ISCTE IUL

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Enterprise Business Ecological Strategic Capabilities and Enterprise Group Ecosystem Health: an Analysis Based on the Sichuan Port and Channel Development Enterprise Group

LI Hongjiang

Thesis submitted as partial requirement for the conferral of the degree of

Doctor of Management

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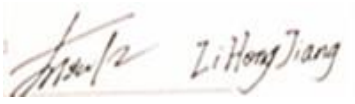
Signed 

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Abstract

An enterprise group is a complex group of independent enterprises that are linked by a number of formal or informal relationships. Regarding enterprise group as a kind of business ecosystem, this dissertation explores the relationship between enterprise's business ecological strategic capabilities and enterprise group's ecosystem health based on Sichuan Port and Channel Development Enterprise Group, adopting business ecological perspective, enterprise capability theory and social network analysis theory. From ecological perspective, enterprises within a business ecosystem will be playing different roles. Therefore each of them will be having different basic strategic capabilities corresponding to its specific role, which will not only be influencing the enterprise's own performance, but also stimulate the system's ecosystem health. This dissertation used role-capabilities matching model to measure enterprise's business ecological strategic capabilities, and construct a regression model of the enterprise's role-capabilities matching rate and performance. We demonstrated and clarified enterprises business ecological strategic capabilities' influence to the enterprise group's ecosystem health.

We proposed relevant theoretical hypotheses of the relationship between enterprise's role-capabilities matching rate and enterprise group's ecosystem health, the every dimension of business ecological strategic capabilities of niche player and enterprise group's ecosystem health, and verify our hypotheses using data from questionnaires responded by the top management in Sichuan Port and Channel Development Enterprise Group' s enterprises. Main conclusions drawn were that 1) the higher the enterprise's role-capabilities matching rate was, the better the enterprise group's ecosystem health would be; 2) The niche player's business ecological strategic capabilities of every dimensions have a positive impact on the enterprise group's ecosystem health, yet different dimensions of business ecological strategic capabilities have different mechanisms in impacting such performance. Our findings have practical significance in enterprise group governance.

Keywords: Business Ecological Perspective; Business Ecological Strategic Capability; Ecosystem health; Enterprise Group; Role-Capabilities Matching Rate

JEL: L14; M10

Resumo

Um grupo empresarial é um grupo complexo de empresas independentes ligadas por várias relações formais e informais. Considerando o grupo empresarial como um tipo de ecossistema empresarial, com base no Grupo Empresarial do Desenvolvimento do Canal e do Porto de Sichuan, esta dissertação explora a relação entre capacidades estratégicas ecológicas de negócios da empresa e a saúde do ecossistema do grupo empresarial, adotando a perspetiva ecológica de negócios, teoria de capacidade empresarial e teoria de análise de redes sociais. Do ponto de vista ecológico, as empresas num ecossistema de negócios desempenharão papéis diferentes. Por isso, cada um deles terá diferentes capacidades estratégias básicas, correspondentes ao seu papel específico, que não apenas influenciarão o desempenho da própria empresa, mas também estimularão a saúde do ecossistema. Esta dissertação usa o modelo de função-capacidade para medir as capacidades estratégicas ecológicas de negócios da empresa e constrói um modelo de regressão sobre a taxa de correspondência de função-capacidade da empresa e o seu desempenho. Demonstrámos e esclarecemos a influência das capacidades estratégicas ecológicas de negócio da empresa na saúde do ecossistema do grupo empresarial.

Baseado na revisão extensiva de literatura na área de perspetiva ecológica de negócios, de teoria de capacidade empresarial e de teoria de análise de redes sociais, propomos hipóteses relevantes à relação entre a taxa de correspondência de função-capacidade da empresa e a saúde do ecossistema do grupo empresarial, entre cada dimensão das capacidades estratégias ecológicas do jogador de nicho e a saúde do ecossistema do grupo empresarial. Pesquisamos na relação entre empresas no ecossistema do grupo empresarial, as capacidades estratégicas ecológicas de empresa, a saúde do ecossistema do grupo empresarial, com base nos questionários feitos pela administração sénior das empresas do Grupo Empresarial do Desenvolvimento do Canal e do Porto de Sichuan e verificamos as nossas hipóteses através dos dados obtidos a partir dos questionários. As conclusões são: 1) mais alta a taxa de correspondência de função-capacidade da empresa, melhor saúde do ecossistema do grupo empresarial; 2) as capacidades estratégicas ecológicas de negócios de cada um dos participantes de cada dimensão têm um impacto positivo na saúde do ecossistema do grupo empresarial, mas

diferentes dimensões das capacidades estratégicas ecológicas de negócios têm mecanismos diferentes para influenciar esse desempenho. Os nossos resultados não apenas contribuem para a construção do ecossistema de negócios dentro do grupo empresarial, mas também têm significado teórico para estudos quantitativos sobre micro-questões relacionadas ao ecossistema de negócios.

Palavras-chave: Perspectiva Ecológica de Negócios; Capacidade Estratégica Ecológica de Negócios; Saúde do Ecossistema; Grupo Empresarial; taxa de correspondência de função-capacidade

JEL: L14; M10

摘要

企业集团是商业生态系统的一种表现形式，在商业生态系统的背景下，当企业集团中不同角色企业采取与之对应的企业理想战略的时候不仅对企业自身绩效有影响，还对整个系统网络绩效都具有促进作用。基于此，本文尝试以商业生态系统为视角，综合运用社会网络结构理论、企业能力理论以及匹配理论，在探究集团企业网络节点企业角色的界定标准和节点企业“角色—能力”匹配模型的基础之上，通过构建节点企业“角色—能力”匹配度与绩效的回归模型来揭示企业集团网络节点企业的角色及其商业生态战略能力选择对集团网络绩效的影响。

本文研究主要分为：文献综述、理论研究、实证分析三大部分。在文献综述部分，本文主要对商业生态系统理论、社会网络结构理论、匹配理论以及企业能力理论进行了梳理归纳。在理论研究部分，基于我国实际情况，结合文献综述相关理论基础的总结和启示，本文构建出在商业生态系统网络视角下我国企业集团网络节点角色及其能力匹配情况与绩效之间关系的理论（概念）模型。最后在实证分析阶段，利用四川省港航开发企业集团相关数据，实证研究上述理论模型，得出的主要结论包括：节点企业“角色-能力”匹配度越高，集团网络绩效越好；缝隙型企业的商业生态战略能力维度对集团网络绩效均有正向作用，但各结构维度对集团网络绩效的影响机制不同。

目前，关于商业生态系统中企业角色及其商业特征行为的相关研究还多数停留在理论分析阶段，并且针对商业生态系统健康与行业发展方面实证研究也较为少见。而本文创新性地给出了商业生态系统网络中企业角色的判定方法，并依据该方法进一步分析了企业的角色与能力，这有助于商业生态系统相关的微观问题定量研究的展开，对商业生态系统相关理论的发展发挥基础性的作用。此外，本文借鉴组合背离战略匹配模式原理，采用欧氏距离测算法对企业实际商业生态战略能力与基础商业生态战略能力之间的匹配度进行测量。通过匹配模型将企业角色及其能力的匹配情况转化为匹配度数值，探索性地解决了角色与能力匹配状况的定量化问题。本文的研究，为商业生态系统理论在中国情境下的进一步拓展具有一定理论意义。

关键词：商业生态系统；社会网络分析；企业能力；匹配模型；企业集团

JEL: L14; M10

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Contents

List of Tables

List of Figures

List of Abbreviations

BZHT	Baizhanghu Tourism Development Co., Ltd
CPID	Chengping Investment and Development Co., Ltd
CXCTHP	Cangxi Channel Transport and Hydroelectric Power Development Co., Ltd
FYCTHP	Fengyi Channel Transport and Hydroelectric Power Development Co., Ltd
FYWA	Fengyiwan Agricultural Development Co., Ltd
GAPO	Guang'an Port Operations Co., Ltd
HSXCT	Hanshuixiucheng Tourism Development Co., Ltd
JLRCT	Jialing River Channel Transport Development Co., Ltd
JLRT	Jialing River Tourism Development Co., Ltd
JNEP	Juneng Electric Power Co., Ltd
JPCTHP	Jinpanzi Channel Transport and Hydroelectric Power Development Co., Ltd
JSCTHP	Jinsha Channel Transport and Hydroelectric Power Development Co., Ltd
JXCTHP	Jinxi Channel Transport and Hydroelectric Power Development Co., Ltd
JYEC	Jiangyuan Engineering Consulting Co., Ltd
LGPS	Ligang Property Service Co., Ltd
LZPO	Luzhou Port Operations Co., Ltd
MJPCTHP	Minjiang Port Channel Transport and Hydroelectric Power Development Co., Ltd
NCPO	Nanchong Port Operations Co., Ltd
PCC	Port and Channel Construction Co., Ltd
QWCTHP	Qianwei Channel Transport and Hydroelectric Power Development Co., Ltd
SHWD	Shanghewan Development Co., Ltd
SNA	Social Network Analysis
SPC	Sichuan Port and Channel Development Co., Ltd
TZCTHP	Tongzihao Channel Transport and Hydroelectric Power Development Co., Ltd
XLCTHP	Xiaolongmen Channel Transport and Hydroelectric Power Development Co., Ltd
XZCTHP	Xinzheng Channel Transport and Hydroelectric Power Development Co., Ltd
YJT	Yongjing Tourism Development Co., Ltd
YRCT	Yangtze River Channel Transport Co., Ltd

Chapter 1: Introduction

1.1 Research background and research issues

1.1.1 Background

An enterprise group, which is a complex group of independent enterprises that are linked by a number of formal or informal relationships, is a product of socialized production and market economy. It is also closely related to modern economy's development and the globalization of economy. Ever since the second industrial revolution in the 19th century, enterprise groups, especially the larger-sized ones, have been the core players driving the world economy. Thus, they are, as a matter of fact, driving the momentum of modern economic growth (Chen, Peng, & Yang, 2016). The evolution from enterprise towards enterprise group initiated from the reform and opening-up in China in 1978. The country has enjoyed thirty years' development and fostered many large enterprise groups led by state-owned enterprises in monopoly fields including energy, telecommunication, trade and so on. Enterprise corporations have played and will be continuously playing an important role for the development of China's economy (Li, Guo, & Lin, 2014).

The theory of business ecosystem (Moore, 1993; Moore, 1996) was a major ideological change in the field of strategic management in 1990s. A whole new research method was therefore established for the theory of traditional strategic management. Before that, strategic theories would mostly discuss competition issues and focus on competition and competitive advantages (Porter, 1980; Andrews, 1987). Now, what we are experiencing are dynamic industrial environment, globalized competition, diversified customer demands and accelerated technology innovation. With regard of that, enterprises had realized that no matter its strengthen core capabilities (Barney, 1991; Teece, Pisano, & Shuen, 1997) or expanding new markets, they would all require the organic collaboration between corporate and industries. In this way, new values can be created that will interest consumers. Under such background, Moore (1993)

established a brand new concept which was business ecosystem, which studied strategic issues systematically. It believed that, though competition and cooperation, business ecology (Moore, 1993) would create a new form of business organization, with enterprises evolving together and therefore co-existing (Moore, 1993; Moore, 1996).

The present era is one marked by constant change in social and economic environment, where competition is no longer happening between individual enterprises but within business ecosystems. Enterprises no longer view themselves as isolated organizations, but a member of the business ecosystem instead (Bai, 2013).

Therefore, strategic perspectives that are applicable to individual enterprise or individual business no longer fully apply to the development of enterprises nowadays (Li et al., 2014). In the new era, enterprises' roles and capabilities in the group should be evaluated in the perspective of business ecosystem. Going forward, only strengthening enterprise groups' health and vitality will enable it with competitive advantage in the fierce market competition (Moore, 1996).

Therefore, the research should treat the enterprise group as a business ecosystem and analyze accordingly.

1.1.2 Research issues

This dissertation looks into enterprise group ecosystem, a kind of business ecosystem. It studies the relationship between the enterprise's business ecological strategic capabilities and the health of enterprise group's ecosystem. In this research, Sichuan Port and Channel Development Enterprise Group will be the case studied. Theories applied to the research include business ecological perspective, enterprise capability theory and social network analysis theory. This dissertation attempts to answer the following questions through theoretical deduction and empirical research: What are the relationships between the enterprise's role-capability matching rate and the enterprise group's ecosystem health? And what are the mechanisms by which the enterprise's ecological strategic capabilities affect the performance of the enterprise group ecosystem?

1.2 Main research content and methodology

1.2.1 Research content

The basic structure of this dissertation is divided into three parts: literature review, research hypothesis and empirical analysis. Accordingly, this dissertation is divided into eight chapters, and the specific contents are as follows:

Chapter 1: Introduction. This chapter first elaborates the research background on the reason why this dissertation should study enterprise group from the perspective of ecosystem. On the basis of the research background, the author puts forward the research questions, the main research contents.

Chapter 2: Literature review. This chapter summarizes the relevant theories and literature in the fields of business ecosystem perspective, social network analysis and enterprise capabilities. It then determines the boundary and lays the theoretical foundation for the study. In particular, this chapter first introduces the business ecological perspectives from three aspects: concept, the role of enterprises within ecosystem and its strategy and the business ecosystem health. Then, the author reviews the development of social network theory and widely used dimensions in social network analysis. Finally, the evolution of the enterprise capability theory is introduced.

Chapter 3 presents the research framework and hypotheses. First of all, based on the existing research theory, this chapter summarizes the dimensions of the enterprise's ecological strategical capabilities and the basic ecological strategical capabilities related to the role of enterprise within business ecosystem. Secondly, the methods and standard to identify the role of the enterprise are illustrated, and the matching model of "role-capabilities" is constructed. On this basis, this dissertation puts forward the research hypothesis about the relationship between the matching rate of the "role-capabilities" of enterprise and the enterprise group ecosystem health. Thirdly, this dissertation focuses on the niche player, and puts forward the research hypothesis about the relationship between every dimensions of the niche players' business ecological strategical capabilities and the enterprise group ecosystem health. Finally,

the conceptual model of this study is summarized.

Chapter 4 is about the overview of the context enterprise group - Sichuan Port and Channel Development Enterprise Group. It mainly introduces in detail three aspects of Sichuan Port and Channel Development Enterprise Group, namely its background, the development stage as well as the development strategy. In this chapter, the author illustrates the basic situation and main characteristics of the research object and provided the basis for the theoretical modeling and empirical analysis of subsequent research.

Chapter 5 presents the methodology. In this chapter, the author mainly describes the measurement of dependent variables, independent variables and control variables, as well as the design of the questionnaire for data collection. The author also confirms the reliability and validity of data acquired. Finally, the descriptive statistical analysis of the sample data is carried out. This chapter's questionnaire data is from Sichuan Port and Channel Development Co., Ltd.

Chapter 6 is the one of results chapter about the relationship between enterprise's role-capabilities matching rate and enterprise group ecosystem health. First of all, the author applies social network analysis method to identify the role of enterprises of the enterprise group, namely Sichuan Port and Channel Development Enterprise Group. Then, the matching rate of each enterprise is calculated by the role-capabilities matching model, thus the independent variable in the empirical analysis of this chapter is formed. Finally, SPSS is employed to conduct correlation analysis and regression analysis of the relationship between the role-capabilities matching rate of enterprise and the health of enterprise group ecosystem.

Chapter 7 is another one of results chapter about the relationship between the key dimensions of business ecological strategic capabilities and enterprise group ecosystem health. In order to further analyze the impact of dimensions of the business ecological strategic capabilities of enterprise of the Group on the ecosystem health of the group, the niche players are chosen as samples. This chapter is also based on data collected in chapter 5. By employing SPSS once again, the relationship between the dimensions of business ecological strategic capabilities structure and enterprise group ecosystem health is analyzed, followed by the regression analysis.

Chapter 8 is the conclusion and prospect of the research, which mainly includes the

research conclusions and the relevant management practice recommendations.

1.2.2 Methodology

The main research methods of this dissertation are questionnaire based empirical research method.

In this dissertation, appropriate variables and measurable mode are selected for testing the theoretical hypotheses. Data needed for empirical research is collected through designing and releasing questionnaires to sample corporations. Moreover, hypotheses are examined using the econometric model. This thesis mainly adopts multiple linear regression models to get the empirical result and the final conclusion.

1.3 Main innovation points of the study

First, from the perspective of business ecosystem, this dissertation integrates the analysis of social network and enterprise capabilities to explore the identification method of the role of enterprise within the ecosystem. Based on the perspective of business ecology, enterprises in the same ecosystem share a common destiny. The strategic choice and the positioning of enterprises in the system should start from their roles and focus on the ecosystem health. Therefore, it is particularly important to identify roles of the enterprises in the business ecosystem. Much of the existing research classifies such roles into three categories: keystones, dominators, and niche player. Yet, there is little literature providing the operable methods to identity the role of an enterprise. Based on the existing research on the characteristics of enterprises' role and the characteristics of their strategic behaviors in the business ecosystem and social network analysis theory, this dissertation starts from the two dimensions, namely the structural features of social network and the strategic expansion of enterprise integration. It provides an innovative method to identify the roles of enterprises in the business ecosystem. Then according to this method, the role and business ecological strategic capabilities of the enterprise are further analyzed. Under the perspective of business ecosystem, the author explores the method of identification the role of enterprise. It helps to deepen the quantitative research of related enterprise capabilities in business ecosystem. Moreover, it plays a

fundamental role in the development of related theories of business ecosystem.

