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The Empirical Study on the Relations Among Network Structure, Strategic Flexibility and Technology Innovation Performance

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Abstract
Nowadays, enterprise has to learn to make Technology Innovation by making full use of resources from other organizations or agencies because of the increasing of scientific and technological level and economic globalization. Through studying on the related articles about Network Structure, Strategic Flexibility and Technology Innovation Performance, this paper proposes a conceptual model which can explain the relationship between Network Structure, Strategic Flexibility and Technology Innovation Performance. By using SPSS 16.0 to analyse the sample data which is acquired from distributing questionnaires, expert visiting and others, this paper examines the affecting degree empirically of Network Structure, Strategic Flexibility on Technology Innovation Performance. Thus, enterprise should perfect enterprise's network structure, enhance enterprise Strategic Flexibility and then improve the Technology Innovation Performance.

Key words: Technology innovation performance; Network structure; Strategic flexibility; Empirical study

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INTRODUCTION
Along with the rapid progress of technology and the drastic completion among enterprises, the environment which the enterprises faced with has changed a lot and will continue to change. Change has become the basic characteristic of the network environment of the enterprises. How to deal with the challenges of dynamic environment, or how to seize the opportunity by using the dynamic environment, get competitive advantage and make sustainable development, has become the key problem for enterprise manager in practice. Enterprise should continually learn and make innovation in the social network environment, and then can improve capacity and win a sustainable competitive advantage. At the same time, the enterprise must try to cultivate Strategic Flexibility to adapt to the environment and then can get high Technology Innovation Performance. This paper focuses on discussing the problems of Strategic Flexibility in the enterprise Technology Innovation Strategy, probing how to cultivate and apply the Strategic Flexibility through dynamic enterprise network environment, promoting Technology Innovation Performance. Implementing Scientific Outlook on Development, cultivating and raising the technology innovation ability of our enterprise, is the important goal for long-term development of China's society, economy, and science and technology. Especially for the high-tech enterprises, how to enhance the technology innovation ability and performance has become an important research subject.

1. DEFINITION AND MEASUREMENT OF THE VARIABLE

1.1 The Meaning of the Network Structure

Network Structure is considering the individual differences in the network connection, which means that the members of the social network get close to the information through the interaction, and at the same time, the members are connected. The characteristics of connection will influence the information accessibility, timeliness and quality. This paper argues that, the Network Structure is the mode of direct or indirect contacting between network participants.

1.2 The Measurement of the Network Structure

Table 1
The Measurement of the Network Structure

Items of Measurement	Origin
(a1) When contacts with enterprises in the social cooperation network, the company or organization always participates in	Ohannisson (2002), Bell (2005), LI Yugang (2007), Peng Xinmin (2009)
(a2) When contacts with enterprises in the social cooperation network, the company of organization always gets rich resources and information	
(a3)The company of organization owns more stable network connection than competitors in the social cooperation network.	
(a4) The company of organization can solve problems more easily in the social cooperation network	
(a5) The company of organization can strengthen the trust with other members of the social cooperation network	
(a6) Your company maintains a close contact with other related enterprises	Arranz & Arroyabe (2006), XU Qingduan (2002)
(a7) Your company often keeps contact with other related enterprises	
(a8) Your company often cooperates with other related enterprises to overcome difficulties	
(a9) Your company frequently exchanges resources and information with other related enterprises	
(a10)Your company emphasizes mutual long-term cooperation, mutual trust and mutual benefit with other related enterprises	
(a11) Comparing with the similar local industry, your company contacts with more upstream enterprise	Adler & Kwon (2002), Jenssen (2001), WANG Xiaojuan (2007)
(a12) Comparing with the similar local industry, your company contacts with more downstream enterprise	
(a13) Comparing with the similar local industry, your company contacts with more trade enterprise	
(a14) Comparing with the similar local industry, your company contacts with more government agencies	
(a15) Comparing with the similar local industry, your company contacts with more research institutions	

1.3 The Meaning of Strategic Flexibility

Strategic Flexibility is the management ability of developing and cultivating strategic resources and dynamic capability with common effectiveness at present or in the future, which is used to improve the efficiency and the adaptability of the organization, adapt to the change, use change and make changes to improve its own core ability for a set of rules and the corresponding choice action plan.

