Matching of Interfirm Network and Organizational Learning: Implications for Technological Innovation

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Abstract: - There has been a burgeoning literature about interfirm network and innovative performance. However, in reviewing the extant literature we find different interpretations regarding how firms should be tied to one another in networks. The paper employs case study to explore and explain the relative propositions of interfirm network, different organizational learning and technological innovation. It addresses two critical research questions. First, strong ties or cohesive network are valuable in environments that require exploitation, while weak ties or sparse network would be more appropriate for exploration. Second, the benefits of each type of interfirm network vary across each other such that certain types of interfirm network will matter more or less under different conditions and objectives. Therefore, exploration and exploitation are two essential organizational learning models, under which firms need make a reasonable choice between them according the development stage, environment requirements and innovative targets.

Key-Words: - Interfirm network, Organizational learning, Exploration, Exploitation, Network Density, Tie strength, Technological innovation

1 Introduction

There is a rapidly expanding body of theoretical and empirical literature showing that interfirm network constitute a valuable means for integrating complementary resources into a firm's innovation processes, thereby significantly increasing a firm's innovation success. However, research has produced contradictory and confusing implications regarding how firms should be tied to one another in networks [1]. Depending on a firm's innovation targets, internal resources and its external context, different external resources are needed. We assume that different types of interfirm network are particularly appropriate to contributing specific kinds of resources and know-how [2].

In this paper, we propose that interfirm network are not uniform in their effects on firm innovation, but rather vary across different types of network ties a firm has developed as well as the environment requirements. Together, these two dimensions, network tie strengths and network density, form the basis of our exploration into the contingent value of interfirm relationships for firm technological innovation. We focus on two types of tie strengths: strong ties and weak ties, two types of network density: cohesive network and sparse network, and two types of learning: exploration and exploitation. And we will discuss the mechanism of interfirm network influencing on innovation performance.

2 Theoretical Background

This section will review related theory including organizational learning, technological innovation and interfirm network. Finally, the analytical frame would put forward.

2.1 Organizational Learning

Organizational Learning could be divided into exploratory learning and exploitative learning based on enterprise existing knowledge and different technology trajectory [3] [4]. Exploration and exploitation have been characterized as fundamentally different search modes [5]. While exploitation involves local search that builds on a firm's existing technological capabilities, exploration involves more distant search for new technological capabilities. From innovation exploitative learning involves perspective, components improvements in existing and architectures and building on the existing technological trajectory, whereas exploratory learning involves a shift to a different technological trajectory. Empirical literature reflects this dichotomy, often distinguishing between innovations that leverage a firm's existing knowledge and innovations that rely on no previous firm knowledge.

Following the seminal work of March in 1991, a great number of researchers have studied the notion of exploitation and exploration from different perspectives. However, this paper focuses in particular on the interpretation of exploration and exploitation in the literature on technological innovation. An assumption is that truly exploratory, variance-increasing activities require distant search and a departure from a focal firm's store of current skills and capabilities. The idea of exploration as distant search can be extended by characterizing an organization's innovative activity along a continuum, measured by the extent to which it is anchored in knowledge used in a firm's previous innovations. Innovation is increasingly exploratory the more it departs from knowledge used in prior innovation efforts and, conversely, increasingly exploitative the more deeply anchored it is in existing firm knowledge [6].

2.2 Technological Innovation

The notion of exploration and exploitation has been widely used in studies on organizational learning, strategic renewal and technological innovation. Because technological innovation is considered as a critical competitive capability for growth and adaptation [7], and it demonstrates a firm 's capability of effective organizational learning [8]. Owing to the different natures of learning for exploration and exploitation, they may have different relational features. For instance, exploration and exploitation may differ in ways of building social ties and network configurations and risk taking among organizations. Thus, a relational perspective on exploration and exploitation, complementary to the learning perspective, can be a promising direction for future studies [6]. So, our framework was developed based on the existing literature in innovation management with a strong emphasis on the organizational learning and interfirm network perspective.