Secondly, there is little previous research systematically summing up and extracting capability dimensions of the business ecological strategy of enterprises. This dissertation concludes business ecosystem strategic capabilities dimensions by deduction methods based on literature review. Furthermore, depending on the role of the enterprise, the author manages to identify the basic capability dimension characteristics of each of enterprise business ecological strategy.

Thirdly, in the perspective of the business ecosystem, we construct role-capabilities matching model to measure the enterprise's business ecological strategic capabilities. In existing business ecosystem research, the roles of enterprises and their corresponding business ecological strategic capabilities are quite thoroughly researched. However, there are still deficiency in the methods of quantifying the correspondence between roles and capabilities. This dissertation addresses the problem by innovatively constructing the role-capabilities model to quantify the correspondence between roles and capabilities. It is based on the social network analysis theory, which helps to identify the roles of enterprises in the business ecosystem. More than that, it also identifies dimensions and characteristics of the basic business ecological strategic capabilities of enterprises with different roles.

Chapter 2: Literature Review

From the business ecosystem perspective, this research uses social network analysis to research the relationship between corporate capabilities and the performance of the ecosystem that the corporation is in. This chapter will review the evolving literature on business ecosystem theory, social network analysis and corporate capability theory. By concluding existing literatures and the research results in the above mentioned three perspectives, it will help define the scope of this research and provide its theoretical basis.

2.1 Business ecological perspectives

2.1.1 Business ecosystem concept

Starting in the 90's, Scholars in the field of management and economics demonstrated ecology as a metaphor for the business world's living organisms and introduced the term ‘business ecosystem’ (Moore, 1993). Even up to now, Business ecosystem is still a relatively new concept in the field of business research, addressed by a certain number of researches (Zhao & Wang, 2008; Gong & Jiang, 2016; Kapoor & Agarwal, 2017).

Since the term ‘business ecosystem’ was concerned by academics in the field of economics and management in the 1990s, the business ecosystem studies have largely been focusing on conceptually defining business ecosystem or describing its framework (Moore, 1993; Moore,1998; Iansiti & Levien, 2004; Peltoniem & Vuori, 2004; Zhao & Wang, 2008). Moore (1993) suggested “a company be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries. In a business ecosystem, companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations”. Subsequently, Moore highlighted interaction within a business ecosystem and further defined business ecosystem as “an economic community supported by a foundation of

interacting organizations and individuals – the organisms of the business world" (Moore, 1996). In other studies, Moore defined Business ecosystem as an "extended system of mutually supportive organizations; communities of customers, suppliers, lead producers, and other stakeholders, financing, trade associations, standard bodies, labor unions, governmental and quasigovernmental institutions, and other interested parties. These communities come together in a partially intentional, highly self-organizing, and even somewhat accidental manner." (Moore, 1998). Obviously, he emphasized more on self-organization and decentralized decision-making in this definition of the concept.

In order to understand the business ecosystem, Iansiti and Levien (2004) used business networks to analogize the business ecosystem: "We found that perhaps more than any other type of network, a biological ecosystem provides a powerful analogy for understanding a business network. Like business networks, biological ecosystems are characterized by a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival. And like business network participants, biological species in ecosystems share their fate with each other. If the ecosystem is healthy, individual species thrive. If the ecosystem is unhealthy, individual species suffer deeply. And as with business ecosystems, reversals in overall ecosystem health can happen very quickly." Iansiti and Levien (2004) argued that features of a business ecosystem include fragmentation, interconnectedness, cooperation and competition and the relationship between participants and ecosystem.

Besides, Peltoniem and Vuori (2004) also emphasized the structure and participants of business ecosystem. According Peltoniem and Vuori (2004), business ecosystem is composed of interconnected and dynamic business organizations, including suppliers, distributors, social public service institutions and related organizations, and consumers. In China, the scholar Lu (1996) put forward the concept of business ecology theory and business ecosystem earlier. She proposed that the integration of enterprise and its environment formed the business ecosystem, and the science of the relationship between the enterprise and the living environment is the enterprise ecology. Zhao and Wang (2008) further concluded that business ecosystem is a new business mode with special growth power and mobility, value creation and value sharing.

Scholars have studied the concepts and certain issues related to business ecosystem from

different perspectives. This dissertation divides the research of business ecosystem into three categories according to different perspectives as follows:

2.1.1.1 From the perspective of value chain

A value chain, which concept was first described by Michael Porter in his 1985, is a set of activities that an organization operating in a specific industry performs in order to deliver a valuable product or service for the market (Porter, 1985). As early as 1979, Porter put the concept of value chain in to use to the competitive strategies paradigm developed (Porter, 1979). In Porter's value chains, “Inbound Logistics, Operations, Outbound Logistics, Marketing and Sales, and Service are categorized as primary activities. Secondary activities include Procurement, Human Resource management, Technological Development and Infrastructure “(Porter, 1985). Since the Porter’s value chain framework was thought as a powerful analysis tool for strategic planning, it quickly made its way to the forefront of management.

As a strategy tool used to analyze, the goal of value chain analysis is to recognize, which activities are the most valuable (i.e. are the source of cost or differentiation advantage) to an organization and which ones could be improved to provide superior performance relative to other competitors in the same industry or superior performance relative to the industry average. With the development of social division of labor and collaborative production, value creation activities are no longer completed within a single enterprise, but cross the scope of a single enterprise, forming the industrial value chain (also known as the supply chain) and the global value chain (Gereffi, 1993). Therefore, industrial value chain and global value chain become the components content of value chain analysis. Similarly, with the wide application of Internet technology, more and more companies have been gradually embedded into the business environment and need to develop together with other companies. Therefore, scholars began to analyze the business ecosystem from the perspective of value chain (Gothlich, 2003; Zhang & Wang, 2005; Song & Gu, 2010).

From the perspective of value chain, Gothlich (2003) had broaden the concept of core ecosystem by including related corporations related to the core enterprise through, for instance, capital lending and borrowing, logistics, innovation and development, which had provided an explicit business ecosystem structure. In addition, Zhang and Wang (2005), based on the theory

of value chain, put forward the concept of the value ecosystem, making the value chain, industry chain; talent chain and knowledge chain a whole dynamic system to analyze the hierarchy structure of the system. And Song and Gu (2010) also propose that the business ecosystem is a network system based on the industrial chain. They believe that the keystone enterprises are the main suppliers and distributors of the enterprise ecosystem. They are in the key position in the enterprise ecosystem and provide important intermediate products or service for other enterprises. The niche enterprise refers to the suppliers below the first level enterprises, which provide the intermediate products to the dominant enterprises. Based on the analyzing conception, structure and action of business ecosystem by summarizing the existing literature, Xiao and Li (2009) point out the business ecosystem is neither a vertically integrated enterprise internal value chain system nor an extended supply chain, and the business ecosystem is essentially a value ecosystem. The reason is that the ultimate goal of a business ecosystem is to meet customer (existing and potential) value. In a complex market, the needs of customers are multi-dimensional, and a single enterprise cannot complete this task, requiring the whole system to provide solutions. Enterprises in different location of the business ecosystem have different values, and their value contribution and value sharing to the ecosystem are also different. Obviously, these enterprises which are related to each other in value activities finally show an orderly structure, and this structure is the most essential structure of business ecosystem.

2.1.1.2 From the perspective of system theory

A system is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made. In terms of its effects, a system can be more than the sum of its parts if it expresses synergy or emergent behavior. For example, some systems function mainly to support other systems by aiding in the maintenance of the other system to prevent failure.

System theory treats the system as the research target. It believes that a system is an organic entity that consists of inter-related and synergistic elements with certain structure and functions. The goal of systems theory is systematically discovering a system's dynamics, constraints, conditions and elucidating principles that can be discerned and applied to systems at every level of nesting, and in every field for achieving optimized equifinality (Beven, 2006).

From the perspective of system theory, Moore (1996) had proposed the structure of the business ecosystem based on its concept. He pointed out that there should be three system layers in a business ecosystem: the core system layer, the extended system layer and the whole system. The core system layer includes core system players such as direct suppliers, core product manufacturer, seller, direct customer, and so on. The extended system layer consists of core system players and extended system players such as suppliers of direct suppliers, customers of direct customers, and so on. The whole ecosystem not only includes core system layer and extended system layer, but also includes industry competitors and macro environment. Based on Moore's (1996) classification results and the classification method of industrial value chains, Han and Wang (2006) divided the business ecosystem model into four systems: competition system (It consists of competitive business organizations), core supply chain system (It is composed of upstream and downstream enterprises such as suppliers, producers and buyers), social natural environment system (composed of government and society) and supporting environment system (It consists of trade associations, research institutions and investment institutions). Li and Hu (2011) based on Han and Wang (2006), concretely divide China's low-cost airline ecosystem into core system, support system, social and natural environment system and competition system. In addition, Ji and Gu (2012) also put forward that the core business is the producer of the final product of the business ecosystem, and the other enterprises can be divided into subsystem manufacturer, module manufacturers and parts manufacturers. Tong and Yu (2014), from the systematic perspective, put forward that many subsystems form a business ecosystem, and the most important part of which is the technological innovation subsystem and the business mode innovation subsystem.

In our opinion, the business ecosystem is generally composed of three hierarchical systems, they are: core system layer composed of suppliers of direct, core product manufacturers, seller, direct customer; extended System Layer composed of direct supplier's supplier, direct customer's customer; and Environment System Layer composed of Government and other regulatory bodies, risk bearer such as investors, industry associations, industry competitors, complementary product manufacturers, universities, research institution.

2.1.1.3 From the network perspective

Network theory, which is the study of graphs as a representation of either symmetric relations or asymmetric relations between discrete objects, has applications in many disciplines including statistical physics, computer science, biology, economics, finance, and sociology.

Some scholars like Power (2001) believed that the network factor in the business ecosystem was very important. According to their definition, a business ecosystem was a global network, part of a real interactive world and a physical system constituted by non-biological elements in the environment. Li and Jie (2012) pointed out that the function of a specific structured business ecosystem was to build platforms for value creation and sharing. It could also bring core enterprises, similar suppliers and policies together to create the network of business values. Zhao and Chen (2007) put forward that members in the business ecosystem constituted the value chain which links are symbiosis; multiple symbioses constituted the value network of a business ecosystem. Chain network integration, the foundation of the system, enables the circulation of material, energy and information through value network. Li and Ruan (2010) believed that the organizational synergy of many enterprises bred key enterprises in the strategic networks. It is the key enterprises who have effectively stimulated the evolving of strategic networks.

2.1.2 The roles of enterprises in the business ecosystem and their strategies

There are a large number of enterprises in the business ecosystem. Enterprises play their different roles in the ecosystem. Based on the above concept of business ecosystem, scholars further point their research direction to the business role in business ecosystem. Among them, the most widely cited classification of the role of enterprise is the three types and their criteria proposed by Lansiti and Levien (2004). Namely, there are three types of enterprises: keystones, niche players and dominators. Keystones are at the center of the business ecosystem. Their function is to build up value-creating platforms and provide effective value creation methods for the business ecosystem. Dominators have very important positions in the system; they tend to obtain value while actively creating value. Niche players make up the largest mass of the business ecosystem and are at a lower position when it comes to value distribution.

Existing literature (Gawer & Cusumano, 2002; Han & Wang, 2006) shared similar view

with Iansiti and Levien (2004) on enterprises roles. Therefore, this research will follow Iansiti and Levien's (2004) theory and categories the business role and the corresponding strategy of each enterprise in the business ecosystem.

2.1.2.1 Keystones

First is the strategic study towards what Iansiti and Levien (2004) call keystones. As the constructor and manager of the business ecosystem, keystone enterprise performs as the core in the system and shares resources with the members in the system. Different literature has different names for keystones. Apart from keystone enterprise (Iansiti & Levien, 2004), there were "core-of-network enterprise" (Han & Wang, 2006) or "network platform enterprise" (Gawer, 2002). Therefore, there have been elaborations of different perspectives on the keystone enterprise's function in its ecosystem. Iansiti and Levien (2004) believed that the keystone enterprise provided a platform through value creation. It shares resources with members in the business ecosystem. In the meantime, it tries to create values and share them with the members. Therefore, for the whole business ecosystem, values created by the keystone are very influential.

Additionally, the keystone has more connection with other nodes compared to other members. It strengthens interaction in the business ecosystem, brings convenience to member communication, reduces system complexity and further enhances the productivity in the ecosystem (Iansiti & Levien, 2006). Gawer and Cusumano (2002) suggested that a leader-platform enterprise, which is the keystone, was capable of establishing an industry platform and aggregating many niche enterprises. This leader-platform enterprise should also consider the benefits of the majority of the enterprises on this platform before major decision-making.

Han and Wang (2006) believed that the technology innovation of the keystone could help system members to create values and attract more enterprises to participate in the existing ecosystem. It can help achieve complementary advantages and strengthen the competence of the business ecosystem. Through that, the ecosystem could then acquire dominance in the market and become the industry rule-maker.

Ji and Gu (2012) defined the strategy of the keystones, that was, to enlighten and assist other enterprises in the coordination of resource acquisition and allocation, production system design, operation, regulation and management etc. While Di (2013) argued that what the keystones provided were core products; therefore, the value proposition of the core business could have a direct influence on the niche market which was appealing to enterprises.

2.1.2.2 Dominators

There was some strategic research on what Iansiti and Lvien (2004) called dominators. Even though dominators enjoy key positions in the system, different from keystones, their business purpose is to capture value as much as they can. For example, according to Iansiti and Levien (2002), dominators were prominent in the system. Through integrating vertical and horizontal resources, they become directly in charge of most resources in the business ecosystem. Meanwhile, the dominators will endeavor to capture value created by other members in the system, wielding its influence in a more traditional and straightforward way.

Yet, from the perspective of overall ecosystem health, Naeem, Thompson, Lawler, Lawton, and Woodfin (1994) suggested that dominators would occupy most of the key nodes in the system. In addition, when the dominators are in charge of the system, the system itself may become vulnerable and unstable due to lack of diversity, especially when under external impact. The reason is that they capture value as much as they can so that other members of the system do not have resilience and lack the resources to innovate. Song and Gu (2010) believed that first-tier suppliers and vendors were normally the dominators in the business ecosystem, vital in the business ecosystem, offering intermediate goods to the keystones, actively capturing value with or without control over assets in the system.

In general, it is believed that the existence of dominators can harm the development of the business ecosystem. As mentioned by Liang and Tan (2005), because the dominators aggressively obtained value, it would collapse the ecosystem by lowering the productivity and consuming the ingenuity of the niche market. Thus, for better development, business ecosystem should stay away from dominators (Liang & Tan, 2005).

2.1.2.3 Niche players

There is a lot of strategic research on niche player. Most of the enterprises in the business ecosystem fall into this category. They focus on narrow market segments and survive through differentiation. As an important part of the balance of business ecosystem, the role of niche enterprises is irreplaceable (Moore, 1996; Iansiti & Levien, 2004). However, in the system, the growth of niche players is challenged from all aspects. For example, although they occupy most of the locations and constitute the main body of the system and undertake most of the value creation and innovation work in the system, they are usually controlled by a certain keystones or dominators and thus are in a weak position in value distribution. Therefore, how to accurately grasp the characteristics of the business ecosystem, successfully obtain the system resources, adjust the internal growth factors, and find the growth mechanism that is both in line with the system characteristics and in line with their own characteristics is a problem that always lies in front of the gap enterprises (Liang & Tan, 2005).

Iansiti and Levien (2004) believed that an enterprise had to meet either of the following requirements to be confirmed as a niche players: 1) not occupying a critical ecosystem network location and do not have the capability such as ability to reposition its network location to become a dominator or a keystone; 2) although it has the conditions to become a dominator or a keystone, such as occupying a critical ecosystem network position, it lacks the capabilities to play the role of a dominator or a keystone. Niche players are committed to developing their professional knowledge in the system and distinguish themselves from other members. Liang and Tan (2005) also believed that niche players' strength in innovation was critical to business ecosystem. The diversity of system which is benefited by niche player innovation would protect enterprises from external impact and help create value. Meanwhile, such diversity has been continuously creating valuable niche market for the business ecosystem and enhancing the provision of actual marginal value.

