How Important are Entrepreneurial Social Capital and Knowledge Structure in New Venture Innovation?

Yang Xu
Penn State University, New Kensington

Drawing upon the resource-based view and knowledge-based theory, this research investigated the roles of entrepreneurial social capital and knowledge structure in the process of new venture innovation. A questionnaire survey was conducted on a sample of 1000 new ventures in U.S. The analysis results show that an entrepreneur's social capital influences their knowledge structure of new production development, and ultimately impacts new venture innovation. By incorporating the entrepreneur's knowledge structure with their social capital in the context of new venture innovation, this research attempted to develop a theory of action which connects individual differences with social structure.

INTRODUCTION

Innovation is the driving force of economic growth; however, there is still much confusion over how to make it happen. Drawing upon the resource-based view (Barney, 1991; Peteraf, 1993) and knowledge-based theory (Grant, 1996), this research attempts to investigate the roles of entrepreneurial social capital and knowledge structure in the process of new venture innovation. Two related issues are addressed. First, how does an entrepreneur's social capital influence their knowledge structure concerning new product development? Next, to what extent does the entrepreneur's knowledge structure influence new venture innovation?

Entrepreneurial firms are risk taking, proactive and innovative (Barringer & Bluedorn, 1999), and the entrepreneur plays a critical role in the new venture success (Hall & Hofer, 1993; Herron, 1990; Shane & Venkataraman, 2000; R. W. Stuart & Abetti, 1990). Entrepreneur's social network and knowledge structure are critical factors in new venture innovation. In a complex and uncertain environment, the entrepreneur's social network and knowledge structure change through adaptation and learning.

Social capital is defined as networks of relationships and assets located in these networks (Batjargal, 2003; Bourdieu, 1985; Coleman, 1988). This study focuses on network content – the characteristics or attributes of the members embedded in the entrepreneur's social network. Network diversity describes the extent to which each member's attributes are different from other members.

Knowledge structure is defined as mental templates that entrepreneurs impose on an information domain – new product development in this research – to give it form and meaning (Lyles & Schwenk, 1992; Walsh, 1995). Two knowledge structure characteristics are relevant to innovation activities: complexity and centrality. Complexity reflects the level of differentiation and integration in an actor's knowledge structure (Walsh, 1995). Centrality reflects the level of focus and hierarchy in an actor's knowledge structure (Eden et al., 1992). Complexity measures the entrepreneur's information-processing capability of capturing a broad collection of environmental, strategic and organizational concepts.

Centrality measures the entrepreneur's tendency to centralize a strategy frame around a few core concepts. This study focuses on these two characteristics of knowledge structure.

Drawing upon the representative works on innovation, social capital and organization learning, next I derived a series of hypotheses linking entrepreneurial social capital, knowledge structure, and new venture innovation, followed by the methodology and data analysis, and ended with the discussion.

HYPOTHESES DEVELOPMENT

Social network has significant impacts on outcomes such as the performance of new ventures (Baum, Calabrese, & Silverman, 2000; T. E. Stuart, 2000), organizational learning (Anand & Khanna, 2000; Kale, Singh, & Perlmutter, 2000; Kraatz, 1998; Oliver, 2001), and innovation (Powell, Koput, & Smith-Doerr, 1996; Shan, Walker, & Kogut, 1994). In a diverse network, knowledge and information are dispersed among the actors embedded in the network. When knowledge is broadly distributed, the entrepreneur obtains non-redundant information, knowledge, and resources from various social and business relations. This information diversity enhances their comprehension of a business context or phenomenon from multiple perspectives. Their knowledge structures become more complex during this process of outsourcing cognitive tasks to diverse information connections.

However, diverse information and knowledge assimilated from different business ties may create information overload. Through gradual learning over time, the entrepreneur is more likely to develop a hierarchical knowledge structure to process these diverse information and knowledge. This hierarchical knowledge structure entails a clear distinction between the core concepts and the peripheral concepts (Carley & Palmquist, 1992). Consequently, a diverse social capital enhances the entrepreneur's knowledge structure centrality. In a diverse network, entrepreneurs tend to centralize their strategy frame around a few core concepts in order to process efficiently a broad collection of environmental, strategic and organizational concepts.

