The Study of the Improvement Mechanism of the Efficiency of Social Network

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***Abstract*—The paper discusses the connotation and constituent factors of the efficiency of social network (ESN). Applying the theory of structural holes, the study analyzes impact factors of ESN on the structural level, the resources level and the strategic level such as structural autonomy, nonredundancy and structural holes strategy. The effect mechanism model of ESN is established according to the active routes among constituent factors and impact factors. Data collected from 266 samples is used to validate the theoretical model by the structural equation model (SEM). In the light of the result of the operation, causation and interrelation among factors is researched. Based on this, the paper gives practice propositions of raising ESN.**

***Index Terms*—the efficiency of social network, structural holes theory, improvement mechanism, practical strategy**

I. PREFACE

The social network refers to a set of social actors and the relationships among them in which the node represents the social actor and the line represents the relation between them. Social network analysts establish the models of these relationships, investigate the impact on group functions or individuals in the group. In otherwords, they take the social network as a factor that provides opportunities and restrictions to social actors. The behaviors of actors are actually interrelated and these connections do act as channels that transmit information and resources. The final results of the social actors depend on their social networks.

As a result, the efficiency of social network can have important impact on whether social actors could obtain opportunities and win advantages in competitions easily.

To investigate the issue of how to improve the efficiency of social network, one should understand the essence of the efficiency of social network and analysis its construction factors and its internal influential mechanism.

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II. THEORETICAL ANALYSIS

Around what domestic and foreign scholars study the efficiency of social network (ESN) is identifying opportunities and gaining competitive advantages. Opportunity is the substantive element of ESN. As a result, it is necessary to consider the factor of opportunity and competitive advantages when the definition of ESN is concerned. We suggest that the ESN is the ability to use the relations in one's social network and obtain opportunities and competitive advantages. So we can summary three component factors from the circumscription: the relation network, the social resources and the opportunity strategy of social actor. They are component factors of ESN on the structural, resources and strategic level respectively.

Inspired by the theory of structural holes - the representation of social network analysis(SNA), we make some conclutions for the three constituent factors as follows.

Firstly, the social actor could be more autonomous and more independent in his social network and his ability to control, to mobilize network resources could be enhanced by his structural autonomy(a concept defining the extent to which a player's network is rich in structural holes, and thus rich in opportunity, and thus rich in information and control benetits.) in the relation network. Therefore he can make it easier to get more control benefits and information benefits of the social network, moreover he can more effectively identify and develop opportunities. So structural autonomy strengthen the ability to gain competitive advantages on the structural level of ESN, is the structural impact factor.

Secondly, nonredundant contacts(a concept which means contacts are disconnected or connected with structural holes in some way – either directly, in the sense that they have no direct contact with one another, or indirectly, in the sense that one has contacts that exclude the others.) can reduce the opportunity cost, optimize resources structure and increase resources efficiency. Because the social actor can transfer his time and energy from the mutual redundant contacts of social resources to

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the new nonredundant individuals and groups from different circles as much as possible. In short, nonredundancy enhance the ability in obtaining opportunity on the resources level of ESN, is the resources impact factor.

Thirdly, structural holes strategy(a concept includes two meanings: one is to distinguish opportunity relationships and constraint relationships in a player's network – discriminate the hole signature of the network, another is to decide what strategy action a player should take.) make the social actor insight the complext conflicts of benefits in the network, so he could recognize or create potential opportunity. At the same time, the social actor could take an appropriate strategy with the identity of middleman to involve in the conflict for getting the profit as the fisherman while resolving contradiction. Thence structural holes strategy improve the effectiveness of opportunity identification, utilization and creation on the strategic level of ESN, is the strategic impact factor.

On this basis, we establish the effect mechanism model of ESN using the theory of structural holes, as shown in Fig. 1. In the model, there are 12 hypotheses in the dotted box. The hypotheses explain the acting paths of impact factors of ESN effecting directly or indirectly the capacity in acquisition of competitive advantage and profit opportunity by means of control benefits of relation network, information benefits of social resources and the effectiveness of opportunity strategy, thus the underlying action mechanism of affecting ESN is described. Assumptions are as follows:

H1a: there is significant positive correlation between structural autonomy and control benefits of relation network.