We argue that the environmental uncertainty is useful for understanding the conditions under which strong and weak ties are advantageous. Uncertainty also challenges managers by making it difficult for them to predict the future. We focus on market uncertainty, the extent to which the industry environment is volatile and fast changing, because it creates greater uncertainty about the actions of other economic actors, such as customers, competitors, suppliers, and regulators [9].

When the market uncertainty is high, firms are required development new product to sustain their competitive advantages, so exploring new knowledge is more important than exploiting existing knowledge. Rather, when the market uncertainty is low, firms can enhance their product quality or reduce the cost to win the competition, in the situation, exploiting existing knowledge is more important.

Moreover, one of the implications of Afuah's (2000) [10] study of alliances among computer workstation manufacturers is that a firm operation in a turbulent environment (rapid technological change and obsolescence) should not invest all of is alliance resources in strong ties to a small set of suppliers and horizontal partners. A technological shock dramatically impede its competitive could advantage, because it is overcommitted to the strategic position established through its close partners. Thus, firms need to allocate resources to maintaining at least weak relationships with alternative partners, who represent options for dealing with environmental shocks. Overall, the relationship between tie strengths and firm performance depends on whether the environment demands a relatively high degree of exploitation or exploration.

2.3 The Characteristics of Interfirm Network

There are many different dimensions to analyze the interfirm network, but the paper focus on two dimensions: tie strength and network density.

2.3.1 Strong Ties Versus Weak Ties

Much of the early research on tie strengths draws on Granovetter's (1973) [11] conceptualization of ties with a focus on information flows among individuals. The crux of his theory is that strong ties among individuals facilitate information flows but such individuals are likely to possess highly redundant information. In contrast, individuals with weak ties will likely possess more diverse information (increasing the likelihood of finding novel ideas), but the weakness of their ties increases the difficulty of information flow among them. Thus weak ties have a greater potential for generating novel solutions but lack the characteristics to realize that potential.

Rangan (2000) [12] conceptualized a tie between organizations as an information bridge between

them. Information is transferred over this bridge between the parties. Both strong and weak ties have different roles with information transfers. Both of them benefit innovation differently. The strong tie benefits innovation with the transfers of complex information. This kind of information is often uncertainty, unclear and difficult to understand without processing. However, it carries great insights that are particularly useful to innovation. To transfer complex information, much effort is required in the transfer processes. The strong tie eases transfer processes by encouraging parties to spend time and have close communications. However, the strong tie carries undesirable effects. Partners may end-up locked-in among themselves and lock-out new partners who potentially bring in novelties. The results bring a lack of new information and potentially hindering innovation. Here is where the weak tie helps innovation. The weak tie benefits innovation with the transfers of simple information. This kind of information captures a limited content.

However, it does not take much effort to transfer simple information. The information is largely context independent and highly portable [13]. Unlike the complex information in the strong tie, a breadth of information is carried by the weak tie. Salman and Saives (2005) [14] argued an organization requires a number of weak ties to fully benefit innovation because innovation benefits from a variety of information.

2.3.2 Cohesive Network Versus Sparse Network

To exploitation, a firm enjoys access advantages when its ties share membership in a closed, cohesive network. In such networks, resources will be more accessible as others offer assistance based on mutual identification, a sense of social obligation, and 'enforceable trust' [15]. Enforceable trust lowers the risk of dealing with a firm because the closure and cohesion of the network ensure that an opportunistic new firm faces the prospect of sanctions from others within the network. This mechanism of enforceable trust facilitates the asymmetric exchanges that often occur within cohesive networks. These cohesive networks are critical to exploitative learning since potential resource providers may be unwilling to exchange with a firm where future reciprocity (i.e., financial payments) is uncertain. Firms that lack membership in such cohesive networks may be particularly limited in gaining access to needed resources [16].

While cohesive networks offer advantages in gaining access to available resources, they have a fundamental weakness for firms: available resources

are likely to be limited to those within the somewhat closed network. Both relationships and resources, particularly information, within these dense networks are likely to be high in redundancy and low in diversity. Thus, to exploration, firms need to move beyond the initial, close and cohesive networks in order to find and develop new ties that can provide more available resources.