Simultaneously, thinking drives strategy making. Networking is a key strategic action and a process of an individual's interacting with the environment. The entrepreneur's knowledge structure influences their networking process. An entrepreneur actively establishes ties through which information and aid flow (Baron & Markman, 2003; Shane & Stuart, 2002). Those with a more complex mental model are able to collect more information from the environment and process the information. In complex situations, the more complex the cognitive structure is, the more accurate the perception is, and the more effective the behavior is (Bartunek, Gordon, & Weathersby, 1983). However, information overload may hinder the actor's ability to make effective decisions. Entrepreneurs with a more centralized knowledge structure are more efficient to establish a diverse social network because they are able to differentiate the key business ties from the other business ties for the peripheral factors.

> **Hypothesis 1a**: The diversity of an entrepreneur's social capital is associated positively with their knowledge structure complexity.
> **Hypothesis 1b**: The diversity of an entrepreneur's social capital is associated positively with their knowledge structure centrality.

The process of new venture innovation is influenced by the entrepreneur's knowledge structure through which they acquire, store, transform, and use information. As a mental template, the entrepreneur's knowledge structure guides their strategic actions (Walsh, 1995). During the process of interacting with a technology, actors' mental templates help them construct different interpretations of the technology (Bijker, Pinch, & Hughes, 1990; Bloomfield, 1986; Woolgar, 1981). A technical system is operated by different social systems such that ultimately the design of work depends on human choices about how best to optimize the fit between the technical and social systems (Thompson, 1967). Human understandings and mental models influence the ways in which the technologies function. There is no objective "real" organization or technology independent of the mental templates of the people involved

(Weick, 1979). Actors' mental model plays an important role in decisions about technological innovation (Swan, 1995, 1997).

In new venture innovation, the entrepreneur's knowledge structure influences the process of receiving information, seeking reference points, and establishing work routines. Entrepreneurs collectively construct organized knowledge about an information environment – new product development in this study – that enables interpretation and action in that environment. They continuously assimilate information and knowledge from the others they interact with. As learning depends on experimentation and feedback, learning opportunities tend to be local to previous knowledge (Teece, Pisano, & Shuen, 1997). Entrepreneurs with a more diverse knowledge structure will create and select ideas with greater novelty than those with access to a more narrow pool of knowledge. Meanwhile, entrepreneurs with complex knowledge structure are more alert to various types of information and other external influences. They are paying more attention to the different reference firms, and are less constrained by the stable routines. Diverse reference points and flexible work routines drive the entrepreneur to select the most creative ideas that will be advanced into innovations in new areas.

At the same time, the entrepreneur with a more centralized knowledge structure selectively receives certain information and knowledge relevant to the core concepts and peripheral concepts. This efficiency enhances the actor's ability to assimilate more information and knowledge to explore new productive resources. Meanwhile, since the entrepreneur can differentiate core factors from peripheral factors, this hierarchical knowledge structure enables them to imitate diverse reference companies for different factors. Furthermore, this information-processing efficiency enhances their ability of noticing the environmental changes and being less constrained by the existing organizational routines.

> **Hypothesis 2a**: The entrepreneur's knowledge structure complexity is associated positively with the new venture's degree of innovativeness.
> **Hypothesis 2b**: The entrepreneur's knowledge structure centrality is associated positively with the new venture's degree of innovativeness.