Table 2-1 Enterprise Strategy's Value Attribute and Connection Attribute in the Business Ecosystem

Roles and Types	Strategic characteristic in the business ecosystem	Value attribute		Connection attribute	
		Value sharing	Value creation	Number of connection nodes	Variation of connection nodes

Niche	Value-adherence	Low value sharing	Very low	Comparatively Low	Comparatively large	Comparatively small
Keystone	Value-sharing	Build up and maintain value-sharing platform	Highest	Comparatively high	Largest	Largest
	Value-balanced	Focus on the creation of its own value and consolidate the value-sharing platform	Comparatively high	Highest	Comparatively large	Comparatively large
	Value-return	Value-return enterprise is similar with value-sharing enterprise, but it provides more professional business opportunities.	Comparatively high	Comparatively high	Comparatively small	Comparatively large
Dominators	Value-exclusive	Value-exclusive enterprise, hosted by the business ecosystem, is parasitic on value platform.	Very low	Lowest	Comparatively small	Comparatively small

Source: Li and Jie (2012)

As for the strategic choice of a niche player in the business ecosystem, Bai (2013) believed that the strategic relevance matching degree and resource coupling degree of a niche player and a keystone should be considered. To be specific, when the resource coupling degree between a niche player and a keystone is low, if the strategic relevance matching degree between the niche player and the keystone is high, the niche player can choose keystone as the target of partner in the future, and do not join its business ecosystem at present, until to the resources of these two enterprises becoming match, cooperation can be considered; When the resource coupling degree of a niche player and a keystone is high, but the strategic relevance matching degree of a niche player and a keystone is very low, while cooperating with this enterprise, the niche player should find a more appropriate business ecosystem to disperse the cooperation risks. Additionally, Wu and Sun (2010) pointed out that the main strategy for a niche player was to actively utilize the opportunities in the system, so as to achieve professional advantages and avoid adverse factors in business ecosystem.

According to Li and Jie (2012), following the characteristics of value attribute and connection attribute, that is, the degree of value sharing and the degree of connection of value network, they divide the role of the enterprise within the business ecosystem into five types,

including value-adherence, value-sharing, value-balanced, value-exclusive and value-return type. Each type of roles value attribute, connection attribute and strategic characteristic in the business ecosystem see Table 2-1 above for reference.

2.1.3 Health of the business ecosystem

Healthiness is the key element of an enterprise ecosystem, influencing the existence and long-term development (Iansiti & Levien, 2002; Iansiti & Levien, 2004; Guo, Sun, Zheng, & Shao, 2014). If an enterprise was to bind its destiny with an unhealthy ecosystem, its future outlook would be full of uncertainty.

Iansiti and Levien (2004) believed that the enterprise ecosystem would only be operating well when it was healthy, so that the system could also be more stabilized and sustainable. Also, only when the ecosystem was healthy, would it have the abilities of maintaining its own structure, achieving self-regulation and quick response to external stimulation. Iansiti and Levien (2002) carried out a research on the healthiness of business ecosystem. They suggested three dimensions to evaluate the business ecosystem health, namely productivity, robustness and niche creativity. According to Iansiti and Levien (2002), Iansiti and Levien (2004), as well as Xiao and Li (2009), inside of the ecosystem, elements including value-creation, value-attribution and diversity, heterogeneity and complexity of ecosystem all have impact on the structural stability of the business ecosystem.

Also, Zhao and Chen (2007) had defined the most basic standard evaluating the vitality of the system, which was the survival rate of members of business ecosystem; whereas the standard to evaluate the creativity of the niche market was whether the system could create functions of new values. However, Di (2013) believed that niche enterprises were the majority of the system, that their diversity is a significant symbol of the healthiness of the business ecosystem. Guo et al. (2014) proposed an assessment index system for the healthiness of manufacturing enterprise ecosystem. It included five indexes, namely growth, stability, resistance to brittleness, recoverability and adaptability.

2.1.4 Summary

Existing research already have reached similar definitions of the business ecosystem. Upon that, the structure and correlations in the ecosystem was analyzed from the perspectives of value chain, system theory and network. Previous studies had also categorized enterprises in the ecosystem based on their functions and roles. Above that, from different perspectives and varied depth, scholars had researched on the strategic features of enterprises in the business ecosystem. Through their studies, they had formed into a unified view towards the strategic functions of enterprises of different roles.

However, by reviewing the literature, we can see that the research on the business ecosystem and players in the system are mostly theoretical analyses, which lack practical identification methods of the roles of the enterprises. In addition, the existing literature discusses the definition of business ecosystem health, the relationship between the system health and enterprise development and the dimensions of the ecosystem health from different perspectives. It has enabled the author to quantify the research towards business ecosystem's health.

2.2 The analysis of social network

As mentioned in the description of the theoretical foundation of business ecosystem, the economic behavior of modern enterprises is no longer isolated from other social behaviors, but deeply embedded in the network. To study the modern business enterprise strategic behavior, it should consider the specific position of enterprises in the network structure. It is the social network that provides a method of analysis.

Social network analysis examines the structure of relationships between social entities (Wasserman & Faust, 1994). These entities are often persons, but may also be groups, organizations, nation states, web sites, or scholarly publications. Since the 1970s, the empirical study of networks has played a central role in social science.

2.2.1 The development of social network theory

Social network analysis (SNA) originated in the 1950s. It started from psychological

research, and was later applied in sociology, anthropology, science and other fields. SNA analysis is a quantitative study of the relationships among actors in the social network, which is a social structure made up of many nodes that usually refer to individuals or organizations, and social networks represent various social relationships. The objects of SNA can be regarded as a collection of actors and their relationships. Since the social network analysis method focus on the process of change as well as the overall contact and interaction, using social network analysis method to study the problem about embedded in the network is approved more and more widely among academic circles (Granovetter, 1985; Burt, 1992; Inkpen & Tsang, 2005). This can be preliminary seen from the process that the literature referred to the aspect of social network research presents an exponential growth. Therefore, there are different methodologies and statements in the development of social network analysis theory (Borgatti & Foster, 2003). This dissertation summarizes the following important theories about social network analysis.

2.2.1.1 Theory of Embeddedness

The theory of embeddedness is represented by Granovetter (1985). This theory mainly concerns the extent to which economic action is embedded in structures of social relations.

The term of “Embeddedness” was created by economic historian Karl Polanyi (1968) as part of his Substantivist approach. According Karl Polanyi (1968), in economics and economic sociology, embeddedness refers to the degree to which economic activity is constrained by non-economic institutions. Rather than being a separate and distinct sphere, the economy is embedded in both economic and non-economic institutions. A substantivist analysis of economics will therefore focus on the study of the various social institutions on which people's livelihoods are based. However, Economic Sociologist Mark Granovetter argued that substantivists had an "over-socialized" view of economic actors, refusing to see the ways that rational choice could influence the ways they acted in traditional, "embedded" social roles. Similarly, he argued that the neoclassical view of economic action which separated economics from society and culture promoted an 'undersocialized account' that atomises human behavior. Consequently, Mark Granovetter provided a new research paradigm (neo-substantivism), which is a theory of embeddedness (Granovetter, 1985).

According to Granovetter (1985), embeddedness refers that “Actors do not behave or

decide as atoms outside a social context, nor do they adhere slavishly to a script written for them by the particular intersection of social categories that they happen to occupy. Their attempts at purposive action are instead embedded in concrete, ongoing systems of social relations". The theory believes that the relationship between any individual and other individuals will have an impact on the behavior of the individual. Before that, White (1981) has put forward that the market is the result of the evolution of social network. He mentioned that "social network is the foundation of all economic transactions" (White, 1981). This pioneering study made by White analyzes the role structure in market, which provides a new way of thinking for the research of social relations network theory. In addition, "The Strength of Weak Ties Theory" that is another theory proposed by Granovetter (1973) divides the relationship between individuals, and different organizations into strong ties and weak ties. It measures relationship strength from four dimensions, including the interaction frequency, the emotional power, the intimacy and the reciprocal exchange. Based on that, it indicates that weak ties can serve as a bridge of information, which means weak ties are conducive to the exchange of new information.

2.2.1.2 Social Capital Theory

The second theory is the social capital theory represented by Lin, Ensel, and Vaughn (1981) and Coleman (1988). Social capital broadly refers to those factors of effectively functioning social groups that include such things as interpersonal relationships, a shared sense of identity, a shared understanding, shared norms, shared values, trust, cooperation, and reciprocity. There are many possible representations of social capital including both tangible (public spaces, private property) and intangible ("actors", "human capital", people) resources and the value of these resources, the relationships among these resources, and the impact that these relationships have on the resources involved in each relationship, and on larger groups.

Scholars who have been studying social capital theory have pointed out that the individual's instrumental goals can be achieved through the social relations around them. They also suggest that social resources are related to social networks. Specifically, personal social resources, such as power, wealth and prestige, are embedded in social networks, which are not directly acquired by individuals, but from direct or indirect social relations. Lin et al. (1981)'s

theory not only supports the “weak ties” of Granovetter’s (1973), but also expands Granovetter’s theory. It advances that the given quantity and quality of resources to the individual are determined by the heterogeneity of individual social network, the relationship between individuals, the members of the network, and the social status of different network members. However, American socialist Coleman (1988) also believes that social capital mainly existed in social groups and social networks, that it was the resources received due to their positions in the social structure. From the network perspective, Inkpen and Tsang (2005) “define social capital as the aggregate of resources embedded within, available through, and derived from the network of relationships possessed by an individual or organization”. According Inkpen and Tsang (2005), networks of relationships are a valuable resource (i.e., capital) for the individual or organization. A firm that establishes a network tie with another firm becomes a social capital resource of the two firms.

2.2.1.3 Structural Hole Theory

Structural holes is a concept from social network research, originally developed by Burt (1992), which is understood as a gap between two individuals who have complementary sources to information. Structural holes theory based on a fundamental idea that the homogeneity of information, new ideas, and behavior is generally higher within any group of people as compared to that in between two groups of people (Burt, 2004), suggests that individuals hold certain positional advantages/disadvantages from how they are embedded in neighborhoods or other social structures.

In this theory, it is believed that within a social network, some individuals are having direct contact, some indirect, yet all connected. The structure would then look like a network structure with holes in it. In economic organizations, the strength of the relationship and the amount of social resources and social capital are not necessarily related. What really determines the strength of the relationship is its position in the network. When defining advantage, it is not only a resource advantage but also a relationship advantage. In the competition, the player with more structural holes (connected to more nodes) has a bigger advantage in relationship networks, with higher reputation and more opportunity to obtain high profit and return. Burt (1992) has absorbed many research results in the field of sociology and presented relevant

concept of the structural holes, mainly including Granovetter's the strenth of weak ties theory, Freeman (1977) 's centrality theory, and Burt (1980) 's own theory of structural autonomy brought about by network complexity.

2.2.2 Widely used dimensions in social network analysis

According to the different focus of the study, the analysis dimensions used by the researchers are also different. For example the study of individual network often analyzes the relationship among individual members, including dimensions such as relationship intensity and the heterogeneity; but as for the research of the whole network, it will study all the actors overall the internal network, and the structural dimensions including density which describes the portion of the potential connections in a network that are actual connections, and centrality which identify the most important vertices within a graph will be mainly utilized (Liu, 2014).

This is a kind of classification method in most commonly used dimensions of the study the social network analysis. In addition, a more commonly used classification method widely raised by scholars domestic and overseas is the summary based on two dimensions—"relationship" and "structure". Granovetter (1985) puts forward the conception of "embeddedness" and divides it into two categories: "relationship embeddedness" and "structural embeddedness". "Relationship embeddedness" refers to the intensity, continuity and direction of the relationship, and "structural embeddedness" refers to the position of an enterprise in the network. Similarly, on the basis of previous studies, scholars such as Zhang, Sun, Pei, and Qi (2015), have integrated some dimensions of the measurement of network structural characteristics at the present stage. The characteristics are divided into "qualitative" dimension and "quantitative" dimension. The qualitative dimension studies the relationship intensity, the relationship quality and the network heterogeneity, while the quantitative dimension studies the centrality, core and the structure hole. Based on the "network relationship" and "network structure", we summarize the analysis dimensions in the existing literature when studying social network.

First of all, as for the "network relationship", the mainly analysis dimensions include relationship intensity and heterogeneity. As for the relationship intensity, Granovetter (1973)

defines the conception of "network" by four sets, including mutual trust, the emotional intensity, the frequency and reciprocity of contact, and puts forward the relationship has different strength among people, which is also for organizations. This relationship will affect knowledge acquisition, creation and transmission. In addition, he thinks that the network relationship can be divided into strong relationship and the weak one. Strong relationship often appears as frequent interactions, similar preferences and long-term cooperation. On the contrary, the weak one always means infrequent interactions, fragile emotions and short-term cooperative relations. Network heterogeneity refers to different degrees of attribute differences among social network objects (Marsden, 1987). Wheten (1982) thinks heterogeneity is an important manifestation of network relationship. There are differences in target, product, service and target clusters among network members.

From the view of "network structure", it is mainly composed of network density, network centrality, structural hole and other main dimensions. The network density refers to the degree of density between individuals in the network and others outside the network, such as ones in upstream and downstream firms, government sectors, financial institutions, intermediary service institutions, universities and scientific research institutions. More frequent communication among the members in high network density is beneficial to the promotion of information transmission, which has a positive impact on the operation of the whole network. Therefore, this dimension is more suitable for the measurement in the whole network, which directly reflects the proportion of the actual number of actors in the network (Tichy, Tushman, & Fombrun, 1979). The network center is described based on the connections of external enterprise, and the centralities include degree centrality (the total number of points which links to this point in the network), betweenness centrality (if a point is on the shortest path between two points, then it has a relatively high betweenness centrality), closeness centrality (if the distance between one point and others points is very short, then the point is the overall center) (Freeman, 1979). The core of the network is to determine whether the enterprise is at the core of the network or at the edge of the network (Borgatti & Everett, 1999). In addition, another major dimension that can describe the location of the network is structural hole. In social networks, there are direct connections between individuals and indirect connections among all

individuals, which makes the relationships of these individuals like a network. There is no direct or discontinuous correlation between them, as a whole, it looks like a cave in the whole network. In the network relations, enterprises in the position of structural holes are more likely to obtain information from different information channels and clusters (Burt, 1992).

In conclusion, we summarize common dimensions and their indicators of social network analysis in the existing literature as shown in Table 2-2.

Table 2-2 Social Network Analysis Commonly Used Dimensions

	Qualitative Dimension	Quantitative Dimension
Structure Dimensions		Centrality; Network density ;Centralization; Structure hole
Relationship Dimensions	Intensity ;Continuity; Direction ;Quality; Heterogeneity	

2.2.3 Summary

In the existing research literature, a more detailed study of network structure stems from social network theory. The theory describes the relationship between subjects through conceptual network structural model and provides a complete set of quantification analysis tools for network structure analysis. The analytical methods in the view of the network relationship and network structure provide a more comprehensive method for characterizing the structures of enterprises in the network.

2.3 The evolution of the enterprise capability theory

2.3.1 The origin of enterprise capability theory

The enterprise capability theory is based on the company's internal growth theory, and its source can be traced back to the classical labor economist Adam Smith's (1776) theory of labor division. Marshall (1925) later stated that there was a “differentiated division of labor” among various functional departments within enterprises, between enterprises and across the industry,

and that this division of labor is directly related to the skill and knowledge of each member. Followed by Penrose (1959), who perfected this view and put forward *The Theory of the Growth of the Firm*, which describes the ways which firms grow and how fast they do. In theorizing about companies that grow, Dr. Penrose (1959) wrote: "There are important administrative restraints on the speed of the firm's growth. Human resources required for the management of change are tied to the individual firm and so are internally scarce. Expansion requires the recruitment of more such resources. New recruits cannot become fully effective overnight. The growth process is, therefore, dynamically constrained". Penrose is considered to be the first economist who posited what has become known as the Resource-based view of the firm.

Since Richardson (1972) first proposed that corporate capabilities could bring about sustainable competitive advantages for enterprises, the enterprise capability theory has also been widely accepted by the academic community and has been rapidly developed. Starting from the 1970s, the theory of strategic management began to focus on the study of the enterprise capability theory. The focus of academic research on the enterprise's lasting competitive advantage has shifted from the industry to the enterprise. It is believed that the special capabilities possessed by the enterprise are the key influence on its long-term competitiveness (Yu, 2001).

2.3.2 Development of enterprise capability theory

Modern enterprise capability theories have experienced four stages of evolution and development (Dong, Ge, & Wang, 2011), including:

(1) Resource-based Theory: Wernerfelt (1984); Barney (1991)

The resource-based view (RBV) (Wernerfelt, 1984; Barney, 1991) is a managerial framework used to determine the strategic resources with the potential to deliver comparative advantage to a firm.

Wernerfelt (1984) presented the enterprise resource-based theory for the first time. He pointed out that the enterprise is a resource aggregate, and the resources owned or controlled by the enterprise affect the competitive advantage and income level of the enterprise. The key to the enterprise growth strategy is to seek a balance between the existing resources utilization

and the cultivation of new resources. Specifically, that internal resources had important strategic value for enterprises to gain profits and obtain competitive advantages. He believed that resource barriers such as a tacit knowledge could protect the enterprise's advantages, and that it could transform this resource advantage into a cost advantage in the process of use and further help enterprises achieve sustainable competition.

Barney (1991), on the other hand, understood corporate resources as assets, quality, organizational processes, information and knowledge that enabled enterprises to improve their operational efficiency. He believed that only resources that could promote enterprises to achieve sustainable competitive advantages were strategic resources. Such resources should have four characteristics: valuable (when they enable a firm to conceive or implement strategies that improve its efficiency or effectiveness), rare, imperfectly imitable and non-substitutable (VRIN). Subsequently, the enterprise capability theory based on the view of VRIN resources was gradually introduced to scholars.

