated members outside the gangs in a group as an indicator of fragmented structure. Since the establishing of friendship cliques is the first step in gang formation, finding the cliques in a network is an important step to identifying isolated members. Two questions were drawn; one was the largest

factor-loading item from among the three friendship questions, while the other item represents resource exchange. The number of isolated members was calculated by first keeping the strong ties and erasing the weak ties in the friendship network. Strong ties were defined simply as a mutual recognition of friendship by both sides (Granovetter, 1973). It is reasonable to assume that members in a friendship clique will have strong connections among one another. Therefore, we computed the components with more than three nodes within this strong-tie friendship network (Wasserman and Faust, 1994). By the same token, we also computed the components having more than three nodes within the resource-exchange network. The overlapping portions of both friendship and resource-exchange networks were identified as gangs. The number of nodes not in any gang was taken to be isolated members. However, we realized that the size of a department might influence the number of isolated members in it; that is, larger networks will tend to have more isolated members. Therefore, to correct for the bias caused by network size, we calculated the ratios of isolated members to network size to use as our indicator of fragmented structure.

Group knowledge creation

Denison et al.'s (1996) study on the dynamics of cross-functional teams identified three main concerns with teams: context, process and outcome. In the domain of outcome, they designed 25 questions that could be classified into seven categories. Most of these questions were related to group member development and group efficiency, but eight questions in the two categories of information creation and capability development were related to group knowledge creation. We made slight modifications to these seven-point Likert questions and selected six out of eight as our indicators. This measurement is not an indicator of innovation like the number of patents, but rather a measure of the improvement of existing knowledge.

These questions were not distributed to group members, but to the direct supervisors of these groups. For each group, at least three supervisors were asked to evaluate the performance of group knowledge creation, but some were not returned. Finally, we took the aggregate of the six questions and averaged in the evaluations to obtain a single index of performance for each group.

Controls

Four controls were included in the explanatory model - group type, age variance, tenure variance and education variance. Concerning group type, "0" indicated administrative or engineering departments and "1" R&D teams. Age, tenure and education were all measured by years. Following Allison (1978) and Pfeffer and O'reilly (1987), we computed the variance of age, tenure and education by the CV method, namely the standard deviation over the mean.

Reliability and validity

According to research by Bagozzi and Yi (1988), composite reliability should reach over 0.6 in order to claim internal consistency. In the present study, the reliabilities for the constructs' measurements are all over 0.76. As a result, we concluded that these constructs have high internal consistency. For more information about these reliability analysis results, please refer to Table 1. We conducted the following confirmatory factor analysis to demonstrate both the construct validity and the convergent validity of the questionnaires used in the present study. As reported in Table 1, both construct validity and convergent validity were satisfactory.

Table 1. The questions of variables and their confirmatory factor analysis.

Construct	Item content	Loading	Goodness of fit	Composite reliability
Group knowledge creation	The team/department keeps getting more effective all the time.	0.89***	$\chi^2=42.21,$ ($P < 0.001$) DF=9, GFI=0.98, AGFI=0.88, CFI= 0.99	0.90
	A lot of learning went on in the team/department.	0.86***		
	People in the team/department share their special knowledge and expertise with each other.	0.82***		
	Now that the team/department has worked together for a while, its capacity to do work has improved.	0.82***		
	The team/department developed many new ways to look at our task and took an innovative approach to solving the problem.	0.69***		
	The team/department made major innovations along the way.	0.52***		
General trust	I think that my company encourages me to speak openly and talk freely	0.93***	$\chi^2=19.47,$ ($P < 0.021$) DF=9, GFI= 0.92, AGFI=0.82, CFI= 0.97	0.94
	I think that my decisions in my work are often respected by my company.	0.92***		
	I think that my leader will clearly explain the firm's decisions to me and make me satisfied.	0.91***		
	I think that I will get advanced notice before any changes about my job.	0.89***		
	I think that my leader is honest.	0.85***		
	I think that my company takes its employees' opinions seriously.	0.81***		
Density of trust network (computing density)	Overall, I think I trust him/her.	0.93***	$\chi^2=5.15,$ ($P < 0.076$) DF=2, GFI=0.96, AGFI=0.84, CFI=0.99	0.94
	I think that he/she is concerned about my interests.	0.93***		
	I think that his/her behavior is stable	0.92***		
	I think that he/she is honest.	0.91***		
The concentration of informal power (computing group centrality)	Please identify the three or more people you are most familiar with.	0.84***	$\chi^2=0$ ($P < 0.001$) DF=0, GFI=1.00, CFI=1.00	0.76
	Who would chat about their personal affairs with you?	0.75***		
	If feeling frustrated or getting bossed around by superiors, to whom would you air your complaints?	0.53***		