H1b: there is significant positive correlation between structural autonomy and information benefits of social resources.

H1c: there is significant positive correlation between structural autonomy and the effectiveness of opportunity strategy.

H2a: there is significant positive correlation between nonredundancy and control benefits of relation network.

H2b: there is significant positive correlation between nonredundancy and information benefits of social resources.

H2c: there is significant positive correlation between nonredundancy and the effectiveness of opportunity strategy.

H3: there is significant positive correlation between structural holes strategy and the effectiveness of opportunity strategy.

H4a: there is significant positive correlation between structural autonomy and structural holes strategy.

H4b: there is significant positive correlation between nonredundancy and structural holes strategy.

H4c: there is significant positive correlation between structural autonomy and nonredundancy.

H5a: there is significant positive correlation between control benefits of relation network and the effectiveness of opportunity strategy.

H5b: there is significant positive correlation between information benefits of social resources and the effectiveness of opportunity strategy.

The paper verify the theoretical model by the methods of questionnaire investigation and structural equation model(SEM). Then we explore practice propositions of raising ESN efficiently.

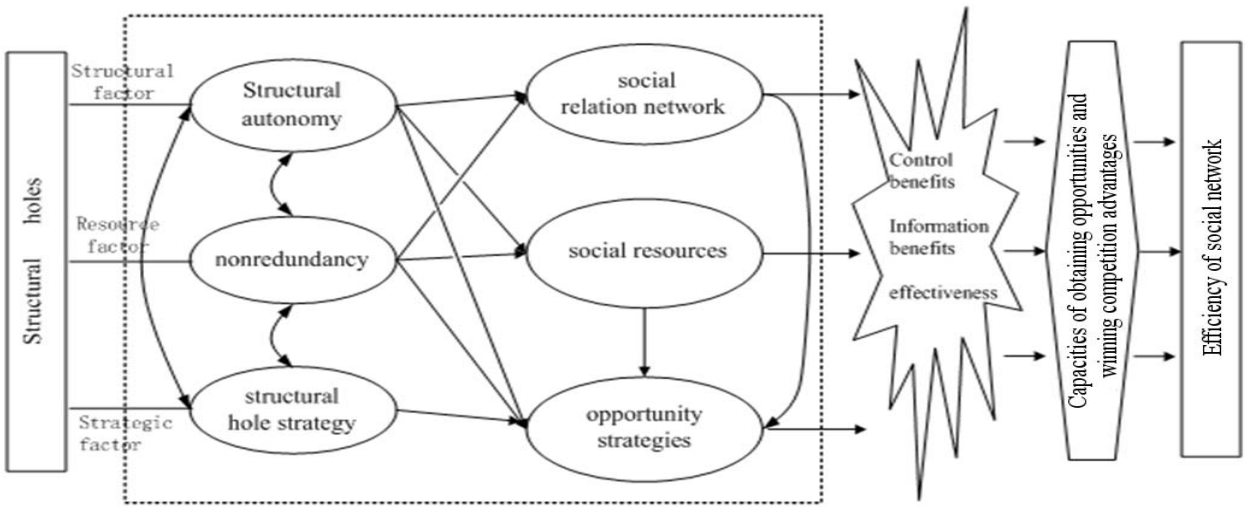

Figure 1. The effect mechanism model of ESN using the theory of structural holes

III. RESEARCH DESIGN

A. Data Collection

The main goal of the present study is to investigate the effect mechanism of ESN and as a result, the survey subjects are sampled from the social actors. Entrepreneurs play an important role in the development of social economy and the active entrepreneurial behaviors always lead to many entrepreneurial opportunities directly. Thus, they could be representatives of social actors. It could help us obtain important insights to investigate their ESN. To improve the survey effect, we chose some particular cities to conduct our survey. Considering the economy and culture differences that might exist, we finally pick provinces or cities such as Hubei, Guangdong, Chongqing and Zhejiang to conduct the survey. Besides, the subjects were randomly selected from the list of entrepreneurs in each city.