METHODOLOGY

Sample and Survey Design

A survey was conducted on a sample of 1000 new ventures in U.S. Participants were recruited directly by sending out the paper questionnaires addressing the owner of the firm followed up with telephone calls. Owner's contact information was obtained from the Hoover's Company Database. I employed four criteria when developing the mailing list. First, I selected new ventures from multiple technology industries to increase the findings' generalizability. These industries are chemicals, computer hardware and software, consumer products manufacturing, electronics, industrial manufacturing, pharmaceuticals, telecommunications equipment. Second, I restricted the remaining sample to firms 10 years of age or younger in this study. Different age ranges have been used in the previous literature, such as 12 (Covin, Slevin, & Covin, 1990), 8 (McDougall, 1989; S. A. Zahra, 1996) , and 6 years (Shaker A Zahra, Ireland, & Hitt, 2000). By the age of five, many startups have become extinct if they have failed to build strong market positions; meanwhile, older companies (up to the age of 12) have survived the liability of newness but have not become established firms (Bantel, 1998). Given the need to include enough samples in the mail survey, I used only firms 10 years of age or younger. Third, the potential sample was required to be an independent business, rather than a subsidiary, a division of another firm, or a unit of a conglomerate. Otherwise, the startup's social capital and innovation is attributed to decisions made by the parent firm rather than the entrepreneur. Fourth and finally, only firms with fewer than 500 employees were allowed to be in the sample.

The original questionnaire was revised based on the feedback from industry experts and two pilot tests. To encourage participation and valid responses, the introduction script of the questionnaire emphasized the potential benefits of this project to the entrepreneurs themselves. If any respondent request, I would send them an analysis report about comparing his/her knowledge structure and social

capital with those of others as well as their effects on new venture innovation. Approximately 1000 technology U.S. new ventures were contacted during the period between August 2006 and January 2008. 151 firms could not be reached, in spite of checking their address data. As a result, 849 firms were reached by mail. Among these 849 firms, 89 completed the full six-page questionnaire. Among the 89 respondents that completed the questionnaire, 70 are the founders of their businesses.

Variables Operationalization

Following previous literature (Autio, Sapienza, & Almeida, 2000; Eisenhardt & Schoonhoven, 1990; Smith, Collins, & Clark, 2005), I developed a two-item scale to measure the degree of innovativeness. The respondents were asked to indicate their degree of agreement with the following statements using a five-point Likert scale ranging from 1 to 5 (Scale 1–5: Strongly Agree–Strongly Disagree): (1) We used all existing knowledge to build the first product, service or technology. (2) We synthesized existing knowledge to produce our first product, service or technology. The cronbach alpha 0.8905 supported the internal consistency validity of this two-item scale.

Social capital is measured by the position generator method. This methodology captures occupational or positional characteristics of network alters, and enables one to collect data on strong and weak ties simultaneously (Lin, 2001). The position generator methodology has been used fruitfully in the social science studies (Batjargal, 2003; Belliveau, O'Reilly, & Wade, 1996; Lin & Dumin, 1986) because it allows the respondents to summarize their social contacts in each occupation, and report the tie strength simultaneously. This method is *theoretically meaningful* because occupation plays an important role in modern societies. A person's occupation indicates their social resources. People who know others in a wide variety of occupations can access the broader range of various resources. Researchers can measure the network diversity with the position generator by counting up the number of different kinds of occupations in which a person knows someone. Using this methodology, I measured the entrepreneur's access to occupational positions through social relationships. These social ties are critical for them to seek advice, obtain funding, establish cooperative relationships, and promote their products or services.

A table was presented in which 18 types of occupations are listed in rows, and three types of tie strength (Relatives, Friends, Acquaintances) are placed in columns (Lin & Dumin, 1986; Lin, Fu, & Hsung, 2001). The respondents were asked to indicate how many people were in each cell. I developed the following eighteen types of occupations based on the research of numerous previous studies (Batjargal, 2003; Belliveau, et al., 1996; Cooke & Wills, 1999; Dakhil & Clercq, 2004; Erickson, 2004; Lin & Dumin, 1986; Lin, et al., 2001; Van der Gaag & Snijders, 2004): (1) Professionals in universities, research institutes and government labs; (2) Professionals in trade associations and industry associations; (3) Managers of large banks, venture capital firms or other financial institutions; (4) Other staff members of large banks, venture capital firms or other financial institutions; (5) Managers of medium and small banks, venture capital firms or other financial institutions; (6) Other staff members of medium and small banks, venture capital firms or other financial institutions; (7) Owners or managers of large firms in your own industry; (8) Other staff members of large firms in your own industry; (9) Owners or managers of medium and small firms in your own industry; (10) Other staff members of medium and small firms in your own industry; (11) Owners or managers of large firms in different industries; (12) Other staff members of large firms in different industries; (13) Owners or managers of medium and small firms in different industries; (14) Other staff members of medium and small firms in different industries; (15) High-rank official in local governments; (16) Middle- and low-rank official in local governments; (17) High-rank official in ministries and agencies; (18) Middle- and low-rank official in ministries and agencies.