(2) Core Competence Theory: Prahalad and Hamel (1990)

A core competency is a concept in management theory introduced by Prahalad and Hamel (1990). It can be defined as "a harmonized combination of multiple resources and skills that distinguish a firm in the marketplace" (Schilling, 2013). Therefore, core competency is seen as the foundation of companies' competitiveness in the most of strategy literature.

Prahalad and Hamel (1990) proposed that core competencies were the result of accumulated learning in the organization, especially how to coordinate different production skills and organic integration of multiple technologies. Different from the original enterprise resource capability theory, the enterprise core competence theory emphasized the knowledge accumulation and the application of enterprise competencies. Barney (1995) suggested that the enterprise’s most important core competencies was the valuable organizational culture that was difficult to imitate.

In addition, Barton (1992) argued that core competencies were a collection of knowledge that enabled enterprises to be unique and to protect their competitive advantage. In addition, scholars who support the theory of core competence believe that corporate competitive advantage stems from the company’s core competencies. Core competencies appear as the final

product in the market, and its material carrier is the core product. This is also the basic way of associating core competencies and end products.

(3) Dynamic Capabilities Theory: Teece, Pisano, and Shuen (1997a)

Dynamic capability is the capability of an organization to purposefully adapt an organization's resource base. The concept was defined by David Teece, Gary Pisano and Amy Shuen (1997a) as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"(Teece et al., 1997a). The term is often used in the plural form, dynamic capabilities, emphasizing that the ability to react adequately and timely to external changes requires a combination of multiple capabilities.

Enterprise capability theory based on the view of dynamic capabilities began to enter the new stage of history (Dong et al., 2011). Teece et al. (1997a) proposed that dynamic capabilities referred to the ability of companies to integrate, establish, and restructure internal and external capabilities to respond quickly to changes in the environment. Among them, "dynamic" refers to the ability of enterprises to constantly update to adapt to changing market conditions. "Capabilities" refers to the important role of strategic management plays when enterprises are updating their capabilities to adapt to changes in the environment. Thus, dynamic capabilities refer to the ability of an organization to maintain or change its ability based on competitive advantage. The idea of dynamic capabilities, developed on the basis of resource-based theory and core competencies theory, places enterprises in a dynamically developing competitive environment. It emphasized that enterprises could break the core rigidity by adjusting the mechanism of resource allocation according to changes in the external environment. It could also explain how companies acquired sustainable competitive advantage in a dynamic environment (Teece & Pisano, 1994; Teece, Pisano, & Shuen, 1997b; Teece, 2007; Dong et al., 2011).

(4) Knowledge-based Theory of the firm : Connor and Prahalad (1996); Grant (1996)

The knowledge-based theory of the firm considers knowledge as the most strategically significant resource of a firm. Although the resource-based view of the firm recognizes the important role of knowledge in firms that achieve a competitive advantage, proponents of the knowledge-based view (Connor & Prahalad, 1996; Grant, 1996) argue that the resource-based

perspective does not go far enough.

Almost at the same time, enterprise capability theory based on the viewpoint of knowledge had gradually received widespread attention from the academic community. Conner and Prahalad (1996) proposed that the enterprise's capabilities include knowledge exclusivity. It was the transitioning from exclusive knowledge to enterprise capabilities that had allowed the enterprise to earn economic rent, instead of from tangible exclusive resources. There are differences in the performance of different companies. This is a manifestation of the asymmetry of knowledge creation and utilization mechanisms, that is, the performance of the differences in enterprise capabilities. Yet, Grant (1996) believed that, under the influence of knowledge creation and knowledge storage, enterprises had the ability to coordinate and integrate decentralized individual knowledge into enterprise knowledge, and then put enterprise knowledge into production and services. Therefore, the key to obtaining enterprise capabilities is to integrate and use knowledge, especially the establishment of the coordination mechanism of tacit knowledge. Since the way to acquire knowledge is learning, scholars based on the perspective of invisible knowledge emphasized that organizational learning was an important way to improve core competence.

2.3.3 New component of enterprise capabilities: Enterprise Network Competence

With the development of information technology and the diversification of user needs, the enterprise network development has become an important choice for modern enterprise strategies. Under this scenario, networks are an imperative strategically resource of enterprise, and directly determine to achieve a competitive advantage. In other words, the improvement of enterprise network competence is a significant path for firms to achieve their competition advantage. Therefore, more and more scholars believe that network competence is the new acquisition capability of enterprises and should be the new component of enterprise capabilities in the network era (Hakansson, 1987; Möller & Halinen, 1999; Ritter & Gemünden, 2003) and the ability to adapt to the network development strategy also began to show. The enterprise network competence has received rather much attention recently.

It was Hakansson (1987) who initially put forward the idea of enterprise network

competence, and he defined enterprise network competence (In fact, in his book he used the term of networking ability) as an enterprise's ability to reposition its network location and handle a certain relationship. Ritter (1998) has developed a concept of an enterprise network competence to “which captures the level of network management task performance and the network management qualifications possessed by the people handling a company’s relationships” (Ritter & Gemünden, 2004). For a company, network competence empowers it to establish and use relationships with other organizations.

Analyzing the dimensions and framework of network competence is one of important contents in the field of network competence research. For example, Möller and Halinen (1999) who proposed its dimensions: network vision competence, network coordination management competence, relationship portfolio management competence and relationship management competence. Ritter and Gemünden (2003) points out that network competence is composed of task execution (contain certain relationship between two aspects of tasks and task execution across relationship), and qualifications (made up of professional and technical qualifications and social communication qualification). The qualification is the premise of performing network tasks, and the qualification of network management in the process of task execution can be effectively improved.

However, in spite of increasing studies on the network development related competence, there hasn’t been much research on the capability system related to enterprise network development strategy. Especially, there is little literature that defines enterprises’ business ecological strategic capabilities comprehensively and carries out quantitative research.

2.3.4 Summary

In the face of more and more complex environment and more and more dynamic competition, modern strategic management research has had evolving emphasis the analysis towards the fundamentals constituting enterprises' competitive advantage. Whether it is resource-based, core competences, dynamic capabilities and knowledge management capabilities, the development of these different theories reflects the evolution of enterprise strategy, which therefore determines its basic capabilities. With the development of information

technology and uncertainty about the business environment has increased, enterprises need to develop new capabilities to gain and maintain competitive advantages. As a result, not only enterprise capabilities keep continuous developing and new capability such as network competence is becoming the new component of strategically enterprise capabilities, but also relevant capability theories are still evolving.

2.4 Literature review conclusion

From existing relevant research, we found out that research on ecologic system had been increasing, with the majority focusing on the structure and performance of the ecosystem qualitatively. Not many of them were empirical quantitative discussion of the relationships of network structure, competence and performance.

It was even seldomly seen to view an enterprise group as a network ecosystem and discuss its network structure of subsidiaries, business ecological strategic capabilities and group performance. In concrete, the following issues have been greatly overlooked in the existing research:

First, it was pointed out by Iansiti and Levien (2006) that future competition would no longer just be about technologies of individual enterprises, but between or inside of an ecosystem. Especially with the development of internet and the acceleration of globalization, external environment has become more complicated and fast-changing. For enterprises, their own resources would not be enough for acquiring effective competence in the market. They will need better usage of external resources. Since individual enterprises are not enough to generate high competence in the market, as researchers, our perspectives should be shifted from individual enterprises to business networks formed jointly by multiple enterprises.

Obviously, relevant theories on business ecosystem have provided our research with solid theoretical foundation. Especially that Iansiti and Levien (2006)’s categorization of enterprises with three different ecological roles has laid a great cornerstone. Yet, when it comes to the specific categorization criterion, there has not been a unified conclusion.

Secondly, through organizing and reading relevant social network analysis theories, we

found out that by measuring the structural dimensions of the entire network, positions and roles of members of the network can be discovered (Liu, 2014). Other than that, structural dimensions in social network analysis, including network centrality, structural holes and core-edge analysis all seem to be closely related to enterprise characteristics in the business ecosystem theory.

Lastly, although there has been much literature studying enterprise performance from its capabilities or its network position, but mostly limited to individual enterprises. Nowadays, individual enterprises are not as competitive in the market. Thus, treating individual enterprises as research targets have limited significance to the enterprises themselves or the economy's development in the era of network economy (Gong & Jiang, 2016; Kapoor & Agarwal, 2017). Hence, this study, despite of rooted in each individual enterprise in the business ecosystem, focuses more on the comprehensive group network system instead of independent individual enterprises. Based on existing theories and research methods, the author will study the factors and mechanisms influencing the performance of the comprehensive network of the group business ecosystem from the perspective of the business ecological strategic capabilities of the enterprises.

Chapter 3: Research Hypotheses

3.1 Analysis of the dimensions of business ecological strategic capability

The business ecosystem refers to the symbiotic system of the value network consists of different enterprises and organizations. In that system, resources, information and benefit are exchanged and circulated in the network of system members (Moore, 1996). From the perspective of business ecological network, there are several key points in enterprises' strategic management: 1) the enterprise needs to figure out its relationships with other enterprises and its position in the business ecosystem; 2) it also needs to manage assets and resources that do not belong to itself but the whole network. An enterprise's business ecological strategy is then defined as the categorization of node enterprises in the enterprise's ecological system and measures and resources allocation carried out to help the categorization.

Iansiti and Levien (2004) believed that there were mainly three roles in the center of the business ecosystem, namely keystones, niche players and dominators. In modern strategic theories, the strategic capabilities of an enterprise are the premises and foundation of implementing strategies. Then, what are the capability dimensions of enterprises implementing business ecological strategy?

The author has organized relevant literature on business ecosystem and concluded four dimensions of the enterprises' business ecological strategic capabilities based on the ecosystem's perspective. Furthermore, it further identifies the dimension characteristics of the business ecological strategic capabilities of enterprises based on their network roles. The rationales behind these four dimensions of enterprise business ecological strategic capabilities are elaborated in the following parts.

3.1.1 The dimensions of business ecological strategic capabilities of enterprise

3.1.1.1 The dimension of network competence

Network elements in the business ecosystem are very important (Power, 2001; Li & Jie, 2012). Enterprises in the ecosystem need to manage the network relationships between themselves and other enterprises in it so as to share resources, information and values. Iansiti and Levien (2004) referred to the constructions of natural ecosystem, that the keystone in the business ecosystem should be its constructor, the coordinator and the very center. The keystone is supposed to ensure the healthy development of the business ecosystem by influencing behaviors of the system.

Moreover, for a keystone, it is important to nurture the ecosystem's management capabilities so as to win the competition among the systems (Xing, 2007). On the other hand, to achieve an orderly and stable development of the business ecosystem, it is very important to attract other organizations to join the system at low cost or without cost. Hakansson (1987) defines the ability of an enterprise to improve its network position and handle relationships as the enterprise network competence. Ritter (1999) introduced the notion of network competence as an enterprise-specific characteristic. Formally stated, a "company's degree of network competence is defined as the degree of network management task execution and the degree of network management qualification possessed by the people handling a company's relationships" (Ritter & Gemünden, 2003). According to Ritter, Wilkinson, and Johnston (2002)'s research results, network competence is a two-dimensional construct. The first dimension is task execution, which can be further subdivided in relationship-specific tasks (i.e. tasks to maintain a single relationship - initiation, exchange, and coordination) and cross-relational tasks (i.e. tasks to maintain the network of connected relationships as whole - planning, organizing, staffing, and controlling). The second dimension concerns the qualifications whereby specialist and social qualifications are distinguished.

In summary, we have understood the network characteristics of business ecosystems and the relationship and role of enterprises in the ecosystem and the definition of the enterprise network competence. We believe that since the important content of the business ecology strategy is the role-based planning in the ecosystem and the action sequence and resource allocation to achieve the plan, the network competence dimension should be the constituent of

the strategic capabilities of the enterprise's business ecosystem.

3.1.1.2 The dimension of innovation capability

Innovation capability refers to the ability of enterprises to explore new opportunities and transform them into new products, new crafts or new systems in order to respond to and change market conditions (Szeto, 2000). In order to maintain its value in the ecological network, the innovation capability is one of the fundamental capabilities for the implementation of its business ecological strategy. The innovation ability of niche enterprises is very important to the business ecosystem, because it enables the diversity in the system. The diversity of systems reflects the capability of enterprises to adapt to external shocks and the potential for value innovation (Liang & Tan, 2005). Han and Wang (2006) believed that the technologies of keystones needed continuous innovation and development, which would not only bring value to the members of the existing system, but also attract more other companies to join the ecosystem.

In summary, regardless of niche players or keystones, their capabilities to innovate are important for ecosystem competition, cooperation and value creation. Therefore, we believe that the strategic capabilities of enterprise business ecosystems should include the dimension of innovation capabilities.

3.1.1.3 The dimension of resource integration capability

Resource integration capability refers to that enterprises select, absorb, configure and activate resources from different sources, levels, and structures, reconstruct the original resource system, make it highly flexible, orderly, systematic and valuable, and gradually form a new core resource system (Dong et al., 2011). The cooperation between the two enterprises takes place on the platform for the exchange of information and resources. The participants of the cooperation alliance share the technology and knowledge to obtain the scarce resources needed. Teece et al. (1997) suggested that in the ambiguous and unpredictable market context, the key to an enterprise maintaining a sustainable competitive advantage is to integrate, build, and reconfigure its internal and external resources through resource integration capabilities. From a business ecosystem perspective, the resource integration capabilities of enterprises in

ecosystems play an important role in the implementation of their business ecosystem strategies. The systems formed by entities that are loosely linked, but that maintain their independence, become increasingly interdependent and symbiotic in the process of mutual resource integration (Iansiti & Levien, 2006). The competitiveness of the business ecosystem also comes from the system's capabilities to integrate resources, that is, from the integration of its own value chain, to the integration of system members' resources. System capability can be exponentially increased through resource integration (Fan, 2005). Keystones are the resource platform providers for ecosystems. The ease of resource platforms will affect the capability of other enterprises in the ecosystem to integrate resources, and in turn affect the prosperity of ecosystems (Di, 2013).

3.1.1.4 The dimension of resource sharing intention

The resources here refer mainly to knowledge resources. The so-called knowledge resource refers to a type of resource owned by the organization that can be used repeatedly, built on the basis of information technology, bringing wealth and capacity growth to the organization and can enable the organization to maintain its core capabilities, for example, know-how, trade secrets, information, etc. (Ren, 2005). With the continuous refinement of the social division of labor and the increasing complexity and integration of knowledge, successful technological innovations often require different enterprises to cooperate by investing different types of knowledge. It is increasingly difficult for a single enterprise to complete technological innovation activities for the entire product (Chen et al., 2016). In this context, sharing different and complementary knowledge resources, cooperation and innovation has become an important strategy for all member enterprises in the business ecosystem to create new value, save innovation costs, and dig deeper into profits. In the context of cross-enterprise knowledge sharing, enterprises can exchange knowledge and resources with each other in the process of cooperation or communication, inspiring new ideas or creations, thereby further improving the enterprise's innovation performance (Estrada, Faems, & Faria, 2015). Song, Li, and Xu (2008) had proved in their research that the expectations of the members of the alliance for the excess returns from knowledge sharing led to the alliance between them. At the same time, Song and Gu (2010)’s research also found that keystones in the business ecosystem can promote the

development of enterprise ecosystems by providing a set of stable and predictable resource sharing mechanisms. Therefore, for enterprises, in order to obtain the advantage of sharing knowledge resources, it is of great significance to discover the knowledge resource sharing intention.

3.1.2 Basic enterprise business ecological strategic capability based on its role within the business ecosystem

We divide enterprise business ecological strategic capabilities into two categories for the convenience of subsequent quantitative analysis: basic business ecological strategic capabilities and actual business ecological strategic capabilities. The so-called basic business ecological strategic capability theoretically enables the companies to achieve their business ecosystem role positioning; whereas the practical business ecological strategic capability refers to the enterprise's current status.

In the business ecosystem, companies can choose to be niche players, keystones. Enterprises with different roles have different types of business ecological strategies, and therefore theoretically they should also have different types of business ecological strategic capabilities, which are the basic business ecological strategic capabilities mentioned in this study.

We set out from the four dimensions of enterprise business ecological strategic capabilities and put forward viewpoints on the basic enterprise business ecological strategic capabilities based on their network roles. These views roots from literature reviewed in 2.1.2 on the role of the business ecosystem and its strategy (see section 2.1.2). It also combines our discussion of the definitions and characteristics of the dimensions of the business ecosystem strategic capabilities (see section 3.1.1). We also collate and classify the characteristics of different roles in the ecosystem. The specific points are as follows:

The strategic focus of the keystone enterprises in the business ecosystem is to provide an effective value creation method for the business ecosystem by building a platform for creating value. Therefore, the distinctive features of its basic business ecological strategic capability are high network competence and strong resource sharing intention, medium innovation capability

and resource integration capability.

The strategic purpose of a dominator in a business ecosystem is to extract as much value as possible from the system. By taking up an important position in the system and integrating resources horizontally or vertically, it directly controls most of the resources in the business ecosystem. Therefore, the significant features of its basic business ecological strategic capabilities are high resource integration capability, low resource sharing intention and innovation capability and medium enterprise network competence.