Questionnaires were delivered both by mail and by field survey. There were totally 550 questionnaires delivered and 303 responded (156 by mail and 147 by field survey). The whole survey lasted for about ten months from July 2011 to May 2012.

Of all the respondents, 37 did not complete answers to all questions and their responses were eliminated from the database, leaving 266 (127 by mail and 139 by field survey) responses for analysis.

B. Variable Definition and Measurement

There were two kinds of variable in the present study. The first one are variables that are widely used and studied and these variables are modified in our study according to the main aim of the study. The second kind of variables are variables that we have obtained during the survey of some field experts. A scale of 1-5 is used.

Firstly, component factors measuring. Referred the scale of Tomas (2000), we designed a scale that include 16 questions such as the ability to manipulate network, the ability to influence the competitors, the ability to utilize network, the ability of bargaining, ways of obtaining information, the ability to control network, and etc, to measure the variable of control benefits of entrepreneurial relation network. The variable of information benefits of entrepreneurial social network follow the study of Burt (1992) which was measured using 10 questions including the ability to obtain information, the timing of grasping information, the ability to be nominated, and etc. The variable of the effectiveness of entrepreneurial opportunity strategy is measured following the study of Shane (1998; 2000) which includes 12 questions such as information analysis, possessing special information, concerning about the environment features, the ability of recognizing the real opportunity, supports from friends, the ability of handling passive situation, and etc.

When it comes to the impact factors measuring, few study has been conducted before. As a result, the associated questions are designed based on the concepts and principles of the structural holes theory and the depth interviews with some field experts. The variable of structural autonomy is measured from two dimensions (i.e., the structural holes around the entrepreneurs and the structural holes around other relations). The associated scale includes seven questions such as the differences of contacts between entrepreneurs and others with similar social attributes, the extensiveness of contacts, and etc. The measurement of the nonredundancy includes ten questions such as redundancy by cohesion, redundancy by structural equivalence, and etc. The measurement of structural holes strategy is consisted of 12 questions such as the ability of entrepreneurs to recognize the contacting partners' ability to provide opportunity, situations that the entrepreneurs can find more than two subjects to be interested in same project and earn a profit, and etc.

C. Methods

First of all, we used the method of reliability statistical tests to purify each latent variable measurement terms. Cronbach 's alpha is used to measure the terms reliability, the higher of Cronbach' s alpha value, the greater of reliability. To assess the reliability of measuring, variables are calculated and only those which Cronbach' s alpha values are greater than or equal to 0.70 are considered acceptable and a good indication of construct reliability (Peterson, 1994). Second, Kaiser - Meyer - Olkin measuring of sampling adequacy (KMO) and Bartlett sphere test are used to detect whether a partial correlation between variables is small, and determine whether the data is suitable for factors analysis. The more closer KMO value to 1, the more suitable for factors analysis. But if KMO is too small, factors analysis is not applicable. Third, factors analysis is used for those KMO values that meet the requirements, and variable communalities are determined through factors analysis. Finally, structural equation modeling (SEM) is used, relations among potential variables are analyzed and research model is measured, modified and perfected, the hypothesis are analyzed and verified. Analysis software AMOS 4.0 is used and indicators of best fit are shown in Table I(Wheaton,1977;Bagozzi & Yi,1988;Bollen,1989;Browne & Cudeck,1993).

TABLE Ⅰ
INDICATORS OF BEST FIT

Indicators	Scope	Ideal value
χ^2/df	>0	<3
GFI	0-1	>0.9
AGFI	0-1	>0.9
NFI	0-1	>0.9
IFI	0-1	>0.9
CFI	0-1	>0.9
RMSEA	>0	<0.05

IV. RESULTS

A. Reliability and Validity Analysis of Variables

First, reliability analysis is used to get Cronbach 's Alpha coefficient of each variable, reliability analysis result of the variable of "control benefits provided by the entrepreneurial social network" is shown in Table Ⅱ, the reliability coefficient is 0.898, more than the lowest standard of 0.7, which means the result is credible.