1.4 The Measurement of Strategic Flexibility

Table 2
The Measurement of Strategic Flexibility

Items of Measurement	Origin
(b1) Your company can quickly adjust the allocation of resources according to the changes of the environment	Sanchez (1995), WANG Yonggui (2003), WANG Tienan, etc. (2009)
(b2) Your company can always share some resources in different business activities	
(b3) The level of using the same resources to develop different products or service is very high	
(b4) The cost of using the same resources to develop different products or service is very low	
(b5) The department of product development often can find new use of existing resources by communicating with customers and other company.	
(b6) Your company can always make rapider response than your rivals	Sanchez (1995), WANG Yonggui (2003), WANG Tienan, etc. (2009)
(b7) Your company can always make timely adjustment to the change of the needs of customers	
(b8) Your company is always trying to seek market opportunities in the ever-changing environment	
(b9) Your company often can more effectively deal with all kinds of changes than your competitors	
(b10) Your company is good at discovering unknown fields and can quickly make response to it	

1.5 The Meaning and Measurement of Enterprise Technology Innovation Performance

Technology Innovation Performance includes the indexes to measure the technology innovation activities effect and efficiency. Generally, patent number is considered as its proxy variable abroad. This paper measures the enterprise Technology Innovation Performance from five indexes that most scholars agree. Measuring items are: (1) the number of company's development of new products each year (or service) is larger; (2) compared with the local company with the same industry, the company has more patents; (3) compared with the local company of the same industry, new product (or service) brings more value accounts for the total sales; (4) compared with the local company of the same industry, new products (or service) develop very rapid; (5) compared with the local company of the same industry, innovative product (or service) have high success rate (ZHANG Lixin, 2006), (GUAN Jiancheng, 2000), (ZHANG Fanghua, 2004), (WEI Ying, 2005).

2. RESEARCH ON EMPIRICAL RELATIONSHIP

2.1 The Hypothesis

Based on the "Social Network Theory", "Structural Hole Theory" discussed and relevant documents introduced, most research shows that the Network Structure will have positive influence on enterprise Technology Innovation Performance. Powell (1996), Wellman (1953) thought that the position of Network Center has positive influence on the innovation performance; Ramirez Pasillas & Johannisson (2001) studied and got that that enterprise Network Center position can promote the growth of the enterprise; Podolny (2001) believed each network member used the multiple connection, built competitive advantage, and improved enterprise innovation performance; Kracardt (1992), proposed the "strong coupling advantage theory", studied the strength of the relationship between network brings how to influence the enterprise and affect the enterprise innovation behavior. YAN Ying, CHEN Jianfu (2010) verified that the networks strength influenced cluster enterprise innovation directly or indirectly by empirical study. Bat jargal (2003), through the empirical data analysis, got that the more resources and information the enterprise had, the better enterprise Technology Innovation Performance will be. WU Xiaobo and PENG Xinmin (2009) think Network Structure will influence Technology Innovation Performance through "using and exploring in the learning".

Enterprise network environment can produce two unique benefit mechanisms. Firstly, network members will be able to use such multiple connections and get more key information and valuable channel. Secondly, the network members can joint and coordinate the various actions to promote technical knowledge transfer, enhance the enterprise the knitting weaving learning ability. Therefore, the enterprise Network Structure must have a significant positive impact on the technology innovation. So, we put forward the hypothesis:

Hypothesis 1---H1: The Network Structure of enterprise plays a significant positive role on Technology Innovation Performance.

Malone and Rhyne (1986) put forward, by survey data, the Strategic Flexibility of enterprise and the last income of sales, shareholder return on investment had positive relationship; Paik (1991) also found that the Strategic Flexibility of enterprise had positive impact on performance; Madhavan's (1995) study showed that the enterprise resource flexibility, the organizational flexibility and the technology flexibility of enterprise had a significant positive correlation with the performance; Hatch and Zwcig (2001) believed that in a complicated market competition, Strategic Flexibility would promote the enterprise's sustainable development; Scholars in our country WANG Tienan, WANG Yonggui (2003), verified the hypothesis that the Strategic Flexibility and enterprise performance are positively related. This shows that most scholars think Strategic Flexibility of enterprise palys a positive role in promoting performance.

Strategic Flexibility can enhance the ability of enterprise to deal with the dynamic changes of the external environment, help enterprise shorten the reaction time to the change, and at the height of the fuzziness, expand the scope of the choice of enterprise resource, thus to promote the enterprise development. However, enterprise development depends largely on technology development or the rise of technology innovation, because the technology innovation is the fundamental for the enterprise sustainable development. Based on "strategic flexible theory" and "technical innovation theory" and the viewpoints above, we propose the hypothesis:

Hypothesis 2---H2: The Strategic Flexibility of enterprise and the Technology Innovation Performance have significant positive correlation.