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

RESULTS

Correlation analysis

Correlation analysis found that group knowledge creation was negatively related to age variance. In other words, significant age differences might negatively influence the capacity for group know-

ledge creation. Both density of trust network and general trust were positively correlated to group knowledge creation. It seemed that these two OSC variables were positive factors. Density of trust network was highly correlated to general trust, but was negatively associated with the fragmented structure, as it was with the indexes of age and tenure variance. R&D teams had a higher

density of trust networks. The indicator of the fragmented structure was negatively correlated in relation to general trust, but R&D teams were positively correlated to general trust.

Regression results

As shown in Table 3, H_1 was confirmed, thereby

Table 2. The correlation table (N = 67).

Correlation	1	2	3	4	5	6	7	8
1. Group type								
2. Age CV	-0.39**							
3. Tenure CV	-0.16	0.37**						
4. Education CV	0.40**	-0.22+	0.00					
5. The fragmented structure	-0.32**	-0.04	0.12	0.05				
6. The concentration of informal power	0.21+	-0.33**	-0.16	-0.09	0.04			
7. General trust	0.24+	-0.08	0.19	-0.22+	-0.39**	0.12		
8. The density of trust network	0.58***	-0.39*	-0.24*	0.26*	-0.34**	0.14	0.34**	
9. Group knowledge creation	0.20	-0.21+	0.08	-0.15	-0.19	0.15	0.58***	0.33**

+ p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 3. Block regression analysis for group knowledge creation.

Variable	Group knowledge creation			
	M1	M2	M3	M4
Control variable				
1. Group Type	0.26 ⁺	0.18	0.10	0.00
2. Age CV	-0.26 ⁺	-0.28 ⁺	-0.21	-0.15
3. Tenure CV	0.22 ⁺	0.24 ⁺	0.26 ⁺	0.09
4. Education CV	-0.32*	-0.28*	-0.33*	-0.12
≥R ²	0.17*	0.17*	0.17*	0.17*
The down side of OSC				
1. The fragmented structure		-0.16		0.04
2. The Concentration of informal power		0.05		0.03
≥R ²		0.02		0.05
Trust				
1. The density of trust network			0.33*	0.16
2. General trust				0.48**
R ²			0.07*	0.17**
Overall R ²	0.17*	0.19*	0.24**	0.39**
N	67	67	67	67

+ p<0.1, *p<0.05, **p<0.01, ***p<0.001(all t-test are two-tailed).

demonstrating that general trust encouraged more interaction and sharing and made it easier for group members to openly express opinions when brainstorming. H_{2a} failed to pass the test, since density of trust network showed no significant direct impact on group knowledge creation. The density of trust networks was significantly correlated to both knowledge creation and general trust and showed a significant impact on knowledge creation in the model without controlling for general trust (Model 3, Table 2). However, after controlling for general trust, this effect disappeared. We therefore doubt that general trust is an important factor in mediating the impact of trust network density on group knowledge creation.

In the regression model of general trust (Table 4), its effect on general trust was significant. Therefore, H_{2b} can be confirmed. General trust indeed is a mediator between the density of trust networks and group knowledge creation.

The concentration of informal power, which we measured by group centrality within friendship networks, was not found to have a marked negative effect on knowledge creation, thus disconfirming H_{3a}. It did not exert indirect effects, either. The concentration of informal power produced a weak impact on general trust, which is the only and extremely significant factor affecting group knowledge creation. H_{3b} was disconfirmed.

Though the fragmented structure hindered the process

Table 4. Block regression analysis for general trust.

Variable	General trust		
	M1	M2	M3
Control variable			
1.Group type	0.40**	0.24 ⁺	0.12
2.Age CV	-0.13	-0.19	-0.13
3.Tenure CV	0.30**	0.34**	0.37**
4.Education CV	-0.41**	-0.34**	-0.33**
≥R ²	0.26**	0.26**	0.26**
The Down side of OSC			
1. The fragmented structure		-0.34**	-0.28*
2. The concentration of informal power		0.04	0.04
≥R ²		0.10*	0.10*
The density of trust network			0.30*
≥R ²			0.05*
Overall R ²	0.26**	0.35***	0.44***
N	67	67	67

+ p<0.1, *p<0.05, **p<0.01, ***p<0.00 (all t-test are two-tailed).

of communication and sharing, these effects were relatively indirect. In the Models 2 and 4 of Table 3, it was found that the fragmented structure exerted no direct influence on knowledge creation. H_{4a} found no support in our evidence. But this variable also negatively influenced general trust (Models 2 and 3 in Table 4), suggesting that distrust among isolated members and gangs hindered the social process of knowledge creation. H_{4b} was confirmed, and the indirect effect of fragmented structure was evident.

