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The role of CEO's intra-firm network in innovation orientation of hi-tech entrepreneurial firms

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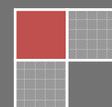
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ABSTRACT

Drawing from the social capital and strategic leadership perspective, the paper examines how CEO's intra-firm network determines the innovation strategy of hi-tech entrepreneurial firms, and how such relationship is moderated by certain top management team characteristics that influence information processing. We collected our data through questionnaires from three high-tech parks. Empirical tests in a sample of 122 entrepreneurial firms provide evidence that CEO's intra-firm network embeddedness has a positive effect on innovation orientation. Besides, TMT cognitive conflict weakens the impact of CEO's intra-firm network on the ambidexterity.

KEYWORDS

CEO intra-firm network; Innovation orientation; Information processing.



INTRODUCTION

For a high-tech entrepreneurial firm, its competitive advantage often depends upon its ability to innovate and development of technological assets. Pursuing different innovation orientation may result in different performance outcomes. In an increasingly dynamic and complex business environment, entrepreneurial firms are often faced with double challenges: one of which is the need for the firms to increase the competitiveness in a short term and create values quickly by making full use of the assets and experience, and the other of which is the need for the firms to be flexible and adaptable in seizing opportunities for the future development. Researches show that an organization can potentially manage both activities at a high level, thereby achieving an ambidextrous innovation orientation^{[1][2]}. There is growing evidence that ambidextrous firms are more successful than firms that are oriented to only exploration or only exploitation^{[3][4][5]}. Lacking of resources and funding prevents the entrepreneurial firm from establishing structural ambidextrous organization to carry out simultaneously exploratory innovation and exploitative innovation. Entrepreneurial firms have to obtain external resources to make up for the inadequacy of their own resources.

In an entrepreneurial firm, CEO is regarded as the gatekeeper and typically exerts the dominant influence on balancing the exploitative innovation and exploratory innovation. CEO in reality plays a key role in determining the technology orientation by possessing both the internal and external social network. The social network of the CEO is an important access to information, and the key factor for strategic choices. These effects render CEO social capital as a uniquely relevant lens to explain innovation orientation because evidence shows that executive influence on technology orientation is especially salient in the context of resource constraints, ambiguity, and uncertainty intrinsic to entrepreneurial action. In this research, we aim to disentangle how CEO's social networks contribute to an entrepreneurial firm's innovation orientation to explore as well as exploit. Our central thesis is that CEO's network creates an information advantage, such that the CEO is in a better position to access and gather information from both within and outside the organization. This will enable the firm to be better cognizant of the locus of exploration and exploitation.

Furthermore, we examine whether the effect of CEO's network on innovation ambidexterity is contingent on top management team (TMT). We argue that TMT cognitive conflict indicates the degree in which the collected information is evaluated and processed. As such, this characteristic will moderate the information advantage brought by CEO's social networks.

LITERATURE REVIEW

Innovation orientation

In terms of concept, March (1991) pointed out that exploratory innovation is the attempt to take new chances, while the exploitative innovation aims to refine and develop the existing technology and capacity^[6]. Bener and Tushman (2003) defined exploratory innovation as pursuing new knowledge and developing new products and services for new customers and markets. According to them, exploratory innovation, which provides new designs, creates new markets and develops new distribution channels, is radical innovation^[7]. At its opposite side, exploitative innovation aims to expand by means of the present knowledge the existing products and services for the existing customers. In their views, exploitative innovation, which broadens the existing technology, improves the existing products, expands the service scope of existing products, and improves the efficiency of the existing distribution channels, is progressive innovation. Nooteboom (2005) pointed out that exploratory innovation on the enterprise level is the development of new products having not patented by the firm and on the industry level is the development of completely new technologies^[8].

Benner and Tushman (2003) held that exploitative innovation, which means the continuous improvement on existing technology, is based on the present technological trajectories, while the exploratory innovation is transferred to a different trajectory^[7]. He and Wong (2004) defined exploitative innovation as technology innovation activities aiming to improve existing products and markets and exploratory innovation as those aiming to enter the markets of new products^[4]. It can be seen that in these studies, both of them involve learning, improvement, and access to new knowledge. The difference between the two is whether the innovation takes place on the same technology trajectory. Vermeulen and Barkema (2001) defined exploratory innovation as "to explore new knowledge", and exploitative innovation as "to continue to use the knowledge base of the enterprise"^[9]. Based on this definition, they take all the acquisitions as exploration innovation, while all the GreenField investment as adoption innovation.