The strategic choice of an enterprise positioned as niche in a business ecosystem is to focus on a narrow segment of the market and find the advantages in the ecosystem through differentiation. Such enterprises rely on their specialization to provide value creation assistance and support services to other members of the business system. Therefore, the distinctive features of its basic enterprise ecological strategic capabilities are high innovation capabilities and resource integration capability, low network competence, as well as moderate resource sharing capability. The above points of view sum up and form the basic business ecological strategic capabilities of different roles as shown in Table 3-1 below.

Table 3-1 The Characteristic of Basic Business Ecological Strategic Capability Based on Its Role

Role / Dimensions	Keystones	Dominators	Niche Player
Network competence (NC)	High	medium	low
Innovative Capability (IC)	Medium	low	high
Resource Integration Capability (RI)	Medium	high	high
Resource Sharing Intention (RS)	High	low	medium

3.2 The relationship between the role-capabilities matching rate of the enterprise and the enterprise group ecosystem health

3.2.1 The method to identify the role of enterprise within the group

The social network analysis method suggests that the "role" of the enterprise's resource acquisition or control in the network can be determined by the structure and relationship of the network in which the enterprise is embedded in. Therefore, we can use social network analysis

method to identify what actual "role" an enterprise plays in the ecosystem.

To study all members of a group and the relationship among them needs to start with the overall network. By measuring the structural dimensions of the overall network, we can explore the position and the role of the network members (Liu, 2014). As for the position, two research parameters are the most important, namely, centrality and structural hole (Freeman, 1999). After the sorting out and analysis of the basic theory of social network analysis, and with a combination of the theoretical foundation of the business ecosystem in the previous sections, in the following sections, we attempt to adopt several important dimensions of the network structure within the frame of social network analysis method to describe the network role in the business ecosystem in a quantitative way.

3.2.1.1 Centrality: basis one for role identification for enterprise within group

One of the important dimensions of network structural characteristics is the centrality, which refers to the amount of the cooperation directly connected with the enterprise during its business process. That is to say the network centrality reflects the richness of network relationship (Nooy, Mrvar, & Batagelj, 2005). Baum, Calabrese, and Silverman (2000) hold that the network centrality, which represents the richness of direct peripheral relationship of the enterprise, reflects the resource space available to the enterprise. An enterprise with a high centricity has more options is more capable of getting rid of the threshold of innovation and is better at flexibly responding to the impact of external uncertainties. In academic world, increasing scholars (Duan & Zhong, 2008; Zhou & Song, 2014) take advantage of this dimension to measure the position of an enterprise in a social network and to measure the external resources acquisition for the enterprise.

It is known that, compared with other members, the keystone has far more connections with other joints in the system. In the business ecosystem, the keystone usually serves as the essential node of the interaction among enterprises. It improves the convenience of the inter-node relationships, thereby increasing the productivity and reducing the complexity of the business ecosystem (Iansiti & Levien, 2006). Iansiti and Levien (2004) divide the enterprises in the business ecosystem according to two dimensions -- innovation and network relationships. Usually, the network relationship complexity for keystones and dominant enterprises is

relatively high, whereas that of the niche enterprise is comparatively low. In addition, Liang and Tan (2005) also mention two means of shaping a successful keystone. The first is to strengthen the construction of network relationship mechanism among enterprises and then improve the network degree of relationship. The second is to strengthen the network governance mechanism. Wu and Sun (2010) believe that the more closely organizations are linked to each other, the greater the risk is for system stagnation, and the greater impact the platform has on the niche players. As a result, niche players will face considerable risks if keystones decide to dominate the network environment. The mobility due to the loose connection endows niche players with great collective bargaining capability. Niche players can use this influence to maintain the "integrity" of the keystones and prevent the latter ones from becoming dominators.

Based on the above relevant theoretical basis, this current research believes that the distinction of the network roles of intra-group enterprises can be done by measuring the dimension of the network centrality of the enterprises. However, the dimensions of centrality measurement are mainly composed of three types: degree centrality, closeness centrality and betweenness centrality. Among them, the measurement of closeness centrality requires that the network must be completely connected (Lian, Yu, & Zong, 2012). Since the network cooperation relationship of the respondents will be segmented, being quite different from the ideal connected graph, this present study chose the degree centrality as the dimension to measure the network centrality. The calculation formula is CD (ni) = Σxij, where ni is the network node, and xij is the node that has direct connection with ni.

3.2.1.2 Structural hole: basis two for role identification for enterprise within group

According to the literature review, we know that there are not only network relationships that are directly linked to each other in the business ecosystem network, but also there are many indirect network relationships among enterprises. These complicated network relationships are exactly the source of network resources sharing. Structural holes in the structural dimension of social network are adequate to address the relationship slack issue because the connection between the enterprise at the location of structural hole and other enterprises in the network is non-redundant (Ren, Zhu, & Gao, 2015). Burt (2004) proposes that when an enterprise forms a partnership with an isolated enterprise, then comparatively speaking, this enterprise instead of the

cooperative enterprises occupies a structural hole and possesses relative structural advantages, reflected by information acquisition advantage and resource flow controlling advantage. Structural hole, as an important dimension for measuring the network agent location, is frequently mentioned in many research literature concerned. Social actors with various structural holes tend to have sparsely-connected network, whereby these actors can play the role as a bridge connecting different groups (Xiao & Li, 2009).

As we know, the fundamental advantage of niche players stems from their ability to focus on the research, development and manufacturing of a product or a service by acquiring and utilizing resources like the technology provided by keystones and platform services (Iansiti & Levien, 2002). However, not all niche players are directly connected with each other, so the complementary resources between them mainly come from the network "middleman" (also known as "agent"), and the keystone is just playing the role as a "middleman" between enterprises. By simplifying the complicated task assignment process among members in the network system, keystones make it possible for the niche players in the system to more efficiently create new products to improve system productivity. Keystones continue to invest and integrate new technological innovation, providing system members a dependable reference point or interactive platform (Iansiti & Levien, 2002).

Based on the above relevant theoretical foundation, this current research argues that the distinction of the network roles of intra-group enterprises can be done by measuring the richness of the structural holes of the enterprise. Structural hole measurement is mainly divided into two dimensions: Burt's structural hole index includes the effective size, efficiency, restriction, degree; intermediary center index. In contrast, the use of the restriction dimensions is more extensive (Liu, 2009).

3.2.1.3 Strategic expansion behavioral tendency: basis three for role identification for enterprise within group

Based on some relevant research, this current study finds that the role identification and classification for most of the enterprises can be accomplished in a reasonable way through the application and screening of the above two types of social network structural dimensions. However, to distinguish between keystones and dominant enterprises that both have a high

degree of network complexity, the current study also needs to determine the strategic expansion behavioral tendencies of the enterprises. The expansion behavior based on the theory of enterprise development strategy represents the degree of tendency of enterprises to "occupy" other related enterprises, thus embodying the decision orientation of enterprises for commercial ecological diversity. In reality, the expansion ways for an enterprise mainly include internal and external expansion. Internal expansion refers to self-investment; while external expansion refers to mergers and acquisitions. As for mergers and acquisitions, the enterprise can use it to eliminate threat from competitors, so as to achieve rapid expansion, and quickly take the superior resources from the competitors (Jiang, Zhang, & Liu, 2008).

The literature (Moore, 1996; Iansiti & Levien, 2002) shows that there are several ways to distinguish between keystones and dominators. The first way to distinguish them is to verify the actual size and the richness of the enterprise. Typically, keystones account for only a small portion of the network compared with the dominators. The second way is to see whether the enterprise can promote the diversity of species. Dominated enterprises will take control of the entire system by taking over the functions or even capabilities of other enterprises to eliminate them. In addition, Iansiti and Levien (2002) also argue that dominant enterprises will leave almost no room available for other enterprises or organizations to upgrade their products' added value by providing complex and customer end -facing products or services. While keystones will sometimes potentially increase the number of niche players "occupied" by them, difference still exists between keystones and dominant enterprises, because the keystones eventually increase the total number of niche players in the system, while the dominators increase its sense of presence at the expense of the entire system.

Based on the above relevant theoretical basis, this current research argues that keystones and dominators can be correctly distinguished by analyzing the strategic expansion behavioral tendency of the enterprises.

3.2.2 Model building of role-capabilities matching rate of the enterprise

Matching, a concept originated from the model of population ecology and traditional

contingency theory, is widely applied in a number of management disciplines. Especially in the fields of organizational theory and strategic management, matching has already replaced "contingency" and evolved as the core concept in these fields (Miles & Snow, 1994). Nowadays, although the concept of matching is frequently found in various sociological studies, the choice of matching modes and methods has not yet been agreed upon in academic world. Niederkofler (1991) and other scholars divide matching into three levels: strategic level, structural level and flow level, among which the strategic level belongs to a higher level of matching mode, and it mainly emphasizes the matching between the enterprise strategy and the external environment (i.e. ecosystem) as well as the internal resource capabilities, directly related to the business performance of the enterprise. Xu, Feng, and Xu (2014) proposed to divide the matching modes into three categories: interactivity, selectivity and systematisms. Interactivity usually refers to matching the organizational structure and situational variables in order to study the impact of their interaction on the enterprise performance. Selective matching requires adapting to the changes in the environment. When the environment changes, an appropriate matching method needs to be chosen. While systematic matching requires the collection of information and environmental features of multi-dimensional organizations and performances, trying to find an effective way of contingency (Xu et al., 2014).

One of the aims of this paper is to explore the relationship between enterprise business ecological strategic capabilities and the enterprise group's ecosystem health. After identifying the role of the enterprise in the group's ecosystem (see 3.2.1), we then conclude its basic business ecosystem strategic capabilities based on its role (see 3.1.2). In the end, we will try to measure the matching value between the practical business ecological strategic capability of the enterprise and its basic business ecological strategic capability and use this to analyze the relationship between the enterprise's business ecological strategic capability and the enterprise group's ecosystem health.

In this way, under the premise of the established enterprise role, the measured value of the matching between the practical business ecological strategic capability of the enterprise and its basic business ecological strategic capability can be adapted to a combination deviation matching model. The so-called profile deviation matching model usually refers to the degree of

matching of one combination to another pre-arranged combination (Govindarajan, 1988). The profile deviation viewpoint allows first setting some kind of ideal combination state and then detecting the influence of the degree of matching of another combination with the previously set ideal combination on the organization efficiency (Venkatraman, 1989).

Based on the abovementioned research and with a combination with the previously suggested the matching mode of integration and deviation, we adopted the following methods and steps to build the model of role-capabilities matching pattern of the enterprise.

The current research drew on the handling approach the domestic scholars Xue and Yi (2014) conducted their research, meaning that Euclidean Distance measurement algorithm was utilized to detect the deviation between the actual capability and the basic capability corresponding to the role of the enterprise. This deviation can reflect the role-capabilities matching rate of the enterprise so that the matching pattern for this research was successfully established.

As to the specific operational skills, the current research mainly referred to the method provided by Govindarajan (1988). First of all, the actual capability for business ecosystem strategy of each enterprise was sorted according to four dimensions. Secondly, the maximum value of each dimension was selected as the effective substitute of the item with the attribute of being high according the characteristic of basic business ecological strategic capability based on its role (see Table 3-1 in section 3.1.1.) At last, the Euclidean Distance between each enterprise and the highest dimension value of its corresponding basic characteristics of the business ecosystem strategic capability was calculated. According to the value of relevant dimensions in the table which demonstrates the basic characteristics of the business ecosystem strategic capability in chapter 3.1.1, for any keystone type of enterprise, for example A, it should have a high network competence and resource sharing intention. Therefore, the Euclidean Distance between the actual capability for business ecological strategy and the basic capability corresponding to the role of the keystone can be calculated and expressed as follows.

$$\mathbf{EDA} = \sqrt{(\mathbf{Xnc} - \mathbf{Xnc_{max}})^2 + (\mathbf{Xrs} - \mathbf{Xrs_{max}})^2} \tag{3.1}$$

Where, Xnc means the dimension value of network competence among the actual

capabilities for the business ecosystem strategy of keystone type of enterprise A. $\mathrm{Xnc}_{\max}$ means the dimension value of network competence among the basic capabilities for the business ecosystem strategy of keystone type of enterprise A. The reason why the maximum value for the dimension of actual network competence of all enterprises is selected as the dimension value of network competence among the basic capabilities for the business ecological strategy of keystone type of enterprise A is that the dimension of network competence of the keystone has a high attribute among the basic capabilities for business ecosystem strategy. Xrs means the dimension value of resource sharing tendency among the actual capabilities for the business ecological strategy of keystone type of enterprise A. $\mathrm{Xrs}_{\max}$ means the dimension value of resource sharing intention among the basic abilities for the business ecosystem strategy of keystone type of enterprise A. The reason why the maximum value for the dimension of actual resource sharing of all enterprises is selected as the dimension value of resource sharing among the basic capabilities for the business ecological strategy of the keystone type of enterprise A is that the dimension of resource sharing of the keystone has a high attribute among the basic capabilities for business ecosystem strategy.

Hence, also based on subsection 3.1.1, it can be inferred that any niche enterprise, like B, should have a relatively high innovation capability and resource integration capability, therefore, the Euclidean Distance between the actual capability for business ecosystem strategy and the basic capability corresponding to the role of the niche enterprise can be calculated and expressed as follows.

$$\mathbf{EDB} = \sqrt{(\mathbf{Xic} - \mathbf{Xic_{max}})^2 + (\mathbf{Xri} - \mathbf{Xri_{max}})^2} \tag{3.2}$$

Where, Xic means the dimension value of innovation capability among the actual capabilities for the business ecosystem strategy of niche enterprise B. $\mathrm{Xic}_{\max}$ means the dimension value of innovation capability among the basic capabilities for the business ecosystem strategy of niche enterprise B. The reason why the maximum value for the dimension of actual innovation capability of all enterprises is selected as the dimension value of innovation capability among the basic capabilities for the business ecological strategy of niche enterprise B is that the dimension of innovation capability of the niche enterprise has a high attribute among the basic capabilities for business ecosystem strategy. Xri means the dimension value of

resource integration capability among the actual capabilities for the business ecosystem strategy of niche enterprise B. $\mathrm{Xri}_{\max}$ means the dimension value of resource integration capability among the basic capabilities for the business ecological strategy of niche enterprise B. The reason why the maximum value for the dimension of actual resource integration capability of all enterprises is selected as the dimension value of resource integration capability for the business ecological strategy of niche enterprise B is that the dimension of resource integration capability of the niche enterprise has a high attribute among the basic capabilities for business ecological strategy.

The meaning of other formulas in the model of role-capabilities matching pattern of enterprises can be inferred accordingly.

3.2.3 Theoretical hypothesis of the relationship between the role-capabilities matching rate of the enterprise and the enterprise group ecosystem health

According to the research hypothesis of this current research, once an enterprise occupies a certain network position in the environment and plays the role of a certain type in the ecosystem, the matching rate between the business ecosystem strategic capability of the enterprise and the network role of the enterprise will influence its performance and the ecological health of the ecosystem (the whole group).

As noted by Iansiti and Levien (2002), it is necessary for keystones to constantly manage and guide the members of the ecosystem to develop, and at the same time, keystone type of enterprises as also need to integrate new technical components into the system platform. The successful implementation of these two strategies can improve not only the creation capability of the whole system, but also the capability of utilizing innovative technologies so as to facilitate the sound development of the system. The strategy of keystones can facilitate the network establishment. The strategy of keystones also plays an important role in the knowledge transfer, operation, evaluation and maintenance of the enterprise's innovative network (Li & Ruan, 2010). If keystone type of enterprises seeks to dominate the system environment, it will pose a huge risk to niche players. Together with the maneuverability caused by the loose connection, niche players can obtain a strong collective bargaining capability. To a certain

extent, this influence will put constraints on keystone type of enterprises and prevent the latter ones from becoming the dominator in the business ecosystem (Wu & Sun, 2010). In a word, when those enterprises which play different roles in the business ecosystem have a high matching rate in terms of business ecological strategy, it can not only influence the enterprise's own performance but also improve the overall capability of the business ecosystem it belongs to. As a result, it will also promote the improvement of the enterprise group ecosystem health of the system.

Summing up the above, the current research proposed the following hypothesis.

Hypothesis 1: The higher the role-capabilities matching rate, the better the group ecosystem health will be.

3.3 The Relationship between the critical dimensions of enterprise business ecological strategy and the health of the group ecosystem

In this thesis, the author studies especially the relationship between role-capabilities matching rate and the health of group ecosystem. It is also an attempt to make an analysis of the influence of dimensions of enterprise business ecological strategic capabilities for the health of group ecosystem.

Moreover, according to the aforementioned analysis of the role characteristics about the enterprise business ecological strategic capabilities (See 3.1.1), only the characteristic attributes of the three dimensions, namely innovation capability, resource integration capability and resource sharing intention, in the niche players are vital, and those three dimensions values are also relatively higher. The dimension of network competence is non-critical to niche players, and its dimension value is relatively lower. Therefore, only the three dimensions of innovation capability, resource integration capability and resource sharing intention are chosen as critical dimensions for the business ecological strategic capabilities of niche players.

For all of these reasons, the influence of critical dimensions of business ecological strategic capabilities of all niche players on the ecosystem health of the group is explored.