DISCUSSION

There is a broad consensus on the importance of social capital to the social process of innovation, but conceptions of OSC still vary considerably. Sometimes, it is defined as what Adler and Kwon (2002) have called external social capital. For example, Tsai and Ghoshal (1998) demonstrated the importance of a business unit's external consultative ties and trust relations for its innovation performance. In the external OSC approach, social relations provide a business unit with access to valuable resources (Lin, 2001), trust refers to the mutual trust that they enjoy with others, and network structure indicates the suitability of their structural position for obtaining resources. One contribution of this paper is that we have clearly distinguished internal from external social capital, focusing especially on the internal OSC and whole-network approach (Marsden, 1990). Instead of focusing on a group's external ties, we take the density of trust ties in a group as the relational dimension of internal OSC. Trust means the average general trust among

group members and network structure refers to the internal social structure of the group. We have attempted to further develop the notion of macro-level social capital on the basis of previous studies, and thus have introduced density of trust networks, general trust and network structure as the three constructs of internal OSC.

Bringing in the idea of network configurations is not new. Sparrowe et al. (2001) pioneered this path, and our paper follows this line of thought in examining the impact of network structure on knowledge creation. However, we have incorporated something new into this study: the downside of OSC, which was not taken into consideration by past studies. We have utilized clique-analysis in studying the process of knowledge creation and have found that the fragmented structure hurts general trust and indirectly influences whole group performance.

Our study found that the clique analysis of friendship networks is important. It is not surprising to find that distrust among gangs and isolated members not only hinders the sharing of tacit knowledge, but limits the open-minded discussions in brainstorming and the willingness to engage in cooperative actions as well. This damage is especially serious in Chinese cultural settings, since political struggles among cliques are a perennial problem with Chinese bureaucracies (Luo and Chi, 2002). Moreover, Chinese managers tend to organize their own "Chin-Shins" (confidant subordinates) as ruling groups, resulting in frequent clique conflicts in Chinese firms (Chi, 1996; Chi and Lin, 1994) and the blocking of information due to selfish clique interests. Thus, clique analysis is especially relevant for the study of Chinese organizational behavior, and we believe it should be taken into account when studying knowledge creation in

a Chinese context.

Our study has introduced informal power distribution into the explanatory model of a group's knowledge improvement and has not found that a low degree of centralization in friendship network is beneficial to group performance. Informal power concentration, or strong leadership, was viewed as a positive factor for group performance in early studies of group structure and process (Shaw, 1964). According to test results obtained by Sparrowe et al. (2001), however, group centrality has a slight negative correlation with the performance of project teams. Ibarra (1993), meanwhile, argues that some leadership is still helpful for innovation roles. Our findings support the conclusions of Ibarra. Strong leadership is not evidenced to be harmful for knowledge sharing and brainstorming.

This paper is only an introduction to an area that still requires further exploration, so we have not attempted at this point to harmonize the data for group performance and OSC in an effort to achieve broader general conclusions. Since whole network analysis depends on closely bounded units from which to collect data, our data set cannot be considered a random sample. Even though the units analyzed in this paper may be drawn from typical Chinese large-sized hi-tech firms and institutes, we still hesitate to generalize our conclusions to all Chinese companies. Rather, this study may be viewed as a representative case in the investigation of Chinese hi-tech firms. If groups from different functions or various industries had been surveyed, the analytical results may well have been different. Thus, it is necessary to collect more data from various work settings before generalized conclusions can be made.

LIMITATIONS

There were several limitations that affected this paper. First, as with much of the research on team performance, our study lacked a large pool of data, and the 67 units analyzed were not enough to ensure solid estimates of the model's parameters. As a result, our conclusions are tentative and those drawing inferences from them should do so with great caution.

Secondly, our data set was not randomly chosen, since collecting network data required not only the cooperation of all the members in a group, but a prior social relationship with the group.

Most of the samples came from engineering groups in Chinese hi-tech organizations, which limits the study's scope of inference. Our results can be considered a representative case for engineering groups in a Chinese environment, but generalized inferences applied to other functional groups or to different cultural settings may not be appropriate. However, some of the conclusions of this paper support the results of previous studies, and it is still possible that general conclusions can be legitimately adopted, such as trust relations being key factors in

knowledge creation. Academic findings are a process of knowledge accumulation, and further studies will gradually clarify our understanding of what optimizes group performance.

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