The CEO's social network

A CEO's social network represents system of relationships that the CEO has with organizational members and other actors outside of their organization^[10]. There are a variety of definitions on the idea of social network. Adler and Kwon (2002) summarized 20 of them, which distinguishes each other in the research perspectives. Social network focuses on the issue of "who are you acquainted with", and therefore it pays great attention to network connections and relationships. In this way, the social network of a CEO refers to values generated by the connections and relationships between the CEO and the stakeholders inside and outside a firm^{[11][12]}. Consistent with these research^{[13][10]}, we conceptualize network extensiveness as ranging from high to low as an aggregate function of the CEO's total set of non-TMT contacts within the firm (e.g. contacts in such functions as R&D, production/manufacturing, marketing/sales, service, and administration) and outside the firm (e.g.

with suppliers, customers, financial institutions, competitors, governmental agencies, and industrial authorities). In fact, the values are brought by a series of behaviors associated with social relations. The relationships of the people in the society are varied, but only those good ones can produce the above-mentioned values^[11], because good relationships among the whole network stimulate people to share information more willingly, so that the firms the mutual influences between enterprises grow and the unity and collaboration of individuals in the network improve^[11]. Similarly, Adle and Kwon (2002) also pointed out that the values of the CEO's social capital are generated by the social structure of the CEO's networks. According to them, the CEO is the focus of a firm, whose fame is an important part of his social capital. Therefore, social network CEO is of great significance for the development of an organization^[11].

As no individual could live outside the social environment, the CEO is in the same way "embedded" in social systems^[11]. A CEO has accumulated personal social capital for many years in the society, and has formed a unique mode of operating this capital in his own way, which profoundly affects the firm's strategic decision-makings. Importantly, CEO manages information through his/her social networks^{[10][13]}. CEOs are typically considered to be embedded in at least two types of social systems—*intra-firm social network* and *inter-firm social network*^[11]. *Intra-firm network* pertains to the set of relationships the CEO has with others within the focal organization. Such a network includes employees from diverse parts as well as diverse levels of the organization. *Inter-firm network* refers to the set of relationships the CEO has with individuals outside the organization who hold information of potential value to the firm, including customers, suppliers, competitors, financial agencies, and administrative agencies^{[10][13]}.

THEORETICAL FRAMEWORK

CEO's intra-firm network and innovation strategy

Drawing from the information perspective, we contend that CEO's embeddedness in the *intra-firm network* can, individually and jointly, generate information advantages, which facilitate the firm's ambidextrous innovation orientation. Prior research has highlighted the conflicting goals and processes between exploration and exploitation^{[7][14][15]}. Exploitation is oriented to improve the firm's existing products and markets. It is aimed for efficiency and variance-decreasing, and thus requires the decision makers to be fully informed of where the firm's existing competencies locate and how to make the best use of them. In contrast, exploration is oriented to generate new products and markets. Such activities seek variety and variance, and thus require the decision makers to be aware of the opportunity sets that go beyond the firm's existing competencies.

We argue that CEO's embeddedness in the *intra-firm network* facilitates a firm's simultaneous pursuit of exploration and exploitation. With regard to exploitation, CEO's centrality within the organization's internal network provides him/her with comprehensive information sources about the resources, operations, and outcomes of the firm. Besides, strong ties ensure that the information collected through such channels is timely and accountable. In other words, a high level of embeddedness in the *intra-firm network* can maximize the CEO's ability to gather information from various parts and levels of the organization, with which the CEO and the firm can make effective evaluation and judgment on where the competencies lie in the organization, and where incremental improvement can be made^{[10][16]}. When the CEO is ill-informed of the firm's resource allocation and productivity distribution, he/she will be less capable of leading the firm to reduce cost or enhance best practice. In this case, exploitation, or building on existing competencies for product and market development, will become less efficient.

Furthermore, CEO's embeddedness in the *intra-firm network* can also facilitate the firm's exploratory behaviors. Exploration, characterized by generating "new possibilities"^[6], or creating new products, markets, and competencies, often results from recombination of existing knowledge and resources. Research has shown that combining knowledge and resources that are from different domains may lead to new discoveries^{[14][17]}. The process of integrating knowledge from a diverse set of domains within the organization is also termed as "bisociation"^[18]. One premise of an effective "bisociation" process is that the CEO be fully aware of the nature and locations of a wide array of resources that reside within the firm. The CEO that is highly embedded in the *intra-firm network* will enjoy this advantage. When the CEO, through his/her connections to the diverse parts and levels of the organization, gains comprehensive and precise knowledge of the resource portfolio within the firm, he/she is in a better position to direct effective combinations and thus initiate exploratory activities^[19]. Based on the above arguments, CEO's *intra-firm network* can facilitate a firm's both exploratory and exploitative efforts. We thus hypothesize:

H1a: CEO's intra-firm network embeddedness is positively related to organizational innovation orientation.