Next I used the Entropy index (Hoskisson, Hill, & Kim, 1993; Jacquemin & Berry, 1979; Palepu, 1985) to measure the diversity of social capital.

The diversity of social capital measures the degree to which an egocentric network contains alters from diverse occupations. The entropy measure measures the degree of dispersion of business ties in various occupations by multiplying a weight variable $\ln(1/p_i)$.

$$Entropy\ Measure = \sum_i [p_i \times \ln(1/p_i)]$$

where *Pi* is defined as the proportion of occupation *i*'s business contacts in all business ties and $\ln(1/p_i)$ is the weight for each occupation *i*.

Knowledge structure is measured by using the causal mapping methodology (Axelrod, 1976). Causal maps are representations of individuals (or groups) beliefs about causal relations. To construct a causal map, the first step is to develop a pool of constructs by conducting a review of relevant literature. In the second step, have each subject select a fixed number of constructs by identifying items from a constant pool of constructs. Finally, construct the causal map of each individual subject by having them assess the influence of each of their selected constructs on their other selected constructs. In this study, to improve the validity of knowledge structure measures and expedite the mapping process, the questionnaire asked the respondents to construct the causal relations between identified concepts directly. From a list of concepts generated from the innovation literature, each respondent selected the concepts they think important for new venture innovations, and established the causal relationship between these concepts. This is an efficient and effective way to capture each respondent's mental map of new venture innovation. I input each causal map matrix into the UCINET software (Borgatti, Everett, & Freeman, 2002) to compute the centrality and complexity measures of entrepreneurial knowledge structures.

Built on the previous literature (Biemans, 1991; Cooper, 1984; Powell, Koput, Bowie, & Smith-Doerr, 2002; Powell, et al., 1996; Sapienza, 1992; Saxenian, 1994; Shan, et al., 1994; Slater & Narver, 1999; Todtling & Kaufmann, 2002; Tyler & Gnyawali, 2002), I generated the following concepts: (1) Anticipate customers needs; (2) Building market share; (3) Encourage customer retention; (4) Appropriate response to target market growth projections; (5) Product builds on firms technological competencies; (6) Coordination of design specifications with operations; (7) Parallel development efforts across divisions; (8) Satisfy customers needs; (9) Competitors innovation activities; (10) Competitors cost advantage; (11) Speed of competitor response; (12) Anticipate competitors moves; (13) Consistent investment in R&D; (14) Existing capabilities to develop new products/services; (15) Potential to patent new products/designs; (16) Coordination between manufacturing and R&D; (17) Flow of market information between units; (18) Venture capital involvement; and (19) Joint research and development with business partners and/or research institutes.

Complexity of the mental model is measured by the density of a causal map. The density of a causal map refers to the ratio of causal links to the total number of constructs in the causal map (Eden, Ackermann, & Cropper, 1992). A higher ratio indicates that the entrepreneur's causal map is densely connected and supposes a higher level of complexity.

$$C_{complexity} = \frac{links}{constructs}$$

I used the established measure of centrality (Eden, et al., 1992) to calculate the degree centrality of each chosen concept and gives the overall causal map centralization. Centrality of each concept in the causal map was measured by adding the total number of concepts to which a specific concept in the map is linked either directly or indirectly. Each successive layer of concepts was assigned a diminishing weight. The centrality of a concept is the weighted average length of all the total paths that link it to other concepts in the map. The centrality of the causal map is the centrality of the most central concept minus the centrality of all other concepts in the map scaled by the total number of possible links between the concepts in the map (Borgatti, et al., 2002; Freeman, 1979).

$$C_{Centrality} = \frac{\sum_{i=1}^{n} [C_{Centrality}(p^*) - C_{Centrality}(p_i)]}{\max \sum_{i=1}^{n} [C_{Centrality}(p^*) - C_{Centrality}(p_i)]}$$

$$C_{Centrality}(p_i) = \sum_{i=1}^{n} a(p_i, p_k)$$

where $a(p_i, p_k) = 1$ if and only if p_i and p_k are connected by a line; 0 otherwise

$C_{Centrality}(p^*)$= largest value of $C_D(p_i)$ for any concept in the map, and $\max \sum_{i=1}^{n}[C_{Centrality}(p^*) - C_{Centrality}(p_i)]$ = the maximum possible sum of differences in point centrality for a map of *n* concepts.