The anslysis method of the other variables is consistent with the above variable. Cronbach's Alpha values for each variable range from 0.721 to 0.898, as shown in Table Ⅲ. These demonstrate that the scales of the formal questionnaire have considerable reliability (Cronbach's Alpha values for each variable are greater than 0 .7).

Second, testing the variable's KMO value and Bartlett significance. The KMO overall measuring of sampling adequacy is 0.712, which is bigger than 0.7. Bartlett's test of sphericity value of sample distribution is 177.238, suggesting that factors analysis is suitable.Detailed test results is shown in Table Ⅳ.

TABLE Ⅱ
RESULTS OF RELIABILITY ANALYSIS

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.898	0.918	16

TABLE Ⅲ
RESULTS OF CRONBACH'S ALPHA

Variable	N of Items	Cronbach's Alpha
Control benefit provided by the entrepreneurs' social network	16	0.898
Information benefit provided by the entrepreneurs' social resources	10	0.896
Effectiveness of entrepreneurs' opportunity strategy	12	0.858
Structural autonomy	7	0.721
Nonredundancy	10	0.801
Structural holes strategy	12	0.839

TABLE Ⅳ
KMO AND BARTLETT'S TEST

KMO Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
	Approx. Chi-Square	df	Sig.
0.712	177.238	15	0.000

Lastly, variable communalities are caculated through factors analysis, as shown in Table Ⅴ. The value of the initial column refers to the common factor variance of each variable before factor extraction (Principal component analysis is used in this thesis). For principal component analysis, this value is the diagonal element of the matrix(correlation matrix or covariance matrix) to be analyzed. For factors analysis, these values are the square of each variable load when using other variables as the predictor variable. The common factor variances of original variables are all 1.000. The value of the extraction column represents the proportion that the variance of original values can be explained by the retained factors. The higher the value, the greater the variable validity. As can be seen from Table Ⅴ, extraction values of the six main variables in this thesis range from 0.865 to 0.962 with the average value above 0.8, suggesting that the questionnaire has good structural validity, and fully conforms to the requirement of statistics.

B. Structure Model and Hypothesis Verification

In the below analysis, statistical analysis software AMOS 4.0 is used and hypothesis concerning the casual relations and correlate relations associated with the impact factors and the component factors based on theory of structural holes are tested. In our study, we set the standard level of 0.05 to judge whether the hypothesis can be supported. If standardized path coefficient significance level is above 0.05, the hypothesis is not supported. If this level is below 0.05, the study assumes that the hypothesis is supported. Results are shown in Fig. 2 and Table Ⅵ.

As can be seen from Table Ⅵ, all the value of the goodness of fit basically reached the standard. Among

TABLE Ⅴ
RESULTS OF COMMUNALITIES

Dimension	Initial	Extraction
Control benefit provided by the entrepreneurs' social network	1.000	.942
Information benefit provided by the entrepreneurs' social resources	1.000	.865
Effectiveness of the entrepreneurs' opportunity strategy	1.000	.875
Structural autonomy	1.000	.907
Nonredundancy	1.000	.962
Structural holes strategy	1.000	.903

(Extraction Method: Principal Component Analysis.)