3.3.1 The relationship between the dimension of innovation capability and the health of group ecosystem

As noted by Iansiti and Levien (2002) niche players account for the greatest majority in the system. They exist on the edge of the system network, where innovation activities are the most active, new products and services are developed, and new markets are under exploration. Niche players have the distributors below the primary level. These distributors are mainly responsible for providing the intermediate products needed in production activities to the dominators (core player). In addition, when deciding on the ecological niche suitable for development, niche players must make efforts to cultivate their business ecological strategic capabilities, take full advantage of the shared resources provided by other enterprises as well as improve and innovate reform specific professional technologies (Song & Gu, 2010). The creation function of the niche market is highly important to a business ecosystem. That is because the diversity of the system can reflect the enterprise's capability to deal with external impact and value innovation. In essence, the diversity means the ecosystem has the capability to create niche markets with values, which can increase the actual marginal value (Liang & Tan, 2005). Therefore, niche players have important functions for value creation and innovation. They tend to be concentrated in a narrow segment market. With relatively high professional abilities, they are able to produce competitive complementary products for profits. The platform created by keystones will affect the value of niche players, but since the latter account for the majority of the system, they are the main body of the system. The diversity of niche players in the business ecosystem can reflect the health status of the business ecosystem (Di, 2013). It can be anticipated that the strong innovation capability of niche players in the business ecosystem can not only enrich the system diversity but also infuse value creation capability into the system in a constant manner. Hence, niche players can push forward the improvement on enterprise group ecosystem health of the overall organization. Based on this, another hypothesis can be put forward as follows:

Hypothesis 2: The stronger the innovation capability of the niche players is, the better the health of the group ecosystem.

3.3.2 The relationship between the dimension of resource integration capability and the health of the group ecosystem

Resource integration means the selection, absorption, activation, allocation and organic integration of the resources with different sources, content, levels and structures. It is the process of restructuring the original resource system, discarding the worthless resources and gradually creating new core resource system (Dong et al., 2011). According to the view of Teece (1992), if there is a high matching rate between resources and core technologies, it will better to realize the commercialization of the core technologies and turn them into the complementary assets. Because it is unnecessary for the enterprise to master all knowledge in every domain for product development and production, the enterprise must be good at integrating external technical resources (Iansiti & West, 1997). As noted by Iansiti and Levien (2002), niche players need to acquire more professional approaches to integrate the system technologies into the field that they specialize in and are good at, thus making their products or services more fresh and attractive to customers. The basic advantage of niche players is that they can integrate and utilize the resources provided by keystones, like technologies and platform services, so as to focus on the research, development and manufacturing of a certain type of product or service. During this process, niche players can constantly acquire some unique capabilities. Once those unique abilities become sustainable and distinguished, the strategy of niche players will focus on business success and profit (Lansiti & Levien, 2004). Therefore, when niche players in the business ecosystem have a stronger capability for resource integration, they can utilize various resources provided by other enterprises in the network to improve the capability of their own products in the market as possible as they can. As a result, the health of the overall group network will improve. Based on this, another hypothesis can be put forward as follows.

Hypothesis 3: The stronger the resource integration capability of the niche player is, the better the health of the group ecosystem.

3.3.3 The relationship between the dimension of resource sharing intention and the health of group ecosystem

Song and Gu (2010) believe that niche players are the distributors below the primary level

and are mainly responsible for providing intermediate products for dominant enterprises (keystones). When deciding on the ecological niche suitable for development, niche players must make efforts to cultivate their professional capabilities, take full advantage of the shared resources provided by keystone and dominant type of enterprises, and improve and innovate reform specific professional technologies. As pointed out by Li and Jie (2012), value sharing means that the value output (opportunity) created by manufacturers that control core assets in business ecosystem outweighs the actually acquired value, forming other spreading and expanding business ecological values.

Value sharing means that the value output (opportunity) created by manufacturers that control core assets in business ecosystem outweighs the actually acquired value, forming other spreading and expanding business ecological values. Value creation means that the control by the business ecosystem on the complementary products, substitute products, service providers as well as the contribution value of different assets with excavation value constitutes the rest part of the value creation and absorption of the business ecosystem. If value creation is the basis of the business ecosystem's existence, then a good value sharing mechanism is the guarantee for the sustainable development of the system. During the course of creating business ecosystem, the keystone is the nuclear, and the key order parameter is the construction of interest and institution of members in the system. The core of strategic management is the common interests between core and niche players. Therefore, it is indispensable to consider the demand of final customers, establish contractual ties between core and niche players, cooperate with each other, and then each obtains what is needed (Dou, 2008). In addition, Qiao and Gu (2008) also claim that enterprises are mutually beneficial in a sound business ecosystem. That is, every enterprise complement advantages in the aspect of core capabilities, creates and shares values so that the system can survive and develop healthily. To sum up, when niche players in the business ecosystem have higher resource sharing intention, the external resources available in the business ecosystem network will be comparatively abundant, and external resources available for the niche players are relatively more, which is not only conducive to their own niche development, but also helps to facilitate the health upgrading of the whole group network. Therefore, based on this, another hypothesis can be put forward as follows.

Hypothesis 4: The higher the dimension of resource sharing intention of niche players is, the better the health of the group ecosystem will be.

3.3.4 Mediator effect of the dimension of resource sharing intention

On the basis of the existing theoretical documents, the current research believes that the niche enterprise, which boasts strong resource integration capability, enhances the performance of group network. It mainly embodies the pipeline resources which is formed through providing more effective complementary resources for other niche players, and then further offers continuous power for the value creation process of niche players. If the niche enterprise only absorbs and takes advantage of relevant resources from the internal network but does not focus on resources sharing among enterprise, the niche enterprise that occupies a key network position will gradually replace other adjacent ones and then become dominant enterprise featured by value extraction tendency. As Liang and Tan (2005) mentioned, the value obtaining behavior of dominant enterprises will lead to a decrease in their system productivity, a depletion of vitality as well as a decline in creativity in the niche market. Eventually, this will give rise to a system collapse and the future for dominant enterprises is doomed. Di (2013) believes that niche players tend to attach great importance to a certain narrow segment market. This type of enterprise relies on the platform provided by the keystones and obtains and shares unique complementary resources on the basis of their professionalized advantage. Niche players are a major part of the system and the health of the business ecosystem can be reflected by their diversities. Therefore, it demonstrates that resources sharing may play an intermediary effect between the niche enterprise's capability to integrate resource and the ecosystem health of the group. Among the niche players, those with higher resource integration capability can, through a higher degree of resource sharing, feedback the network resources absorbed, utilized and developed by themselves to the interior of the group network by more forms and contents. And expanding the resource base of the niche players, they can improve the possibility to enhance the overall ecosystem health of the group. To sum up, based on this, another hypothesis can be put forward as follows.

Hypothesis 5: The resource sharing intention is a mediator between the resource

integration capability and the health of the group ecosystem.

3.4 Summary

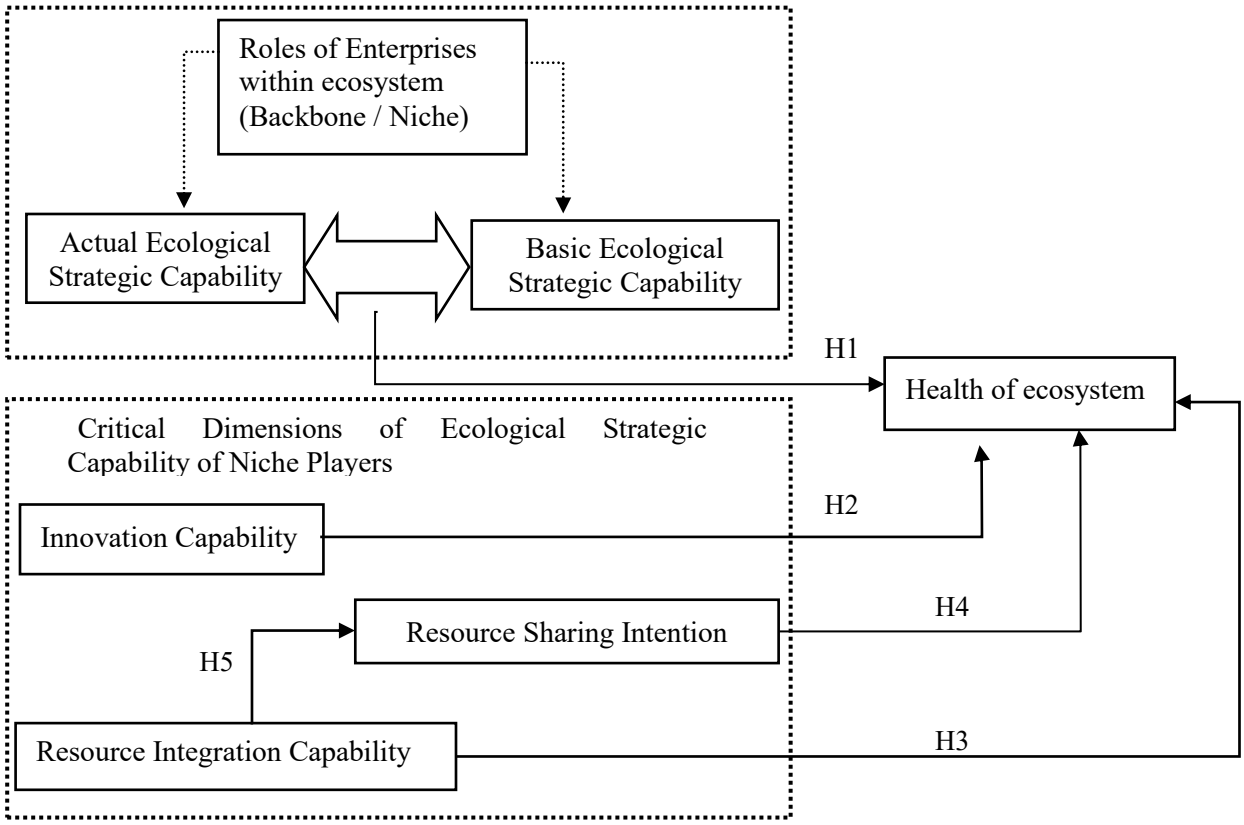


Figure 3-1 Conceptual Framework

Hence, the conceptual framework of this study is formed based on all the hypotheses mentioned above (see Figure 3-1). From the perspective of business ecosystem, this chapter proposes relevant theoretical hypotheses of the relationship between the three: the role-capabilities matching rate of the enterprise, the critical dimensions of business ecological strategy of niche players and the health of enterprise group ecosystem. Furthermore, the author proposes hypothesis about the dimensions of business ecological strategic capabilities of niche players influencing mechanism on health of group ecosystem.

Chapter 4: Profile of Sichuan Port and Channel Development Enterprise Group

In existing research about business ecosystem, the situation of the researched business ecosystem was normally explained before quantitative research (Moore, 1996; Iansiti & Levien, 2004; Guo et al., 2014). The core content of this research is to study the relationship between an enterprise's strategic capabilities and the performance of its network. Therefore, the author refers to existing research. After theoretical hypotheses, the situation of the researched ecological network is illustrated. This chapter mainly covers the business ecological system from the four aspects: the enterprise group's introduction, the parent enterprise, the general strategy of the enterprise group and the business strategy.

In this study, we chose Sichuan Port and Channel Development Enterprise Group (hereinafter referred as "the Group") as context because of the following reasons: 1) It is a typical group enterprise. Sichuan Port and Channel Development Enterprise Group is an enterprise group that has economies of scale and economic advantages, and diversified businesses through diversification and consolidation; 2) It has the basic characteristics of a business ecosystem. The Group has a diversity of businesses, but each of them has resources, technology and business with other members of the system, with mutual dependence and relevance, namely symbiosis; 3) For practical reasons, given the author's familiarity with the group. The author has many years of business relations with the Group. The author's organization has a long-term strategic partnership with it. Therefore, relevant data and questionnaire data are easily accessible, and field research activities are easy to carry out.

Therefore, we believe that the Group can be used as context of this research to demonstrate the relationship between enterprise's commercial ecological strategic capabilities and the group's ecosystem health. In order to analyze more effectively, before the empirical research, the author would like to introduce the group first.

4.1 Overview of Sichuan Port and Channel Development Enterprise Group

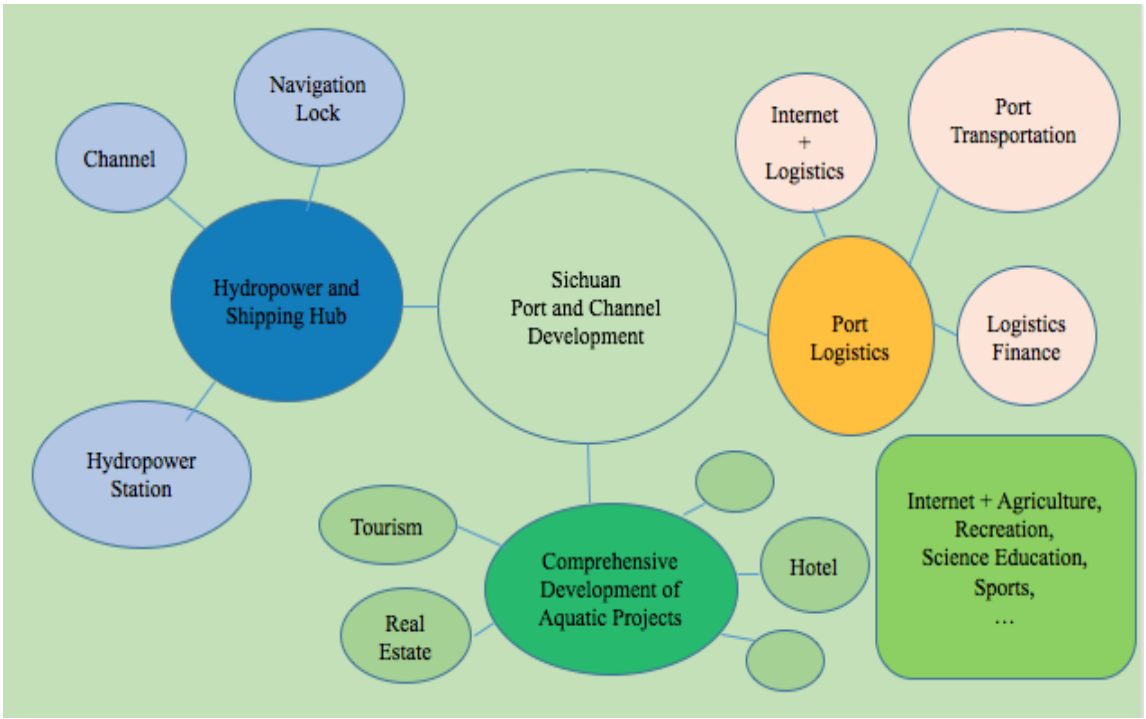
Sichuan Port and Channel Development Enterprise Group is made up of 27 enterprises that are closely related in assets, capital and technology (for the structure of the Group see Appendix 2, Figure 2-4-1). Within these 27 enterprises, Sichuan Port and Channel Development Co., Ltd is the parent enterprise, 12 of them are wholly owned subsidiaries of the parent enterprise, and the other 14 are established, operated and managed by the parent enterprise and local governments or large state-owned enterprises according to market principles. Taking the basin resource of Jialing River and Min River (two tributaries of the Yangtze River in Sichuan Province) as the link, the group focuses on three major business segments: hydropower and shipping hub, port logistics and comprehensive agricultural tourism development.

In recent years, following the provincial guidance of constructing modern comprehensive transportation system and the “Four rivers and six ports” water transportation development initiative, the Group has used its advantage in talents, expertise, assets and financing to take this opportunity of development. Remarkable achievements have been made in the construction of Sichuan port and waterway infrastructure represented by the development of Jialingjiang Channel, comprehensive development of navigation by Lancang Port, and Yanzhou Port, Guang'an Port, and Nanchong Port. The Group took the lead in creating a new model of market-oriented construction of water transportation projects in the “national cooperation between cities and enterprises, market operations and comprehensive development”, which innovatively tackled issues including the commonwealth feature of public transport infrastructure, large investment, long fund recovery period and shortage of construction funds. The Guang'an and Nanchong ports planned to construct during the “Thirteenth Five-Year Plan” (2016-2020) and “Fourteenth Five-Year Plan” (2021-2025) were advanced to the “Twelfth Five-Year Plan” (2011-2015) period and were completed and put into operation. They were fully affirmed by the provincial party committee and provincial government, the Ministry of Transport and the national counterparts.

At the same time, the Group relies on the infrastructure projects of ports, waterways and

water transport hubs to deeply integrate into the economic and social development of the river basin. It has implemented integrated this river basin's development in port logistics, urban operations, river basin tourism, recreation and sports and modern agriculture development of related diversified businesses has been recognized by the National Tourism Administration, the Provincial Development and Reform Commission, the Provincial Tourism Development Commission, local governments, and all sectors of society. It has undergone market inspections and won market recognition.