Control Variables

In the questionnaire, respondents were asked to report age, gender, level of education, level of involvement in social activities, length of working experience, level of ownership, and startup experience. Numerous previous studies have shown that these factors play significant roles in new venture innovation. Among all these variables, the level of involvement in social activities is noteworthy. Since the respondents were asked to report their business ties, it is essential to control their level of participation in social activities at the aggregate level. They are asked to indicate the level of involvement (minimal, regular and heavy) for seven types of organization/club/group (Professional association, Trade association, Alumni association, Athletic club, Political party, Religious group, and Other).

In addition, the questionnaire asked the respondents to report the industry, size, and history of the firm as well as the proportion of R&D expenditure in its annual sales. The following questions are asked in the survey to obtain these control variables: (1) When was your company founded? (2) Number of current employees; (3) On average, how much is invested annually by your company in R&D as a percentage of sales?

RESULTS AND IMPLICATIONS

TABLE 1
PEARSON CORRELATIONS [a]

		Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Degree of innovativeness	2.129	0.992														
2	Knowledge structure centrality	0.178	0.145	-.114													
3	Knowledge structure complexity	0.581	0.621	-.212†	.712***												
4	Social capital diversity	1.086	0.559	.095	.148	.351**											
5	Firm size	20.229	39.002	-.097	-.056	-.046	-.110										
6	Firm history	11.464	6.103	-.039	.118	.142	-.059	.019									
7	R&D investment	3.580	2.452	.037	.234†	.178	.074	-.030	-.033								
8	Participation in social activities	3.529	2.198	.068	-.095	.105	.367**	.057	-.170	-.189							
9	Age	4.043	1.042	.191	-.153	-.116	-.200	.053	.443***	-.168	-.124						
10	Gender	1.129	0.337	-.007	.226†	.122	.085	-.135	.031	-.057	-.171	-.264*					
11	Education	3.429	2.352	-.089	.280*	.315**	-.045	.210†	-.145	.289*	-.046	-.247*	.112				
12	Working experience	19.514	9.930	.061	-.058	-.208†	-.115	.185	.178	-.089	-.201†	.498***	-.163	-.143			
13	Industry dummy	0.662	0.477	-.303*	.254*	.231†	-.197	.113	.195	.364**	-.082	-.118	-.179	.314**	-.091		
14	Ownership	9.043	3.141	.124	.116	.035	.040	-.295*	.151	-.158	-.270*	-.054	.132	-.056	.012	-.040	
15	Startup experience Dummy	0.500	0.504	.044	-.037	-.072	-.064	-.092	-.024	.111	-.046	.180	-.043	-.281*	.119	-.259*	-.005

[a] N =70.

† $p < .1$ (two-tailed) * $p < .05$ (two-tailed) ** $p < .01$ (two-tailed) *** $p < .001$ (two-tailed)

I used general least squares modeling to analyze the data. The model I used to test hypotheses 1a and 1b is represented by the following equation: $y_i = x_i\beta + \varepsilon_{it}$ where y_i is the knowledge structure property of respondent i; x_i is a vector of characteristics of new venture *i*, including the independent variables and

control variables; and ε_i is an error term. The model I used to test hypotheses 2a and 2b is represented by the following equation: $y_i = x_i\beta + \varepsilon_{it}$ where y_i is the degree of innovativeness of new venture *i*; x_i is a vector of characteristics of new venture *i*, including the independent variables and control variables; and ε_i is an error term.