Moderating role of TMT cognitive conflict

Conflict within the team emerges when team members have discrepant opinions, incompatible wishes, or irreconcilable desires^{[20][21]}. Conflict is likely to result from individual differences in demographics, experiences, and values^{[22][23]}. In the decision making research, conflict within TMT has been regarded as one of the most important factors that influence decision quality and firm performance^{[24][25][26]}. In the literature, conflict has been disaggregated into cognitive conflict and affective conflict. The former, also referred to as substantive conflict, is based on disagreements about the task; the latter, also termed as emotional conflict, involves interpersonal friction^[27]. In this paper, we focus on TMT members' conflict over strategy-related information. Thus, the conflict is task-, rather than emotion-, based.

TMT cognitive conflict is often viewed as a double-edge sword. On the positive side, disagreements within the team lead to debate and in-depth discussion of strategic issues. By stimulating different opinions, ideas, and perspectives, the TMT is able to weigh various alternatives thoroughly and have a comprehensive understanding of the issues in question^{[23][24]}. As such, higher decision quality can be achieved. However, such conflict can be detrimental as well. In particular, a high level of cognitive conflict may trigger a high level of affective conflict, which hurts team members' commitment and in turn team effectiveness^[28]. From the information processing perspective^{[29][30]}, the level of conflict should match the complexity of the strategic issue in question. When the degree of variety of viewpoints in the team exceeds the amount of information required to complete the task, the high cost of evaluating different viewpoints and integrating them will thus lead to inefficiency in the decision making.

Building on the above observations about pros and cons of TMT cognitive conflict, we point out that such conflict will strengthen the relationship between CEO's inter-firm network embeddedness and organizational ambidexterity, yet will weaken the relationship between CEO's intra-firm network embeddedness and ambidexterity. CEO's embeddedness in the social networks determines the capacity of information that can be channeled and brought into the decision making team. The information is in turn to be evaluated and processed, providing the basis for the firm's strategy making. A high level of cognitive conflict within the TMT implies that the information is evaluated and processed on a comprehensive basis through debates and integration. Information gathered from CEO's intra-firm network comes from inside the organization, and thus has, to a large extent, already proved relevant and reliable to the firm. As such, too much debates and variety of opinions among TMT over such internally-sourced information will not add much value, but may decrease the efficiency of the decision making^[30]. These arguments thus lead to the following predictions:

H2a: TMT cognitive conflict weakens the positive relationship between CEO's intra-firm network embeddedness and organizational innovation orientation.

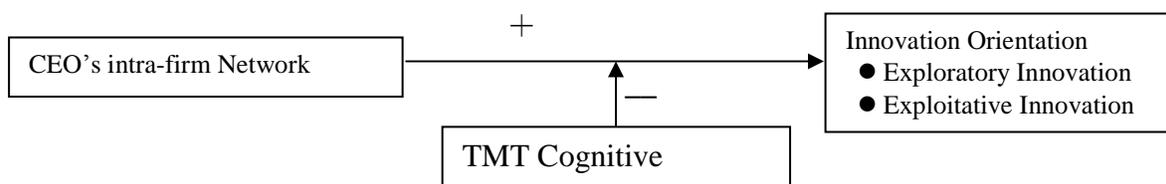


Figure 1 : Model of CEO's intra-firm network and innovation orientation of entrepreneurial firms

METHODS

We collected our data through questionnaires from three high-tech parks. We randomly selected a total of 200 firms out of the total population of firms in three high-tech parks located in three provinces that represent the three major Chinese economic zones: the eastern coastal zone (Shandong), the southern zone (Guangdong), and the midwestern zone (Sichuan). We trained these assistants, who then went to each of the sample firms on site to deliver two separate questionnaires, together with stamped return envelopes, in sealed envelopes to the CEOs and CTOs and also to clarify the requests. The final sample consists of 122 firms, representing completed questionnaires from both the CEO and the CTO with usable data. The response rate was 122/200 (61%). We split the sample into early and late respondents and compared the two groups on the above list of variables, and found no significant mean differences between them on any of these variables. The 122 firms in the final sample averaged 118 employees, \$3.4 million in sales, 6.2 years in age, and 4.7 top management team members (including the CEO). These firms represent a variety of high-tech industries, including biotechnology (3.3%), computer software (14.8%), factory automation (13.9%), electronics (23%), telecommunication (16.4%), environmental technologies (2.5%), specialty chemicals (4.1%), test measurements (4.9%), advanced materials (7.4%), semiconductors technology (4.1%), and medical and surgical equipment (3.3%). We found no significant differences across industries in either firm age or firm size.