2.2 Construct Concept Model

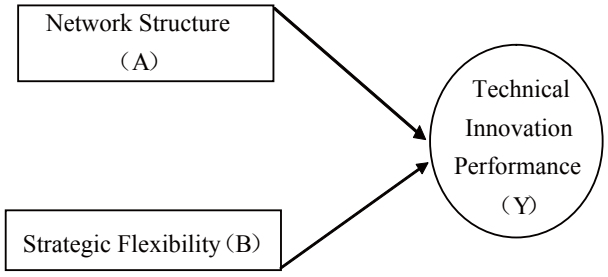

Figure 1
The Concept Model

2.3 The Empirical Research

2.3.1 Sample and Research

In order to verify the above hypothesis, this study adopts questionnaire investigation method. We visited more than 200 top managers of enterprises for the random survey. This study sent 235 formal investigation questionnaires and got 194 questionnaires back. The recovery rate is 82.55%. In the 194 questionnaires, there are 23 invalid questionnaires. Therefore, the effective questionnaire was 171 copies, and the effective recovery rate is 88.14%.

According to the related concept, variable measure adopted Likert's measurement of the five dimensions as given a proposition, the respondents should give comment. We deal with the collected data using the statistical software SPSS17.0. Connected with the statistical analysis of the data, we verify the model and test the hypothesis in this paper.

2.3.2 The Descriptive Analysis

Descriptive analysis is to understand the data's concentrated or discrete trend, analyze the investigated enterprises whether they are representative. From the data statistics results (Table 3), we can see that, the enterprise and the individual are surveyed with wide representativeness.

Table 3
Descriptive Statistics

N	Effective sample	Minimum	Maximum	Mean	Std. Deviation	Variance
a1	171	1	5	2.73099	1.08364	1.17427
a2	171	1	5	3.32164	1.42934	2.04300
a3	171	1	5	2.98246	1.11394	1.24087
a4	171	1	5	3.20468	1.00539	1.01080
a5	171	1	5	3.36842	0.92606	0.85759
a6	171	2	5	4.24561	0.73438	0.53932
a7	171	1	5	4.05263	0.82792	0.68545
a8	171	1	5	3.63158	1.03409	1.06935
a9	171	1	5	3.60234	1.10336	1.21741
a10	171	1	5	4.16959	1.04059	1.08283
a11	171	1	5	3.80702	1.10781	1.22724
a12	171	1	5	3.76023	1.21066	1.46570
a13	171	1	5	3.90058	0.99206	0.98418
a14	171	1	5	3.03509	1.21217	1.46935
a15	171	1	5	2.86550	1.22692	1.50533
b1	171	1	5	3.72515	0.93331	0.87107
b2	171	1	5	3.61988	0.94025	0.88407
b3	171	2	5	3.50292	0.96023	0.92205
b4	171	1	5	3.21637	1.06549	1.13526
b5	171	1	5	3.33918	1.10168	1.21369
b6	171	1	5	3.56140	1.06303	1.13003
b7	171	1	5	3.38012	1.05243	1.10760
b8	171	1	5	3.71345	1.07090	1.14682
b9	171	1	5	3.44444	1.04663	1.09542
b10	171	1	5	3.38596	1.02477	1.05015
y1	171	1	5	3.05263	1.13895	1.29721
y2	171	1	5	2.94737	1.18452	1.40310
y3	171	1	5	3.11696	1.45453	2.11565
y4	171	1	5	3.13450	0.97591	0.95239
y5	171	1	5	3.36842	0.92606	0.85759

2.3.3 The Reliability Test

Reliability coefficient is a reflection of the reliability of the size of the statistics. In this study, Cronbach's (α) coefficient (Table 4) is taken as reliability criteria. The standards are as follows: $0.5 < \alpha < 0.7$, credible; $0.7 \leqq \alpha < 0.9$, very credible; $\alpha \geqq 0.9$, completely credible.

Table 4
Cronbach's Alpha Coefficient Table

Variable	Term	Cronbach's alpha	N of Items
Network Structure	a01-a15	0.777	15
Strategy Flexibility	b01-b10	0.867	10
Technology Innovation Performance	y01-y05	0.889	5

For general basic research, reliability to 0.7 can be accepted. In this study the Cronbach's coefficient, were 0.777, 0.867 and 0.889. It shows that the consistency of questionnaire is good and of high reliability. It corresponds to the requirements of social science questionnaire with internal consistency.

2.3.4 Test of Validity

The survey of this questionnaire is discussed repeatedly to make a choice, and through preliminary examination in small range to try to ensure the questionnaire has certain content validity. We adopt Exploratory Factor Analysis method to test the questionnaire structural validity. As the statistics showing, the common degrees for all the items in questionnaire are above 0.5, showing the questionnaire's structural validity achieves the basic requirements.

(a) Analysis of Network Structure factor.