Table 1 presents the descriptive statistics and correlation matrix of all the variables. It is noteworthy that, even without controlling any other effects, the correlation between social capital diversity and knowledge structure complexity is significant at .01 level. Knowledge structure complexity and centrality is strongly correlated, which means an actor with more complex knowledge structure is more likely to develop the ability of differentiating the core factors from the peripheral factors.

TABLE 2
EFFECT OF SOCIAL CAPITAL DIVERSITY ON KNOWLEDGE STRUCTURE [a]

	Knowledge Structure Complexity		Knowledge Structure Centrality	
	Model 1	Model 2	Model 1	Model 2
(Constant)	-.525	-.568	-.040	-.046
	(.844)	(.746)	(.169)	(.161)
Firm size	-.001	-.002	.000	.000
	(.002)	(.002)	(.000)	(.000)
Firm history	.021	.012	.001	-.001
	(.017)	(.015)	(.003)	(.003)
R&D investment	.029	-.013	.006	.001
	(.041)	(.038)	(.008)	(.008)
Participation in social activities	.062	-.013	.003	-.007
	(.044)	(.044)	(.009)	(.010)
Age	-.012	.036	-.029	-.022
	(.111)	(.099)	(.022)	(.021)
Gender	.267	.057	.107†	.078
	(.310)	(.280)	(.062)	(.061)
Education	.060	.072†	.002	.003
	(.047)	(.042)	(.009)	(.009)
Working experience	-.008	-.013	.001	.000
	(.010)	(.009)	(.002)	(.002)
Industry dummy	.168	.374†	.083†	.111*
	(.239)	(.219)	(.048)	(.047)
Ownership	.012	-.014	.009	.005
	(.031)	(.029)	(.006)	(.006)
Startup experience dummy	.079	.157	.032	.042
	(.206)	(.184)	(.041)	(.040)
Social capital diversity		.638***		.086*
		(.179)		(.039)
R^2	.238	.419	.300	.376
F	1.195	2.46*	1.638	2.055*

[a] The table gives parameter estimates; the standard error is below each parameter estimate in parentheses. N=55 † $p < .1$ (two-tailed) * $p < .05$ (two-tailed) ** $p < .01$ (two-tailed) *** $p < .001$ (two-tailed)

Table 2 and 3 present the results from the least squares regression analysis. The models in Table 2 indicate a significant positive relationship between social capital diversity and knowledge structure complexity, so is between social capital diversity and knowledge structure centrality. Firm industry and entrepreneur's education level are marginally significant. This regression analysis supports Hypothesis 1a and 1b. The models in Table 3 indicate a weak negative relationship between knowledge structure complexity and degree of innovativeness, so is between knowledge structure centrality and degree of innovativeness. R&D investment, age, industry dummy, and ownership are also significant.

TABLE 3
EFFECTS OF KNOWLEDGE STRUCTURE ON NEW VENTURE INNOVATION [a]

	Model 1	Model 2	Model 3	Model 4
Constant	.121	-.128	-.088	-.120
	(1.115)	(1.073)	(1.099)	(1.076)
Firm size	.001	.001	.001	.001
	(.003)	(.003)	(.003)	(.003)
Firm history	-.030	-.019	-.028	-.022
	(.023)	(.023)	(.023)	(.023)
R&D investment	.138*	.151**	.152**	.157**
	(.057)	(.055)	(.057)	(.055)
Participation in social activities	.079	.109†	.087	.100†
	(.059)	(.058)	(.058)	(.059)
Age	.347*	.330*	.315*	.315*
	(.154)	(.147)	(.152)	(.149)
Gender	.240	.328	.438	.407
	(.407)	(.391)	(.415)	(.403)
Education	-.004	.011	.010	.008
	(.061)	(.059)	(.060)	(.059)
Experience	-.003	-.008	-.002	-.006
	(.014)	(.013)	(.014)	(.014)
Industry dummy	-.767*	-.759*	-.671*	-.734*
	(.317)	(.289)	(.315)	(.292)
Ownership	.066	.085*	.082†	.091*
	(.044)	(.040)	(.044)	(.041)
Startup experience dummy	-.313	-.292	-.277	-.302
	(.276)	(.253)	(.271)	(.254)
Knowledge structure complexity		-.394†		-.197
		(.200)		(.307)
Knowledge structure centrality			-1.819†	-1.227
			(1.032)	(1.453)
R^2	.257	.322	.300	.332
F	1.602	2.102*	1.788†	1.984*