As firms add new nonembedded ties and thus reduce cohesion, the most advantageous of these new ties for resource acquisition will be those that in Burt's (1992) [17] terms help the firm to bridge structural holes. Bridging structural holes allows a firm to control resources that others need, thus increasing its added value. Our evolutionary argument helps answer the puzzle of why research on exploitation finds benefits from cohesion [16] while at the same time others demonstrate the benefits of bridging structural holes [18]. For a firm, a sparse network that is rich in structural holes may not offset the risk that potential ties perceive in forming connections with a firm facing a highly uncertain future. However, ties that bridge structural holes are likely to be the most valuable for exploration.

3 Methods

Case studies as tools for generating and testing theory have provided the strategic management field with ground-breaking insights. Comparative longitudinal multiple case study research with the aim of developing theory from an in depth examination of two lead firms and the dynamics of their alliance networks are carried out in the paper.

3.1 Research Design

Following Yin (1981) [19], the case study was deemed an appropriate research strategy to help understand the phenomena under investigation within their rich (inter)organizational contexts by relying on several sources of evidence, while the multiple-case comparative approach guaranteed the robustness of the findings (Pettigrew, 1997) [20]. The longitudinal structure of the cases, based on a retrospective multiple time-period design, allowed me to measure the innovative performance of each lead firm in subsequent time periods and to observe the network structure leveraged by each company in each period, while also providing multiple observations of the processes through which both single ties and the overall networks affected innovation.

Consistent with a multiple-case research strategy, the study incorporated a replication (rather than a sampling) logic, in which multiple cases are treated as analogous to multiple experiments able to disconfirm, refine confirm. or emerging relationships between significant constructs in an iterative process of theory building (Eisenhardt, 1989) [21]. In addition, the investigation of multiple time periods in each case, together with both withincase comparisons across subsequent periods and cross-case comparisons, sustained the internal and the external validity of the study.

After an initial groundwork phase, during which I developed my research questions and design and selected the research setting, sample and data sources, I followed a two-stage research process. Stage one integrated quantitative and qualitative data to unravel the linkage between two archetypical network architectures. emerging from the longitudinal analysis of the sample lead firms' alliance behavior, and the lead firms' innovative performance. Stage two relied on the convergence of qualitative information from different sources to advance an explanation of the evidence gathered in the previous stage.

3.2 Sample

One sample is Haitian Plastic Injection Molding Machinery (hereinafter be abbreviated PIMM) Group Ltd., a Chinese enterprise, was established in 1966. After 42 years' development, Haitian has become a national-large scaled enterprise. With a covered area of more than 566 thousand sq meters and more than 3,000 staff, Haitian Group is nowadays the largest production base of plastic machinery in the world. The case-study methodology is appropriate because it allows us to study the rationale and process of network configuration by which Haitian may evolve from being a small collective firm to a fully integrated producer of advanced technology products.

Another Sample is CHINT Group, originating from Wenzhou City, Zhejiang Province, has more than 20 years history since 1984. It is now a large private joint-stock enterprise which produces high and low voltage electrical equipment, power transmission equipment, instruments, architectural electrical appliances, vehicle electrical appliances and other more than 300 series, 5,000 species, 20,000 kinds of products. Currently, low-voltage electrical products of CHINT achieve the first place in domestic sales. In the low-voltage electrical appliances industry, it ranks first in Asia and third in the world. Data on Haitian and CHINT were gathered from both archival sources and interviews. Interviews were conducted over a 2-months period with managers and engineers in Haitian and CHINT, practitioners and experts in related industry. Anchored in archival data on the firm's development since its founding, semi-structured interviews focused on characteristics of the market and competitive environment facing Haitian, product development, R&D activities, interfirm network and strategic response to changes in its environment.

4 Case Study

The following is the empirical research on the dynamic changing between network tie strengths and innovative patterns of Haitian and CHINT Group.

4.1 Haitian Group

4.1.1 The First Stage (1966-1989): Weak Ties, Sparse Network and Exploratory Learning.

China is on the initial stage of market reform during the 1980s, so the PIMM sales in were small and seldom leading multinational PIMM manufacturers entered into the market. Therefore, the market uncertainty is relatively high. However, Haitian is located in Ningbo city, a coastal port and developed region in East of China, the plastic products are in strong demand which give Haitian a chance to produce low-end products, such as small injection molding machinery.