The Group relies on the infrastructure projects of ports, waterways and water transport hubs to develop related diversified services in port logistics, urban operations, river-based tourism, recreation and sports and modern agriculture. (See Appendix 2, Figure 2-4-2 for the regional distribution of the business.) At present, its business is mainly in the three business segments: hydropower and shipping hub, port logistics and integrated river-based development (see Figure 4-1). The specific investment operations of these three business segments are as follows:



Note: Empty circles represent other similar companies that will not be named here

Figure 4-1 Sichuan Port and Channel Development Enterprise Group's Business Segments

4.1.1 Hydropower and shipping hub

Hydropower and shipping hub business segments include water transportation and hydropower related business.

The Group holds 13 navigation hubs with a total installed capacity of 2.461 million kilowatts and a total investment of RMB 59.618 billion yuan (USD 8.90 billion dollars). As of December 2016, the Group's Qujiang River Jinpanzi junction and the Jialing River, Cangxi, Shaxi, Jinyintai, Xinzheng, Jinxi, Fengyi, Xiaolongmen and Tongziyu junctions have been completed and put into operation. The total installed capacity is 805,000 kilowatts, with a total investment of RMB 11.218 billion yuan (USD 1.67 billion dollars). The Group plans to build four junctions, including Laomukong, Dongfengyan, Qianwei and Longxikou alongside the Min River, with a total installed capacity of 1.656 million kilowatts and a total investment of RMB 48.4 billion yuan (USD 7.22 billion dollars). Among them, the construction of Qianwei hydropower and shipping hub began at the end of December 2015. A mobilization meeting was held on March 15, 2017 for the Longxikou hydropower and shipping hub.

The Group holds 5 hydropower and shipping hubs with a total installed capacity of 1.58 million kilowatts and a total investment of RMB 23.573 billion yuan (USD 3.52 billion dollars). Among them, the four hydropower and shipping hubs of Dongxiguan, Hongyanzi, Qingju and Tingzikou have been completed and put into production, with a total installed capacity of 1.506 million kilowatts and a total investment of RMB 20.481 billion yuan (USD 3.06 billion dollars). The company holds a stake in Chongqing Liling Navigation Junction of Jialing River, with an installed capacity of 74,000 kilowatts and an estimated total static investment of RMB 3.09 billion yuan (USD 0.46 billion dollars).

4.1.2 Port and logistics

The Group have controlling share of four ports, with a container handling capacity of 2.2 million twenty-foot equivalent units and a total investment of RMB 6.1 billion yuan (USD 0.91 billion dollars). Among them, Luzhou Port has become the first million twenty-foot equivalent unit port in Sichuan Province; the first phase of the project of the Guangdonggang Xindongmen Operation Zone was opened for trial operation at the beginning of 2013; the first phase of the Nanchong Port Dujing Operation Zone was opened for trial operation at the end of 2013. The

Group's active reconstruction and expansion project of Fuliutan Canal at Jianqu River, the navigational project of Danjikou Channel at Sijiutan Qujiang River, and the shipping supporting project at Jiangchuan segment, Jialing River in Sichuan Province have a total investment of RMB 2.615 billion yuan (USD 0.39 billion dollars); the proposed Min River (Longxikou to Hejiangmen), with 81km of waterway regulation project and the first phase of Leshangang Laojiangba operation area have a total investment of RMB 1.15 billion yuan (USD 0.17 billion dollars).

The Group holds a transportation logistics company, Yangtze River Channel Transport Co., Ltd (hereinafter referred as “the Yangtze River Company”). The Yangtze River Company's existing total assets is RMB 150 million yuan (USD 22.38 million dollars), with 27 ships, a total load of 30,000 tons. The Yangtze River Company mainly engages in the Yangtze River trunk container, dry bulk cargo and large-scale transport operations. The Yangtze River Company has the highest qualification for the construction of Class III ships in the province and the extremely scarce quality of refined oil wholesale and retail. It is the largest water transportation enterprise in Sichuan.

4.1.3 Water-based integrated development

The so-called water-based integrated development refers to the real estate, tourism, culture and other business categories that are invested and developed along the river and the lake basin.

The Group has invested in nearly 20 development projects in rivers and lake basins, involving culture, tourism, real estate, eco-agriculture, and urban operations. It involves a total investment of more than RMB 70 billion yuan (USD 10.45 billion dollars).

The integrated agricultural development sector mainly includes: Nanchong Port Park-a division of China-France Agricultural Science and Technology Park, with a total planned investment of about RMB 2 billion yuan (USD 0.30 billion dollars) and a total area of 30,000 Chinese mu (20 km²). The total planned investment of Pengshan Park, also a division of a Chinese-French agricultural science and technology park, is about RMB 15 billion yuan (USD 2.24 billion dollars), with a total area of 5.4 million Chinese mu (3600 km²); the total planned investment of Baizhang Lake, Ya'an agricultural tourism and leisure project is about RMB 8

billion yuan (USD 1.19 billion dollars), covering a total area of 15,000 Chinese mu (10 km²).

Tourism integrated development section mainly includes: Nanchong Tourist Ferry Terminal, a total investment of about RMB 400 million yuan (USD 59.69 million dollars), covering an area of 43.8 Chinese mu (0.0292 km²); Dali comprehensive development project planning a total investment of about RMB 4.5 billion yuan (USD 0.67 billion dollars), with a total area of 270 Chinese mu (0.18 km²). Other projects include 1) the comprehensive protection and development project of the ecological tourism in the Jialing River Basin in central Guizhou with about RMB 10 billion yuan (USD 1.49 billion dollars)'s investment and an area of 45,000 Chinese mu (30 km²); 2) Xinmin Hot Spring Tourism Comprehensive Development Project with a total investment of RMB 2 billion yuan (USD 0.30 billion dollars) and an area of 3,000 Chinese mu (2 km²). There are also commercial real estate projects in 7 cities such with a total investment of over RMB 20 billion yuan (USD 2.98 billion dollars).

4.2 The parent enterprise: Sichuan Port and Channel Development Co., Ltd.

The parent enterprise, Sichuan Port and Channel Development Co., Ltd. (hereinafter referred as “the Company”), was a state-owned enterprise approved by the provincial government in June 1996 with a registered capital of RMB 3.6 billion yuan (USD 0.54 billion dollars) and a total asset of nearly RMB 30 billion yuan (USD 4.48 billion dollars). The current asset-liability ratio is approximately 67%. It is one of the three core subsidiaries of Sichuan Provincial Investment Group Company Limited.

The Company has 18 subsidiaries and 8 share-holding companies in the Group. In accordance with the principles of strategic control, planning and overall planning and asset capital management, the Company conducts guidance, supervision and management of each subsidiary or affiliated companies through the shareholders' meeting of the subsidiary company and the board of directors; each subsidiary or affiliated company fulfills specific construction development and production operation management functions. From 2006 to 2016, the total assets of the Company increased from RMB 2.9 billion yuan (USD 0.43 billion dollars) to RMB

30 billion yuan (USD 4.48 billion dollars), an average annual increase of 26%, with the registered capital increased from RMB 80 million yuan to RMB 3.6 billion yuan (USD 0.54 billion dollars). The Company's annual operating income increased from RMB 120 million yuan to RMB 5.8 billion yuan (USD 0.87 billion dollars), an average annual increase of 66%. The number of employees increased from 290 to 2,600, and the percentage of undergraduates and above in employees increased from 10% to 58%.

Up to now, the Company has formed a professional management team and a market-oriented operation mechanism. It has grown from navigation-power and port specialized construction enterprise into a comprehensive investment and operation company integrating more than 10 development businesses including navigation-power, port logistics, tourism, hotels, agriculture, real estate, construction and engineering consulting.

4.3 The comprehensive strategy of Sichuan Port and Channel Development Enterprise Group

The Comprehensive Strategy of Sichuan Port and Channel Development Enterprise Group has specified its strategic positioning. It is based on the industries of waterway construction, hydropower and shipping hub operation and modern integrated port logistics in the economic zone of Yangtze River, Sichuan. Through strategic management, industry leadership and project operation, it will strengthen the business in navigating-power junction, port logistics and integrated agricultural tourism. It aims to become a leading domestic integrated developer that enjoys sustainable innovativeness, and that can help the industry allocation in the river basin and the development of cities alongside rivers.

Followed is the interpretation of the Group’s comprehensive strategy from several perspectives.

4.3.1 Become a promoter of regional economic development—participate in regional planning and developing

The succession of Sichuan's national industrial transfer strategy and the optimization of its

structure require the overall layout of the province's regional resources. The port-centered economy, which relies much on water transportation, is highly relevant to the optimization of industrial structures such as manufacturing, energy and processing. It also calls for the collaboration with resources in Sichuan. Based on the resources of “Four River Six Ports”, the Group promoted the optimization of the economic structure of the basin, hinterland and region, participated in the regional industrial layout planning and promoted the coordinated growth of the regional economy.

4.3.2 Become an integrated provider of regional modern integrated logistics—the upgrade of traditional transportation to modern integrated logistics services.

Based in Sichuan, the Group radiates the Yangtze River basin, expands the southwest and the northwest and strives to become a modern port and shipping logistics company with large scale and strong strength and a core position and leading role in the upper and middle reaches of the Yangtze River. It takes advantage of the government's investment platform to develop the port and rear land resources as a whole. It will coordinate the development of Lingang Logistics Park, Lingang Industrial Park and the port integrated service area, and realize the interaction of three districts in the port area, park and city area. It gathers the core resources of various shipping elements, strengthens the port and shipping logistics industry based on port modernization, large-scale shipbuilding, and intelligent management. Meanwhile, it steadily expands road transportation, railway transportation, warehousing, distribution, agency, circulation processing, and other related issues, which facilitates a complete logistics supply chain service system. The group pays attention to the improvement of comprehensive functions, emphasizing the organic links and integrated development of various logistics elements and various logistics activities. The Group aims to make full use of all kinds of logistics elements, build a logistics network system that is integrated, with effective links and efficiently operations. By all means, the Group strives to create an intensive, networked, specialized, informatized and internationalized integrated modern logistic supplier.

4.3.3 Become a regional integrated developer

The Group hopes to become an integrated developer in the region covering the

comprehensive development of hydropower and shipping hub, port logistics and agricultural tourism. In this way, the Group can achieve integrated development and management of rivers in Sichuan Province and connect the water transport network in Sichuan. Not only that, the Group can also achieve navigation-power engineering and cascade canalization, ensure the development of water transport, and up-level the navigation channel and carrying capacity. In addition, it is complemented by the development of hydropower clean energy, comprehensive tourism development, and modern agricultural development. Through the navigation-power, ports and parks, comprehensive tourism development along the lakes and modern agricultural development, the Group can carry out overall watershed development and industrial service acceptance. On the other hand, it can also vigorously develop the hydropower and shipping hub, port logistics and comprehensive development of agricultural tourism, and give full play to the core capabilities of navigation-power and port logistics. In this way, the Group can drive the comprehensive development of tourism and the development of the comprehensive agricultural industry, constantly optimize the industrial layout and maintain state-owned assets maintain and even increase their value.

4.4 Strategies of business segments

4.4.1 Strategy on hydropower and shipping hub segment

The business of hydropower and shipping hub is as the basic resource builder and cash flow contributor of the Group. The control rights of the infrastructure accumulated by the hydropower and shipping hub construction project will provide the core element resources for the future development of port and channel logistics. The navigation-power-related business is characterized by complex technology, intensive knowledge, and strict management, with a high degree of automation, specialization, and modernization. As the company's core industry, the business management maturity is relatively high. In the future, it is necessary to integrate the management of inventory assets for the operations of the navigation-power business sector according the goals of the Group. The Group adopts localized operations for the subsidiaries during the construction period to improve project management and efficiency. However, for

subsidiaries during the production and operation period, it is necessary to carry out horizontal integration management within the subsidiaries, flatten the management structure and reduce operating costs. At the same time, according the goals of the Group, it is necessary to continue to strengthen internal production refinement management, deepen external marketing management, integrate high-quality assets and implement merger and acquisition strategies, leverage the capital market in a timely manner and improve asset quality and operating efficiency.

The planning of the hydropower and shipping hub segment is as followed:

The first stage: navigation-power project development, construction and management (2016-2017).

The Group actively participated in the development and construction of inland waterway planning and shipping projects in Sichuan Province, expanded financing channels, introduced external capital in construction, promoted project management capabilities and accelerated project development and construction speed. It also overcame difficulties such as small storage capacity, short power generation time, specialization, a large number of abandoned water in ship locks operation, lack of profitability in the process. With the horizontal integration moving into the stable phase, hydropower and shipping hubs were categorized accordingly and improve operational efficiency and management.

The second stage: comprehensive development and operation of navigation-power in the basin (2018-2020).

The navigation-power business entered stable navigation-power traffic management and power generation management, researched the cascade dispatching management in the river basin and gained rich experience in water transport and power generation management.

The third stage: the provider of comprehensive solutions for the development of navigation-power (2021-2024).

Continuing the accumulated professional experience of the provincial and the Group's hydropower and shipping hubs in Sichuan Province and the development of navigation-power development projects, it will provide resolution services in the subdivided areas for the

construction of aeronautical power and other river basin cascade management in other provinces in the Southwest. The Group would like to create the first professional solution provider in China, leading the development of avionics in China, with the advantage of specialization and promoting cross-provincial business integration.

4.4.2 Strategies for port affairs and logistics

The port and logistics business segment are an important platform for the Group to deeply integrate into the construction of the Yangtze River Economic Belt and promote the adjustment of the industrial structure of the river basin. The Group gives full play to its advantage in the province's port and shipping logistics resources and network relations. During the period from 2016 to 2020, it has been systematically integrating various logistics elements within the region, establishing enterprises (e.g. Luzhou Port Operations Co., Ltd; Nanchong Port Operations Co., Ltd; Guang'an Port Operations Co., Ltd) to manage port affairs, extending the port and shipping logistics industry chain, and promoting the transformation and upgrading of port and shipping logistics. This action has made the Group's port and logistics sector a regional integrated provider of integrated modern logistics, and it has also made the Company the most influential port and shipping service center and “waterless port” service center in the southwest region.

The strategic stage of the Company is planned as follows.

The first phase: strengthening the main business of port shipping (2016-2017)

The Group collected, stored and integrated riverfront port coastline and land resources. It relied on the resource endowments, industrial structure, infrastructure, and logistics service capabilities of the port and its surrounding areas. It rooted itself in the port industry and supported by information technology to optimize port logistics resources. With the layout as the goal, the Port Logistics Park, the Lingang Industrial Park and the port integrated service area would be developed in an integrated manner to realize the interaction and linkage development between the port area, the park and the urban area. At the same time, the company relied on the port to develop a logistics system, strengthen strategic cooperation with international large shipping companies, and expand Jianghai combined transport and ocean shipping. On this basis, the Group fully integrated into the international shipping logistics

market, consolidating the hot metal transport business, monopolizing the transportation of major waterway components, expanding the engineering logistics general contracting business, and enhancing the logistics resource allocation capabilities. The company was committed to building a Sichuan port logistics platform that integrates multimodal transport, warehousing and distribution, logistics information, procurement and supply, park operations, and integrated services.

The second phase: Extending Related Logistics Units (2018-2020)

Based on the demands of industry regionalization and diversification strategy, the Group will rely on the core elements of port and shipping logistics, including port operations area, Lingang Logistics Park, Lingang Industrial Park, port integrated supporting service area, and large fleet, to fully expand the park management and enclaves. Business expansion will include fields of logistics, integrated transportation, multimodal transport, warehousing and distribution, procurement agency, logistics finance, logistics consulting, e-commerce, teaching and research training and other logistics business units. In addition, the Group will also establish logistics bases or branches to carry out regional distribution and city distribution operations, further improve the integrated logistics integration platform focusing on port and shipping logistics, and gradually transform itself into a modern integrated supplier of integrated logistics.

The third phase: building a high-end logistics platform (2021-2024)

The Group will use modern information technologies such as the Internet, Internet of Things, and cloud data to integrate all types of functional small and medium-sized logistics companies, control the core elements of the supply chain resources, and improve the supply chain service functions. The Group will also use the new service concept and modern logistics operation mode to provide customers with safe, convenient, standard, value-added full-factor, full-process logistics services and supply chain management services. In this way, the Group can cooperate in business operation, share the benefits and also share the development with its customers, build a high-end logistics integration platform, and become a regional modern integrated logistics supplier.

4.4.3 Strategy of comprehensive water-based business

The Group's integrated water-based development is mainly about the comprehensive development of agriculture and tourism.

Specifically, the comprehensive development of agriculture and tourism has developed specific strategies for the four development stages of eco-agriculture, agricultural-tourism culture, health support and health care, and new rural construction. Its implementation is based on agriculture and policy support, focusing on leisure tourism.

The aim is to bring together the value of the industry, to promote the promotion of regional land value and to project influence with the guidance of re-habitation industry. It also intends to actively promote the development of comprehensive agricultural development. Through the deep integration of traditional culture, communism culture, regional culture and natural scenery along the river, local customs, cultural relics and historic sites and urban architecture and other tourism resources, the Group will create high-quality wading tourism projects and products with rich cultural connotations. In the meantime, the Group can offer advice and suggestions on the development of cities along the rivers and lakes, actively participate in urban planning, investment and construction, help improve the urban environment, and boost the development of cities along the Yangtze River.

The strategic stage of the company's business segment is planned as follows.