[a] The table gives parameter estimates; the standard error is below each parameter estimate in parentheses. 63<= N <=66

† $p < .1$ (two-tailed) * $p < .05$ (two-tailed) ** $p < .01$ (two-tailed) *** $p < .001$ (two-tailed)

The analysis results are consistent with Hypothesis 1a and 1b. An entrepreneur's social capital influences their knowledge structures of new venture innovation. However, a negative, instead of positive, relationship between knowledge structure complexity and centrality and degree of innovativeness was found significant. The possible explanation is that some respondents' firms are operating in the traditional manufacturing industries. Although technologies are involved in the manufacturing process, these new ventures had to explore new knowledge domains to produce their first product, service or technology in these mature industries. Conversely, in the emerging high-technology industries, new ventures can survive by leveraging existing knowledge and technologies. Both the correlation matrix and Table 3 provided evidence that industry dummy is negatively correlated with degree of innovativeness. The implication is that high-technology startups tend to rely on existing knowledge bases to develop product, services, or technologies; whereas new ventures in the traditional manufacturing industries tend to explore new knowledge domains to develop their businesses. Moreover, knowledge structure complexity is positively correlated with industry dummy. In the high-technology industries, entrepreneurs tend to have a more complex mental model. The combined effect of these two correlations significantly influences the analysis results of this study. Furthermore, because the respondent is the sole data source for both independent variables and dependent variable, common method variance (Avolio, Yammarino, & Bass, 1991; Podsakoff & Organ, 1986) could introduce spurious correlation between the variables. Future research could address this issue by focusing on a single industry or use objective measures of firm innovativeness.

DISCUSSION

Contributions

This research extends several sets of literature – organization theory and new venture innovation, as does organizational research methodologies.

Entrepreneurs' social capital influences their knowledge structure of new product development. In a diverse social network, actors' knowledge structure tends to be more complex, and more centralized. This finding highlights the importance of entrepreneurs' social networking activities. When uncertainty is high, entrepreneurs should turn to different contacts to seek advice, establish cooperative relationships, and obtain funding. These business contacts not only provide external resources to the entrepreneurs, but also influence positively their internal knowledge structure. This reinforcing effect of social capital helps the formation of innovation networks. This finding also implies that the networking activities between different industries and regions could benefit the participants' knowledge structures.

Moreover, this research contributes to a richer understanding of the sources and process of new venture innovation. The analysis results suggest that entrepreneur's knowledge structure appear to influence the innovation process. By incorporating the entrepreneur's knowledge structure with their social capital in the context of new venture innovation, this paper attempts to develop a theory of action which connects individual interests with social structure (Poole & Vandeven, 1989). In addition, empirical measures of latent constructs, such as entrepreneur's knowledge structure characteristics, were developed. This empirical study improves on prior research by including measures of knowledge structure that are comparable across entrepreneurs.

Limitations and Directions for Future Research

Despite the contributions this research is expected to make, several unanswered questions remain, providing important directions for future research. First, there might be an interaction between actors' knowledge structures and social capital in the context of new venture innovation. Future research could examine this interactive effect. Second, if technology startups could be traced over time, a longitudinal study could examine the dynamic innovation process. Third, future research could conduct comparative research across industries as well as across countries. Fourth, high-technology regions play a leading role in technological innovations. Future research could target the technology startups in these regions such as the Silicon Valley of California and Research Triangle Park of North Carolina. Regional competitiveness

continues to come from innovative networks. In an incubator park, local policy and service firms play key roles in establishing the scaffolding for the embedded entrepreneurs and their new ventures. Future research could study the effects of these institutions on the entrepreneurs' knowledge structures and social networks. Finally, assessing entrepreneurial knowledge structure's influence on innovation activities is a first step in exploring its impact on organizational outcomes. Further research could study the effects of entrepreneurs' knowledge structure on other organizational outcomes such as profitability, stock price, etc.

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