(1) Interfirm network: At that time, there were only a few state-owned enterprises producing PIMM, and only Beijing University of Chemical Technology and Shanghai Light Group research institutes were working on this technology. Considering the lack of necessary talents, from 1976, on one hand, Haitian cooperated with the technical personnel from state-owned enterprises as well as the experts from research institutes at personal level. On the other hand, Selected staff of Haitian were sent to study in state-owned enterprises, learning the advanced technology and management knowledge, and Haitian got most blueprints and related materials from them. Rely on the support of them, Haitian has acquired the basic technology of PIMM and trained its own technical personnel under their help. Due to these weak ties, Haitian technology capability stepped into a new level and the factory formed a good trend of rapid development and steady progress.

(2) Organizational learning Pattern: Exploratory learning is the dominated innovative pattern during this period. Through the corporation with the stateowned enterprises and the research institutions, Haitian not only accumulated the necessary capital, but also learned how to manufacture and how to build the marketing channel. Through these activities, Haitian also began to build up its understanding of its Chinese customers and their PIMM purchasing habits.

By the end of this initial period, Haitian had made significant progress in creating its national manufacturing network that was a scarce and competitively valuable resource, especially at this early stage of China's market transition. The successful development of the 750 gram PIMM in the stage indicated that Haitian has entered into the large PIMM industry.

4.1.2 The Second Stage (1990-2000): Strong Ties, Cohesive Network and Exploitative Learning

With the rise of the household appliance industry in China, the market requires higher performance of PIMM. Along with the development of China's economy and the expansive demand of plastics processing equipment, more and more international PIMM Giants came to invest in China and formed plastics machinery industry cluster in the Guangdong and Zhejiang. The manufacturing in Ningbo city and "the Yangtze River Delta" area is well developed, especially the manufacture of mechanical and electrical equipment, household appliances, automobile parts, packaging materials, sporting goods, household plastics goods and emerging telecommunications and IT industries. This region has become the largest consumer market of plastics machinery, accounting for 30% -35%, and the PIMM industry in Ningbo has provided a powerful support for this large consumption. The absorptive advantages of the downstream plastic consumer market has promoted the rapid development of PIMM industry, and thereby formed a complete industrial chain with the injection Plastics Machinery industry. So, PIMM market uncertainty is relative low.

(1) Interfirm network: During this period, technology in many domestic PIMM manufacturers still can not satisfy the needs of home appliances enterprises. As a result, many domestic PIMM manufacturers desiderated to attain the necessary technology from the multinational companies through some ties.

For Haitian, to settle the problem of capital, it imported the investment from Hong Kong Ningxing Corporation to establish a joint venture in 1991, which is the birth of Haitian Group Ltd. In order to enhance the technology capability and acquire more advanced technology, Haitian established a joint Congtian Corporation with Taiwan venture Congwei Corporation in 1992. The establishment of the joint-venture has provided a good technology learning platform for Haitian. In 1992, Haitian successfully developed HTF2500 and began the production of large PIMM. Inspired by these successful cases, Haitian cooperated with DEMAG (a corporation in Germany) to establish a joint venture, DEMAG-Haitian corporation, in the same year and take a positive learning technology strategy.

During the process of joint venture, Haitian made some creative improvement of the PIMM based on the domestic market demand and technical feasibility. In 1998, they cooperated to develop the full hydraulic PIMM, which indicated that Haitian's technology had reached the mid-1990s level. We found that strong ties (i.e. joint venture) are more important in the stage.

(2) Organizational learning Pattern: At the same time, Haitian mainly adopted exploitative innovation pattern via technological cooperation with multinational companies. Even while producing its own brand, Haitian continued to production with DEMAG. In addition to solidifying Haitian's position as the dominant PIMM manufacturer in China, it also provided Haitian with the opportunity to closely scrutinize foreign product designs and customer responses.

4.1.3 The Third Stage (2001-now): Strong and Weak Ties, Cohesive Network, Exploratory and Exploitative Learning.

After stepping into 2001, all of the major multinationals are establishing more of their operations in China, either through joint ventures or, more recently, wholly-owned subsidiaries. So, the competitive intensity is more drastic than the previous two stages. At the same time, the market in China is more and more regular. Together, the market uncertainty is moderate than before.