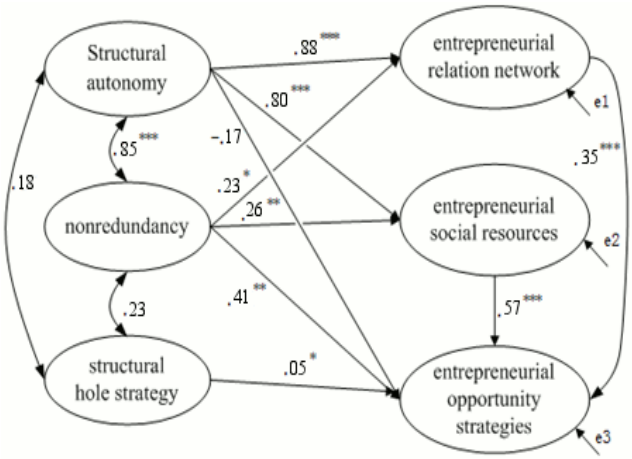

Figure 2 Result of the theoretical model

which, χ^2/df has a value of 1.383, which is smaller than the upper limit (i.e., 5) and less than the more stricter index(i.e., 3); The value of RMSEA (0.056), though larger than 0.05, is marginally acceptable, since the upper limit is 0.1. Both the IFI (0.951) and CFI (0.944) are higher than 0.9, and the GFI (0.878), AGFI (0.841) and NFI (0.855) are all above 0.8, slightly lower than 0.9. To be concluded, all the parameters meet the fundamental requirements which means that the model proposed is validated.

Meanwhile, the results from talble Ⅵ aslo show that most of the hypotheses put forward in the theory analysis are supported in our study, which might indicate that the proposed effect mechanism model of ESN based on theory of structural holes is reasonable and feasible.

V. RESEARCH FINDINGS AND DISCUSSION

A. Main Conclusions

(1) Causation between impact factors and constituting factors

Firstly, there is significant positive correlation between structural autonomy and control benefits of entrepreneurial relation network, the same to structural autonomy and information benefits of entrepreneurial social resources. But structural autonomy is not significantly positively related to the effectiveness of entrepreneurial opportunity strategy. As shown in Table VI, the influence of structural autonomy to control benefits of entrepreneurial relation network is 0.883 (P<0.001) and its influence to information benefits of entrepreneurial social resources reaches 0.795(P<0.001), which means the variable of structural autonomy has the greatest influence to control benefits and information benefits, and it also suggests that it is the most important factor that determines whether entrepreneurs can obtain entrepreneurial opportunity through entrepreneurs' social networks and social resources. Moreover, the influence of structural autonomy to the effectiveness of entrepreneurs' opportunity strategy is -0.174(P>0.05) and this empirical result did not support the hypothesis H1c, that is, there is no significant relation between structural autonomy and the effectiveness of entrepreneurs' opportunity strategy. The possible reasons of the result might be as follows:

Above all, entrepreneurs have the cognitive tendency to exceed the restriction of existing resources and find new opportunities. The nature of entrepreneurs' recognition is opportunity-oriented and is affected by factors such as over-confident, risky-taking, control illusion, and etc. According to the model constructed by Donna Marie、De Carolis & Patrick Saparito (2006) concerning the relations among social network, entrepreneurial cognition, and entrepreneurial opportunity, entrepreneurs tend to be overconfident, risky-taking, and control illusion due to something such as structural holes and confidence in the social network. Importantly, these features make entrepreneurs to be risk insensitive. As a result, it is more likely that entrepreneurs obtain opportunities while facing more risk. When entrepreneurs are structural autonomy, they are of greater competition advantages because they occupy more structural holes. This competition advantage may lead to a control illusion in entrepreneurs which means that entrepreneurs might make decisions that beyond their ability and conformity. In other words, the higher the level of the structural autonomy, the mightier the entrepreneurs in their relations with their partners, and the stronger the illusion that they are in control of the situation. Therefore, more unreasonable decisions are made which lead to decreasing of the effectiveness of opportunity strategy.

Then, as shown in Table Ⅳ, there is significant influence of structural autonomy to control benefits (0.883, P<0.001) and information benefits of entrepreneurs social network (0.795, P<0.001). As a result, increasing of structural autonomy can actually lead to a high degree of coercion of control benefits and information benefits. Although it might be good for entrepreneurs, it may lead risks to entrepreneurs' partners and make them be alert which may in turn prevent them to provide information to entrepreneurs, and refuse to serve entrepreneurs anymore. In other words, the higher the level of structural autonomy, the stronger the alertness the entrepreneurs' partner, which decreases the effectiveness of entrepreneurs' opportunity strategy.