Table 5
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.773
Bartlett's Test of Sphericity	Approx. Chi-Square	1069.060
	df	105
	Sig.	.000

We made KMO measure and Bartlett's Test on each measuring item of Network Structure. The table (Table 5) above is the inspection results by the SPSS17.0. The chart shows that the KMO value of the sample is 0.773, between 0.7 and 0.8, which means the group of variable data is fit for factor analysis (Ma Qingguo, 2002). At the same time, the significant level of X2 statistical value in Bartlett's Test is 0.000, which is less than 0.01, showing that the data fits for factor analysis once again.

(b) Factor Analysis of Strategic Flexibility.

Table 6
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.797
Bartlett's Test of Sphericity	Approx. Chi-Square	773.255
	df	45
	Sig.	.000

We made KMO measure and Bartlett's Test on each item of Strategic Flexibility. The table (Table 6) above is the inspection results by the SPSS17.0. The chart shows that the KMO value of the sample is 0.797, between 0.7 and 0.8, which means this group of variable data is fit for factor analysis (Ma Qingguo, 2002). At the same time, the significant level of X2 statistical value in Bartlett's Test is 0.000, which is less than 0.01, showing that the data fits for factor analysis once again.

(c) Factor analysis of Technology Innovation Performance.

Table 7
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.820
Bartlett's Test of Sphericity	Approx. Chi-Square	534.924
	df	10
	Sig.	.000

We made KMO measure and Bartlett's test (Table 7) on each item of Technology Innovation Performance. The table above is the inspection results by the SPSS13.0. The chart shows: the KMO value of the sample is 0.820, between 0.8 and 0.9, which means the group of variable data is fit for factor analysis (Ma Qingguo, 2002). At the same time, the significant level of X2 statistical value in Bartlett's test is 0.000, which is less than 0.01, showing that the data fits for factor analysis once again.

2.3.5 Validation of Proposition

Correlation Analysis is the common method in the study of the degree of the correlation between two variables. In order to further understand the relationship between the Strategic Flexibility and enterprise Technology Innovation Performance, we carried on the correlation analysis.

Table 8
Pearson Correlation Coefficient Matrix

	Correlations	Center of network	Network intensity	Network scale	Resource flexibility	Coordination flexibility	performance
		A1	A2	A3	B1	B2	Y
A1	Pearson Correlation	1					
	Sig. (1-tailed)						
A2	Pearson Correlation	.258**	1				
	Sig. (1-tailed)	(.00)					
A3	Pearson Correlation	.638**	.245**	1			
	Sig. (1-tailed)	(.00)	(.00)				
B1	Pearson Correlation	.516**	.649**	.404**	1		
	Sig. (1-tailed)	(.00)	(.00)	(.00)			
B2	Pearson Correlation	.181*	.386**	.312**	.184*	1	
	Sig. (1-tailed)	(.01)	(.00)	(.00)	(.01)		
Y	Pearson Correlation	.782**	.550**	.717**	.665**	.271**	1
	Sig. (1-tailed)	(.00)	(0.00)	(.00)	(.00)	(.00)	

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

From the table (Table 8) above, it is known that the Network Structure, Strategic Flexibility and Technology Innovation Performance are positively correlated. In order to make a further study on the relationship between them, we put the Network Structure and Strategic Flexibility as independent variables, the Technology Innovation Performance as the dependent variable, using multiple stepwise regression method to analyze and verify the possible relations. From the rate of F value companions, it can be seen that each is less than significant level 0.01, explaining the introduction of independent variables has significant contribution to the dependent variable explanation.

Table 9
Regression Coefficient and Significant Inspection Table

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std.Error	Beta			Tolerance	VIF
1	(Constant)	-0.595	0.164		-3.631	0.000		
	Network Structure	0.948	0.054	0.798	17.545	0.000	0.558	1.793
	Strategy Flexibility	0.185	0.060	0.140	3.086	0.002	0.558	1.793

a. Dependent Variable:Technology Innovation Performance

Table 10
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Durbin-Watson
1	.898	.806	.804	.408	349.169	0.000	2.058

a Predictors: (Constant), Network Structure, Strategy Flexibility
b Dependent Variable: Technology Innovation Performance

Regression analysis results (Table 9, Table 10) confirm the Network Structure, Strategic Flexibility play positive roles in promoting of the Technology Innovation Performance. According to the results of regression analysis, we can get the following regression equation: Y = 0.798 A + 0.14 B. Through the above correlation and regression analysis, it proves the proposed theory hypothesis and the model of the research.

CONCLUSIONS

From the analysis results of the research, it can be seen that the Network Structure and the Strategic Flexibility have a significant positive impact on enterprise Technology Innovation Performance. Therefore, the dynamic social network environment forces us to focus on Network Structure, Strategic Flexibility, Technical Innovation and other factors. Combined with the practical situation of the enterprises in our country, we should improve the recognition capability about environment, perfect enterprise network construction, enhance enterprise Strategic Flexibility and improve the Technology Innovation Performance.

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