(1) Interfirm network: In the stage, strong and weak ties are important equally. In the face of decreasing advantages to domestic firms and increasing competition from foreign competitors, Haitian developed a large-scale and low-cost manufacturing capability to ensure its costcompetitiveness in the face of the foreign and domestic competition that was intensifying during this period.

First, Haitian turned to strengthen the technical cooperation with university, carry out creative research study and changed to in-house R&D Since it has gained the advantage of backwardness but yet was hard to get more advanced technology abroad. For example, the "Haitian Plastics Machinery Technology Research Engineering Center", established in 1998, was elected provincial level in 2000 and national level in 2005; and the "Haitian Beihua Institute" was established with Beijing Chemical Industry University in 2004. Meanwhile, Haitian positively exported products oversea and promoted the product development and upgraded the innovative capability through building weak ties with relative industry association.

Second, Haitian had direct contact with its important customers such as Haier, Hisense, TCL, CHINT GROUP etc., and other distributors. In addition to observing customer buying habits and choices, Haitian also actively sought out customer input to help guide its product development activities. Suppliers also are the other strong ties. Haitian acquired leading production technology from its extensive imports of manufacturing equipment, along with extensive training by its suppliers.

(2) Organizational learning Pattern: Exploratory and exploitative learning exists simultaneously in this period.

On one hand, Haitian research new products with some universities. In order to become the leading global company, Haitian begins to think about how to take advantage of the global resources for the leading development. Haitian established Haitian Institute in Germany in 2006, and invited the former CEO in DEMAG to be the vice president of corporate strategy and the president of research center in Germany.

On the other hand, Haitian continuously improves its products through dense contact with its customers and suppliers. The close interaction between the two innovative modes enabled Haitian to implement its two-pronged strategy of low-cost manufacturing and innovative products matching the Chinese market.

In sum, the dynamic evolution of interfirm network of Haitian can be drawn in Figure 1.

4.2 CHINT Group



Fig.1. The dynamic evolution of Haitian network

Notes: "----" represents "weak ties", "—" represents "strong ties".

4.2.1 The First Phase (1984-1993): Weak Ties, Sparse Network and Exploratory Learning.

In the stage, CHINT entered into the low-end voltage electrical appliance niche market, focusing on the basic formation of production capacity.

(1) Interfirm network: From 1960s to the end of 1970s, it was the first low-voltage generation when state-owned firms occupied all the market in China. In 1984, when CHINT was started and organized in family-associated style, domestic electrical

appliances market has entered into the second era which was represented by DW15, DZ20, CJ20. To CHINT, a newly established enterprise, in the case of there is no any accumulation of technology and production experience, and the first-and secondgeneration low-voltage electrical products are mature technologies, it employed technical experts from the state-owned firms in Shanghai to obtain low-voltage electrical production technology.

At the first stage, due to financial and technical capacity constraints, CHINT was only able to produce the first relatively low-technical generation products targeting at the low-end market of SMES such as small coal mines, which usually don't require high quality because of the Low barriers. For CHINT, it was crucial for existence to master production technology and processing to the quality of the products as soon as possible, therefore process niche was adopted as the dominant strategy. At this stage, CHINT attached great importance to input of technology and product quality by improving the performance of production equipment, establishing technical departments, introducing talented people and intelligence. From its inception, CHINT has introduced technical personnel in traditional low-voltage appliances from Shanghai and established a collaborative relationship with a number of large firms, research institutes and universities.

(2) Organizational learning Pattern: With the efforts made by technical staff and the help of external technology sources, CHINT mastered technology via "learning by doing" strategy and gradually learned about the low-voltage electrical products, components and structures of principle, and gradually mastered the production process, non-critical components of the internal manufacturing, quality control systems, logistics and production management, plant management, after-sales service and other technology-related things.

4.2.2 The Second Stage (1994-2000): Strong Ties, Cohesive Network and Exploitative Learning

In the stage, CHINT occupied a niche market and gradually enter the mainstream market, focusing on further enhancement of the productive capacity and improvement of products design and redesign.