Secondly, there is significant positive correlation between nonredundancy and control benefits of entrepreneurial relation network, between nonredundancy and information benefits of entrepreneurial social resources, also between nonredundancy and the effectiveness of entrepreneurial opportunity strategies. However, the empirical studies have shown that nonredundancy has less impact upon control benefits and information benefits than structural autonomy(comparisons of the standardized path coefficient: 0.228 < 0.883, 0.258 < 0.795). We would like to interpret these findings as follows.

There are two standards to evaluate nonredundancy (i.e., cohesion and structural equivalence). Cohesion concerns the direct relations and can be handled easily

TABLE Ⅵ
ANALYSIS RESULTS OF THE THEORETICAL MODEL

Relationship between variables			Standardized path coefficient	Hypotheses supported
Causal relations between component factors				
Control benefits of the entrepreneurial relation network	→	Effectiveness of entrepreneurial opportunity strategies	0.348***	H5a：supported
Information benefit of the entrepreneurial social resources	→	Effectiveness of entrepreneurial opportunity strategies	0.566***	H5b：supported
Interactions between influence factors				
Structural autonomy	↔	Nonredundancy	0.848***	H4c：supported
Nonredundancy	↔	Structural holes strategy	0.212	H4b：not supported
Structural autonomy	↔	Structural holes strategy	0.183	H4a：not supported
Causal relations between influence factors and component factors				
Structural autonomy	→	Control benefit of the entrepreneurial relation network	0.883***	H1a：supported
Structural autonomy	→	Information benefit of the entrepreneurial social resources	0.795***	H1b：supported
Structural autonomy	→	Effectiveness of entrepreneurial opportunity strategies	-0.174	H1c：not supported
Nonredundancy	→	Control benefits of the entrepreneurial relation network	0.228*	H2a：supported
Nonredundancy	→	Information benefit of the entrepreneurial social resources	0.258**	H2b：supported
Nonredundancy	→	Effectiveness of entrepreneurial opportunity strategies	0.408**	H2c：supported
Structural holes strategy	→	Effectiveness of entrepreneurial opportunity strategies	0.048*	H3：supported
Goodness of fit index			χ^2/df=1.383;RMSEA=0.056;GFI=0.878; AGFI=0.841;NFI=0.855; IFI=0.951;CFI=0.944	

Note：***indicates p<0.001,** indicates p<0.01,* indicates p<0.05.

while the structural equivalence is associated with indirect relations and is hard to handle. In fact, there are many indirect relations that resulted from direct relations. As a result, many seemingly nonredundant contacts provide redundant informations to some extent actually, thereby makes affect of nonredundancy decrease. On the

other hand, structural autonomy represents the situation that has many structural holes around which may lead to some sure benefits.

Thirdly, there is significant positive correlation between structural holes strategy and the effectiveness of opportunity strategy. The results showed that the effectiveness of entrepreneurial opportunity strategty could be increased notablely by discriminating the hole signature of the network and taking corresponding strategy actions.

(2) Reciprocity of impact factors

There is significant positive correlation between structural autonomy and nonredundancy, however, both of them are not significantly related to the structural holes strategy. Structural autonomy refers to the structural features that structural holes around the entrepreneurs are absent while there are plenty of structural holes around the entrepreneurs' partners. Among different structural holes strategies, some are applied to gain information benefits and control benefits of entrepreneurs' partners. These strategies are aimed at the situation of structural autonomy of entrepreneurs. The others are applied to eliminate the constraints to entrepreneurs due to the absence of structural holes around their partners. These strategies are aimed at the situation of structural non-autonomy of entrepreneurs. From this viewpoint, structural autonomy and structural holes strategy are not internally consistent and not interrelated with each other.

Nonredundancy refers to that entrepreneurs possess social resources that are highly heterogeneous. On the other hand, some of the structural holes strategies are aimed to utilize the sub-structural holes of other partners which are redundanct. Besides, some strategies are aimed at the elimination of constraints to entrepreneurs, including withdrawal from interrelations, etc. It is more than redundancy and Nonredundancy. As a result, there should be no tight relations between nonredundancy and structural holes strategy.