To mitigate common method bias concerns, we collected data for dependent variables and independent variables from different key informants (i.e. CEOs and CTOs); overlapping questions were used for the purpose of validity check. The CTO was the second informant because in these high-tech firms that compete on technology and new products, CTOs naturally play the second most important role in formulating and implementing firm strategies, especially those related to exploiting existing products and markets and exploring new products and markets.

RESULTS

We followed the current studies to measure the intra-firm network, exploratory innovation orientation, exploitative innovation orientation, TMT cognitive conflict and control variables. We performed ordinary least squares regression analysis to test our hypotheses after we got the means, standard deviations, and correlations for the study's measures. TABLE 1 reports the descriptives and the zero-order correlations of all the theory variables and the control variables. TABLE 2 reports the regression results. We used hierarchical moderated regression method to test the contingency hypotheses.

TABLE 1 : Descriptives and zero-order correlations

	Mean	s.d.	1	2	3	4	5	6
1 Innovation Orientation	5.45	.93						
2 Intra-firm network	28.23	23.90	.10					
3 TMT cognitive conflict	2.98	1.20	-.17 [†]	.06				
4 Firm age	6.19	4.41	-.10	.35***	.06			
5 Firm size	4.30	1.11	-.03	.64***	.12	.60***		
6 Growth rate	43.11	57.14	.16 [†]	-.09	.15	-.24***	-.17 [†]	
7 R&D intensity	25.69	18.70	.03	-.13	.10	-.30**	-.28**	.01

p<.1, *p<.05, **p<.01, ***p<.001

TABLE 2 : OLS regressions on the effect of CEO network embeddedness on organizational ambidexterity

	1	2	3
Controls:			
Location-east	.128(.208)	.050(.219)	.056(.215)
Location-south	-.137(.258)	-.176(.262)	-.220(.260)
Industry-computer	-.602(.190)**	-.568(.195)**	-.587(.190)**
Industry-life sciences	-.295(.251)	-.258(.254)	-.307(.250)
Firm age	-.031(.023)	-.034(.024)	-.027(.024)
Firm size	.090(.089)	.056(.116)	.086(.114)
Growth rate	.002(.001)	.002(.001)	.002(.001)
R&D intensity	.002(.004)	.002(.004)	.002(.004)
Moderators:			
TMT cognitive conflict	-.067(.070)	-.057(.072)	-.385(.138)**
Predictors:			
CEO intra-firm network		.018(.009)*	.065(.018)*
Interactions:			
Intra-firm network*conflict			-.010(.004) ***
Constant	4.547(.547)***	4.598(.618)***	5.447(.680)***
R ²	.255	.263	.313
d.f.	10, 111	12, 109	14, 107
F (R ²)	3.791***	3.249***	3.484***
ΔR ²		.009	.050
d.f.		2, 109	2, 107
F(ΔR ²)		.657	3.868*

Unstandardized coefficients reported, with standard errors in parentheses

† p<.1; * p<.05; **p<.01; ***p<.001

Model 2 adds in the main theory variable—CEO's intra-firm network embeddedness. H1 posit that CEO's intra-firm network is positively associated with organizational ambidexterity. This hypothesis is supported by the results.

Model 3 examines the moderating effect of TMT cognitive conflict. The interaction between TMT cognitive conflict and CEO's intra-firm network embeddedness is significant.

DISCUSSION AND CONCLUSION

The finding of the main effect of CEO's intra-firm network embeddedness suggests that the information sourced from the inside of the firm will affect the innovation orientation. Regarding exploitation, information coming through the

intra-firm networks provide feedback on what to look for internally, this can maximize the CEO's ability to gather information from various parts and levels of the organization to make effective evaluation and judgment on where the competencies lie in the organization, and where incremental improvement can be made. With reference to exploration, internally-sourced information enlarge the base for novel combinations. As such, the results imply that CEO's intra-firm networks are important in leveraging information advantage for achieving ambidexterity.

In addition, we have found that TMT cognitive conflict serves as mechanisms of information processing, moderate the effect of CEO's intra-firm social networks on organizational ambidexterity. In particular, TMT cognitive conflict weakens the effect of CEO's intra-firm network embeddedness on the innovation orientation. Too much debates and variety of opinions among TMT over such internally-sourced information may not add much value, but may decrease the efficiency of the decision making.

Overall, the central arguments are based on how information advantage is created through CEO's social networks that source information, coupled with certain TMT mechanism that pertain to the processing of the collected information. CEO that is highly embedded in intra-firm network is privy to a large amount of information both within and outside the firm, which thereby enhances the decision makers' ability to deal with contradiction and ambiguity in the simultaneous pursuit of exploratory and exploitative activities^[31].

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