(1) Interfirm network: After 1990s, many leading domestic businesses began the third generation of low-voltage electrical products development, till the mid-1990s the core technology has basically matured. CHINT continually strengthened the technology and production capacity, improved productivity and reduced production costs, improved products quality by utilizing the knowledge and resources accumulated in niche markets. Therefore, CHINT become the industry's lowest cost producers of low-voltage electrical appliances. Meanwhile, CHINT carried out thirdgeneration products design improvements, gained the appearance design patent and utility model patents, entered the mid-high-end market and adopted the strategic direction of process niche and product niche.

To achieve scale-economy effect and rapidly expand market share, CHINT began an enterprise system reform in 1994. CHINT Group was built up by integrating 48 joint firms which have production cooperation relationship. As a result, the internal groups reached the goal of products complement each other, Complementary funds, the market complement each other, resources share, mutual benefit, and rapidly expanded the field of products, formed a wide range of industrial electrical large firms.

In order to transfer scientific and technological achievements into practical productive forces quickly, CHINT also invest a lot of money for technological transformation to meet the requirement of scale production of the new products. From 1997-2001, CHINT has invested 10 million RMB to establish exchanges contacts with automatic circuit breakers and small assembly line, 80 million RMB for production of complete sets of equipment, 21 million RMB for the instrument production, 65 million RMB to expand intelligent circuit breaker production, 500 million RMB to establish a set of logistics in the production of integrated research and development of high-tech industrial area. In 1995 CHINT gained the ISO9001 quality certification system as the first national lowvoltage electrical appliances. In 2000, the State Quality and Technical Supervision granted CHINT "National Quality Management Advanced Firms."

(2) Organizational learning Pattern: In the marketing mode, CHINT set up a sale service system consisting of direct marketing companies, agents and the third-stage stores by relying on its own strength and taking full advantage of the resources of Wenzhou local people who are good at doing business in domestic as well as overseas. Having formed socialized large sales network to make low-voltage products penetrate into every corner of the country, or even go out of the country, and there are more open channels of communication business information with the outside world.

On the other hand, within the third generation of low-voltage electrical technology paradigm, CHINT began to improve the performance of the product and redesign, achieved a series of good-appearance and practical model patents, and entered the other market segments.

4.2.3 The Third Stage (2001-now): Strong and Weak ties, Sparse Network, Exploratory and Exploitative learning

In the stage, CHINT expanded the market share and step into the related industries, to obtain the capabilities of endogenous technology exploitation progressively on the basis of technical accumulation, to achieve the breakthrough of technology paradigm and the change of technology track.

(1) Interfirm network: After entering 2001, the low-voltage electrical appliances have emerged in many domestic markets. The supply and demand relationship on the low-voltage electrical appliances market has been changing from a seller's market to a buyer's market, and this change has caused fierce competition between different companies. Meanwhile, with the China's accession to the WTO, many international companies are leading the influx of the domestic market, and firmly occupy the highend market. They restrain the development of Chinese firms because China is undeveloped in protection patents. Faced with this extreme change, the CHINT started a brand-new reform and innovation progress. Under the circumstance of the emergent of the Fourth-generation low-voltage electrical technology, the CHINT identified the product niche-oriented strategy. Thanks to this strategy, the CHINT has seized the catching-up opportunity during the shift from the third generation of low-voltage electrical appliances to the fourth generation of low-voltage electrical technology paradigm.

Under the guidance of product niche-oriented strategy, CHINT pay more attention to internal research and development. The Group established a technology-centered and group research development system, and laid a solid foundation for the realization of their strategy. CHINT group has a technical centre at the headquarters of Wenzhou, Zhejiang Province. The physical and chemical testing center, measurement center, low-voltage electrical testing center and high-low-voltage electrical research and development base there are all world class. At the same time, a series of professional technology research and development departments are set up according to the categories of products and the profession of different firms. In addition, CHINT established a high-voltage electrical research and development center in Shanghai, an industrial automation research center in Hangzhou and an edge electrical cutting technology research and development center in Silicon Valley, the United States, where a group of top experts gathered to study CHINT's future electrical products. They extended their tentacles of independent innovation to the forefront of international trade and formed a global and staged innovation system. CHINT also established a wide range of international technical Union and started a joint venture-based technology transfer and learning. In 2005, CHINT established with General Electric a joint venture to produce low-voltage electrical appliances.