When the level of nonredundancy is high, there may have few direct or indirect relations among entrepreneurs' partners. In other words, entrepreneurs' structural autonomy is enhanced due to the abundant structural holes around their partners. In fact, we do find a significant interrelations between entrepreneurs' structural autonomy and nonredundancy in our survey.

(3) Causation among constituting factors

There is significant positive correlation between control benefits of entrepreneurial relation network and the effectiveness of entrepreneurial opportunity strategy, also there is significant positive correlation between information benefits of entrepreneurial social resources and the effectiveness of entrepreneurial opportunity strategy, with the standardized path coefficients to be 0.348 ($P<0.001$) and 0.566 ($P<0.001$) respectively. Entrepreneurs can find opportunity more effectively due to control benefits and information benefits. There are three reasons: firstly, entrepreneurs can expect returns more governably; secondly, entrepreneurs can cut down opportunity costs and resources obtaining costs; thirdly, entrepreneurs can abase the nondeterminacy in gaining opportunity to the lowest.

B. Practice Propositions of Raising ESN

(1) From the viewpoint of control benefits provided by entrepreneurial social network and information benefits provided by entrepreneurial social resources, structural autonomy is of the most significant impact factor. As a result, entrepreneurs should care about their own structural holes, especially the sub-holes, and should maintain an intimate connections with their partners and friends. However, from the viewpoint of utilizing the entrepreneurs' opportunity strategy, the level of structural autonomy is not the higher the better. This may indicate that entrepreneurs should not be too mighty in their social networks and should do their best to achieve a "win-win situation".

(2) In extending their social network, entrepreneurs should avoid the duplicate of their partners. In other words, the greater their partners difference in profession, background, experience, the better. In this way, entrepreneurs can receive informations of all kinds from many different channels and get help in an easy way when they are in difficult situations. On the other hand, entrepreneurs' time and energy can be saved to find and get new partners of different fields, background, and social status. However, it is not valid when it comes to partners who are particularly important, such as the people who are of very high social status, great power, large amount of resources.

(3) Entrepreneurs should pay attention to the classifications of social relations, not all relations keeping connection could bring the entrepreneurial opportunity. In particular, entrepreneurs should know which relations can bring opportunities, which are constraints, and which are currently useless while should maintain. In this way, entrepreneurs can recognize the most possible situation of opportunity within the restriction of limited time and energy, and be alert to take advantage of some potential conflicts that might exist in his social relations. For those relations that are very important but restricted, entrepreneurs should using the structural holes strategy to enhance their control power and break the constraints to create opportunity. In this way, the efficiency of entrepreneurs' social network can also be improved.

(4) During the course of constructing one's social network, nonredundancy should be firstly considered. On the one hand, nonredundancy can significantly improving the efficiency of entrepreneurs social network in all three levels (i.e., structural level, resources level, and strategic level). On the other hand, nonredundancy is significantly inter-correlated with structural autonomy, and the change of any one side can lead to the same change to the other side. In this way, when nonredundancy of resources is improved, entrepreneurs also enhance their status in their social networks. From this viewpoint, the most important thing to do to promote the efficiency of entrepreneurs' social network is to extend their social circles and to establish relations with people of different fields, levels. This is consistent with

the phenomena in reality that successful entrepreneurs have the widest social activities. Just as what people always said, entrepreneurs in China are firstly the social activists. Entrepreneurs can extend their relations by themselves or through their friends. Note that, extension through their friends do not equals to increase the number of same kind of relations. Besides, nonredundancy, structural autonomy, and structural holes strategy are not internally consistent. Therefore, to obtain a social network of high efficiency should consider factors both inside and outside. In other words, entrepreneurs should be highly sensitive to entrepreneurial opportunity, care about the environment features and relation features that are neglected by others, understand structural holes strategy deeply and utilize them flexibly. In fact, many entrepreneurs in the real life like to read books such as "The Art of War", "Three Kingdoms strategy" to learn this kind of ability.

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