(2) Organizational learning Pattern: CHINT has achieved fruitful results in this stage because of the building of innovation capacity. In 2001, CHINT started the application for invention patents which can mostly represent the technological level. In 2002, CHINT received the certificate of "China Compulsory Certification". This was the first time the domestic counterpart received such a certificate. In 2004, CHINT won the "National Quality Management Award" and became the country's first peer to win this award. At the same time, the five series and seven dominant modes of products, such as NSTI intelligent Release, NTE8 electronic thermal relay, NC8 contactor, NRC8 intermediate relay indicated the success of independent innovation of the fourth generation of low-voltage electrical products which are high reliable, communication, energy-saving.

In addition, CHINT made use of its core technical capabilities formed in its low-voltage electrical appliances market. After the consolidation of low-voltage electrical appliances market, CHINT took a related diversified strategy to extend their industry chain to other areas of transmission and distribution domains. In 2003, CHINT's annexation of the Automation Research Institute of Zhejiang University in China signified the entrance to industrial automation. In 2004, CHINT set up a "CHINT Electric Corporation" in Shanghai and began the invitation and production of high-voltage electrical products. The same year, CHINT also established an electrical appliances company that is professional in constructions and automotives and began the professional development in low-voltage electrical field. In 2006, CHINT set up the CHINT Solar Technology Co., Ltd.. So far, CHINT initially completed the historic breakthroughs from low pressure to high pressure, from components to complete sets, from the traditional manufacturing industries to the area of automation, from electrical manufacturing industry to system integration development. The benign interaction between the

strategy and capability in the stage, made CHINT a leading manufacturer in the period of low-voltage electrical fourth-generation technology paradigm shift.

In sum, the dynamic evolution of interfirm network of Haitian can be drawn in Figure 2.



Fig.2. The dynamic evolution of CHINT network

5 Discussions

Based on the theory review and the analysis of Haitian and CHINT Group, the paper analyzed the suitability of different network configurations for different organizational learning aims (i.e., exploration and exploitation) and innovative objectives. Fig. 3 concludes our frame of reference. Specific hypotheses are developed.



Fig.3. Theoretical frame of reference

Whether Enterprises can effectively carry out exploratory learning or exploitative learning depend on the information features provided by the technological innovation network. It is beneficial to exploratory learning for enterprises if information provided by network is heterogeneity. While the information is similar to the knowledge structure of the enterprise, it is conducive to the deepening and development of existing technology, in turn promoting exploitative learning.

Hypothesis 1: Strong ties are valuable in environments that require exploitation, while weak ties would be more appropriate for exploration.

Hypothesis 2: Cohesive network are valuable in environments that require exploitation, while sparse network would be more appropriate for exploration. Hypothesis 3: Organizational learning is more positively related to innovative performance.

Hypothesis 4: Organizational learning acts as mediate role between interfirm network and technological innovation.

6 Conclusions

In this paper, the impact of strong or weak ties in interfirm network and sparse or cohesive network on the pattern of technological is analyzed using the experience of organiztional learning and technology innovation in Haitian Group and CHINT Group. The main conclusions are such as:

Firstly, Strong or weak ties, cohesive or sparse network are characterized by synergistic evolution. The dynamic changes of tie strengths and network density will affect the pattern of technological innovation, and enterprises choose a different pattern of technological innovation also need the corresponding changes of tie strengths and density.

Secondly, firm needs the support of weak ties or sparse network density to conduct exploratory innovation, while exploitative innovation needs the firm to construct relative strong ties or cohesive network. From the firm as a whole, exploration and exploitation are two essential organizational learning models, under which firms need make a reasonable choice between them according the development stage, market environment, innovative objective and industry characteristics, and maintain the number of strong or weak ties and network density at a reasonable proportion.

Additionally, this study is just an exploring research. The theoretical model should be empirical test through a large sample in the future.

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