The first phase: the acquisition and development of core resources and the completion of industrial layout (2016-2017)

The company made full use of the experience and advantages of the development of avionics, port and logistics business development. It seized the opportunities for comprehensive development of agriculture and tourism in Sichuan, and actively carried out the integration, acquisition and development of core resources such as road areas, river basin land resources, and cultural tourism resources. With the market as the guide, the Group developed comprehensive development projects for agriculture and tourism with high social and economic benefits and created a landmark brand for the comprehensive development of agriculture and tourism.

The second phase: the formation of a mature operating model for the comprehensive development of port and agricultural tourism (2018-2020).

Through the construction and operation of the existing comprehensive development projects for agriculture and tourism, the Group will integrate the development mode of avionics and port and shipping logistics, so as to form a mature development model for the comprehensive development of the port and agricultural tourism. Through the comprehensive development of the port and agricultural tourism brand layout, the Group can take the lead across the country. At the same time, it can constantly improve the construction of hardware and software to create a number of exemplary tourism projects and agricultural projects. Through the development and construction of related projects, the Group can achieve win-win cooperation with local residents and cities, highlighting social and economic benefits.

The third phase: boosting the economic and social development of the basin (2021-2024).

The Company will take the comprehensive development of agriculture and tourism as the core capability, together with navigation-power and port and shipping logistics, it will form a new model for river basin economic and social development. It will fully participate in the development and operation of river basins throughout the country, promote the development of new urbanization in the river basin, industrial transformation and upgrade, and improve the ecological environment quality. Promote the sustainable economic and social development of the basin.

4.5 Summary

Sichuan Port and Channel Development Enterprise Group is funded by state-owned capital. It is an enterprise group focused on hydropower and shipping hub, port logistics and comprehensive agricultural tourism development. From the information of Sichuan Port and Channel Development Enterprise Group and its parent company, it can be easily understood that enterprises within the enterprise group are related in capital and business. They are interdependent. In the meantime, from the perspectives of the group’s general strategy and business strategy, this enterprise group has clear strategic targets and business development planning. The purpose of introducing Sichuan Port and Channel Development Enterprise Group in this chapter is to provide the scenario for later analysis and research.

Chapter 5: Methodology

Theoretical hypothesis needs to be supported by empirical verification. Whereas empirical verification needs to be supported by sample data acquired. This chapter first defines dependent variables, independent variables and control variables. By referring to the measurement scale of existing literature, the author designed the questionnaire. It focuses on the whole network structure of the enterprise group, enterprise's strategic expansion behavior tendency, enterprise business ecological strategic capability and enterprise group's health performance. This questionnaire was distributed to top management of each of the enterprises in the enterprise group to acquire raw data. This chapter also carries out reliability and validity examination to the questionnaire and gives out descriptive statistical analysis towards the comprehensive characteristics of the samples.

5.1 Design of the questionnaire

5.1.1 Dependent variables and measurement

This measurement of this research referred to Li and Jie (2013)'s work. It mainly measures operational mechanism attribute, value sharing attribute, functional attribute, ecological attribute and relational attribute. There were 19 questions in total measuring the ecosystem health (see table 5-1). For example, for the measurement of operational mechanism attribute, it mainly included the strategic sense of "value sharing" of keystone companies, the compatibility of keystone companies with business opportunities, the convenience of accessing value sharing and the binding mechanism of interest distribution. While in measuring value-sharing attribute, it mainly included the extent of companies that were associated with keystone companies sharing a high degree of the value created by the keystone companies, the extent of companies that were associated with keystone companies that have a high contribution to the value created by the keystone companies, and the contribution of the keystone companies to customer value.

Additionally, it was also required for participants to compare their company with the corresponding main competitor and state their agreement with a series of statements. The scales were from 1 to 5, which respectively stood for completely disagree, disagree, uncertain, agree, and completely agree.

Table 5-1 Measurement Items of the Group Ecosystem Health

Variables	Attributes	Items	References
Group ecosystem health	Operational mechanism attribute	1. The strategic sense of " value sharing" of keystone companies is clear and long-term	Li and Jie (2013)
		2. The "value sharing" of keystone companies is compatible with business opportunities.	
		3. The access to "value sharing" of keystone companies is very convenient	
		4. The keystone companies have the binding mechanism of interest distribution	
	Value sharing attribute	1. Companies that are associated with keystone companies share a high degree of the value created by the keystone companies	
		2. Companies that are associated with keystone companies have a high contribution to the value created by the keystone companies	
		3. The keystone companies contribute a lot to customer value.	
	Functional attribute	1. The concentration and accessibility of production factors in the group industry are very high.	
		2. The group industry has high factor productivity.	
		3. The total number of companies within the group maintains a relatively fast growth rate	
		4. The Intra group differentiation, and the proportion of products have maintained a relatively fast growth rate.	
	Ecological attribute	1. The enterprise group has a very high level of competition (from price to brand) and a better competition order.	

		2. The enterprise group has a very high ability to resist macroeconomic risks.	
		3. The enterprise group has strong resilience after being subjected to macroeconomic risks	
		4. The enterprise group's industrial life cycle is mature	
	Relational attribute	1. The investment and financing institutions are very enthusiastic about the prospect of the group industry and the investment.	
		2. External scientific research institutes are highly concerned about the history of technology accumulation in the group industry and the future scientific research	
		3. External independent agencies play a great role in promoting group management programs and management level.	
		4. Government agencies provide large policy support for laws and regulations in the group industry.	

5.1.2 Independent variable and measurement

The independent variable in this thesis referred to business ecological strategic capabilities of enterprise. To further analyze the relationship between niche players' business ecological strategic capabilities and enterprise group ecosystem health, the author categorized the business ecological strategic capabilities into four dimensions, namely, the network competence, the innovation capability, the resource integration capability and the resource sharing intention. This came from dimensions of the business ecological strategic capabilities of the enterprises (discussed in 3.1.1). This chapter studies more profoundly on the relationship between every dimension of niche players' business ecological strategic capabilities and enterprise group ecosystem health.

5.1.2.1 Measurement of the network competence

This study made use of the mature scale developed and applied by Ren, Meng, and Wang (2011) in the empirical study. The author measured the business network competence through five items mainly from four aspects: the network vision, the network construction, the

relationship management and the relationship combination. The numbers from 1 to 5 represent five levels respectively: completely disagree, disagree, uncertain, agree, and completely agree. Based on a large number of related mature scales in foreign countries, the scale has been developed under China's special context. The specific measurement items are shown in Table 5-2 as follows:

Table 5-2 Measurement Items of the Network competence

Variables	Items	References
Network competence	1. The company can incisively find potential cooperation opportunities within the group in market development	Ren et al. (2011)
	2. The company actively contacts potential partners with relationship resources within the group.	
	3. The company frequently evaluates the actual effectiveness of cooperation with the partners within the group	
	4. The company continuously deepens and improves the relationship with the partners within the group based on experience	
	5. The company is good at effectively integrating the funds or other resources among multiple partners within the group	
	6. The company is good at distributing company resources reasonably in different cooperative activities within the group	

5.1.2.2 Measurement of innovation capability

Table 5-3 Measurement Items of the Innovation Capability

Variables	Items	References
Innovation Capability	1. The company is able to launch new products (or services) faster than its major competitors	Song, Chen, and Fan (2010)
	2. The company is able to open up new markets faster than its major competitors	
	3. The company attaches more importance to R & D investment comparing with its major competitors	
	4. The company's ability to absorb new technology and transform it into new products is stronger than its major competitors	

This study makes use of the mature scale developed and applied by Song et al. (2010) in the empirical study. We measured the business innovation capability through four items mainly from the aspect of knowledge sharing. The numbers from 1 to 5 represent five levels

respectively: completely disagree, disagree, uncertain, agree, and completely agree. The specific measurement items are shown in Table 5-3 as above.

5.1.2.3 Measurement of resource integration capability

This study makes use of the mature scale developed and applied by Dong et al. (2011) in the empirical study. We measured the business resource integration capability by four items mainly from three aspects: resources identification, resources matching, and resources utilization efficiency. The numbers from 1 to 5 represent five levels respectively: completely disagree, disagree, uncertain, agree, and completely agree. The specific measurement items are shown in Table 5-4 as follows:

Table 5-4 Measurement Items of the Resources Integration Capability

Variables	Items	References
Resources Integration	1. The company can bind and utilize the resources within the group according to the characteristics of them	Dong et al. (2011)
	2. The company can bind and utilize all kinds of resources within the group based on the established target	
	3. The company can enhance efficiency by integrating resources within the group.	
	4. The company can utilize the resources within the group to accomplish cross-department tasks	
	5. The company is satisfied with the development and expansion of the resources within the group	

5.1.2.4 Measurement of resource sharing intention

Table 5-5 Measurement Item of the Resource Sharing Intention

Variables	Items	References
Resource Sharing	1. The company is willing to frequently provide funds and other help to partners within the group.	Lyles and Salk (1996), Yu (2011)
	2. The company is willing to frequently share business experience and know-how with partners within the group.	
	3. The company is always willing to provide information that it has under the request of partners within the group	

For the measurement of enterprise resource sharing, this study makes use of the mature scale developed by Lyles and Salk (1996), later modified and applied in the empirical study by Yu (2011). We measured the business resource sharing by two items mainly from the aspect of

the sharing intention. The numbers from 1 to 5 represent five levels respectively: completely disagree, disagree, uncertain, agree, and completely agree. The specific measurement items are shown in Table 5-5 as above.

5.1.3 Control variables and measurement

In order to effectively study the relationship between enterprise's business ecological strategic capabilities and enterprise group ecosystem health, this research used size and age of enterprise as two control variables in the model. The control variables were chosen on the basis of some relevant theories (Li, Chen, & Yang, 2017).

The size of an enterprise has been a commonly-used control variable in the study of the influential factors in the strategy. It is generally believed that there are two indicators to be used to measure corporate size: the enterprise's assets and the total number of employees in it. In this thesis, the author adopted these two indicators to measure the control variable, enterprise scale. In this thesis, the relevant data of the assets and the total number of employees of an enterprise were available on the official website of the specific enterprise and the corresponding coding processing would carry out afterwards.

The years of establishment has also been a commonly-used control variable in the study of the influential factors in the strategy. Generally speaking, the establishment date of an enterprise could be acquired through the database of a listed company, annual reports of an enterprise and the official website of an enterprise, and then the relevant data of the establishment years of the enterprises would be available. As to this thesis, the relevant data of the establishment years of an enterprise were accessible on the official website of the sample enterprise and the corresponding coding processing would be carried out afterwards.

5.1.4 Measurement strategic expansion behavior tendency

For the measurement of enterprise strategic expansion behavior tendency, this study made use of the mature scale developed by Chen, Ding, Ding, and Li (2004). On the basis of related theories and literature, the strategic expansion behavior tendency of enterprises was measured in terms of horizontal integration and vertical integration, and the number 1 to 5 represents:

completely disagree, disagree, uncertain, agree, and completely agree. The specific measurement items are shown in Table 5-6 below:

Table 5-6 Measurement of Enterprise Strategic Expansion Behavior

Measuring variables	Project	Literature support
Strategic expansion	1. The company is more inclined to expansion by the way of mergers and acquisitions to gain the ownership or control right of our similar competitor enterprises.	Chen et al. (2004)
	2. The company is more inclined to expansion by the way of mergers and acquisitions to gain the ownership or control right of the upstream and downstream enterprises.	

5.2 The structure of the questionnaire

The questionnaire of this study consisted of five parts (for the full questionnaire see the Appendix 3).

The first part was the basic information of the questionnaire informants.

The second part of the questionnaire was related to the measurement of the structural characteristics of the enterprise group network. This thesis used the overall network analysis in the social network analysis for measurement. Specifically, we asked enterprises to select the business partners that they often work with among all the enterprises in the group provided by the questionnaire. The list of partners was obtained in this way and 0-1 is encoded according to the partnership (“0” indicates that there is no cooperation, while “1” indicates the opposite), and then a 0-1 matrix was generated. Finally, it was entered into UCINET software for analyzing and processing to obtain the network structure map and feature dimensions of center degree and structural holes.

The third part was the survey of the strategic expansion tendency of each enterprise.

The fourth part was the inquiry for the dimension of each enterprise's business ecological strategic capabilities, which was mainly for obtaining the relevant data of the independent variables in the research model; and the last part examined the enterprise group ecosystem health, in order to obtain the relevant data of the dependent variables in the research model.

Likert scale was adopted in the questions of the third, fourth and fifth parts in the questionnaire. And if options are more than five, it is difficult for discrimination. At the same time, it avoids the failure of discriminating different opinions significantly due to low points (Li & Zhao, 2013). The numbers from 1 to 5 represent five levels respectively: total inconformity, basic inconformity, average, basic conformity and total conformity.

The stages of the specific design process of the questionnaire are as follows:

(1) At the initial stage of the questionnaire design, the dimensions of the research variables and the specific dimensions were determined according to the concept of the research model. By searching the relevant literature, we found a more consistent theoretical basis or a similar scale for measurement, so that we could directly refer to or make the appropriate adjustments to get the measurement questions needed in this study. For instance, the measurement items were all obtained in this way in the questionnaire, for the firm network competence, the overall enterprise group ecosystem health, etc.

(2) By consulting the experts and professors in the field of research as well as the senior executives of the related industries, we organized, merged and designed related measurement items in order to achieve the actual effects based on the existing research foundation. For instance, the items in the questionnaire were gained in this way, such as innovation ability, resource integration ability and resource sharing intention, etc.

(3) On the maturity scale of relevant literature and the actual development of Sichuan Port and Channel Development Enterprise Group, the initial survey items of the questionnaire were designed. This measurement project tried to cover as many as possible the dimensions of all the variables. After the initial questionnaire was designed, the revised version of the questionnaire was obtained by referring to two professors in related fields and then some of the items were added or deleted according to the feedbacks.

(4) After the revised version of the questionnaire was obtained, it was sent to five top

managers in Sichuan Port and Channel Development Enterprise Group for the pre-test of questionnaire filling. In this way, the effectiveness of the questionnaire in the actual filling process can be examined and appropriate changes can be made to the statements that would lead to misunderstandings and the difficulties of understanding.

(5) According to the feedback and problems from the questionnaire pre-test, the final version of the questionnaire was acquired after the re-adjustment of the questionnaire content.

5.3 Data collection and reliability & validity analysis

5.3.1 Questionnaire release and data collection

To ensure credibility and accuracy of data collection, it is of vital significance to select proper questionnaire subject. Given that research object and questions are more of organization-based, rather than individual-related or team-related, it is crucial to hear voices from senior managers or general managers who are familiar with the overall enterprise operation. So, inviting the top management to fill in the questionnaire not only complies with the research requirement, but also facilitates accurate data collection.

It is more likely to collect abundant data in short time by releasing and collecting questionnaires on site, therefore, the author uses on-site questionnaire release and collection.

Based on the final revised questionnaires, the author conducted a formal survey on all enterprises of Sichuan Port and Channel Development Enterprise Group. Twenty-seven questionnaires were released to the senior managers on the monthly working meeting of Sichuan Port and Channel Development Enterprise Group, with 27 collected, 27 valid. The distribution and collection of the questionnaire took place between March and April 2017.

As to those questionnaires in which there are incomplete items, we interviewed the respondents specifically on the relevant questions to obtain their opinions on the questions and asked them to review the proofs after we completed the relevant items in order to ensure the information of all the returned questionnaires are reliable and accurate.

5.3.2 Reliability analysis

Reliability is defined as the ratio between variance of true score and variance of observed score. Reliability analysis is a method to measure the stability and credibility of a comprehensive evaluation system with Cronbach's α as a common index. α falls from 0 to 1; α over 0.7 means the measure is highly reliable, while α between 0.6 and 0.7 indicates the measure is acceptable.

In the reliability analysis of variables, 27 questionnaires were processed and entered into Spass22.0, followed by analysis—measurement—reliability analysis, and the Cronbach's α=0.924. Therefore, the questionnaires overall signify good internal consistency. In the meanwhile, the Cronbach's α value of the factor combination in each variable is greater than 0.85, which indicates that the variables in the questionnaire also have good reliability (See Appendix 1, Table 1-5-1).

5.3.3 Validity analysis

Before the confirmatory factor analysis, the exploratory factor analysis of innovation capability, resource integration, associative strength and ecosystem health is carried out. The KMO values are greater than 0.5, and Bartlett test of sphericity gets a significant probability of 0.000, which reveals that the questionnaire has more validity. (Appendix 1, Table 1-5-2)

In terms of structural validity, the validation factor analysis is adopted to verify the factor load of each dimension. The results demonstrate that the factor load of each item is greater than 0.7 and the convergent validity is good through Amos Software modeling and path analysis of five variables questionnaire data. Therefore, it can be assumed that each item can explain the corresponding variables well, and the questionnaire items have good structural validity.

The statistics of the reliability and validity of the questionnaire data in this thesis are detailed in Appendix 1, Table 1-5-3.

5.3.4 Overall characteristics of data

Table 1-5-4 in Appendix 1 shows some overall characteristics of the data. It reveals that the respondents are all executives of enterprises including deputy general managers and the above positions. Specifically, chairmen account for 14.8%, followed by 74.1% (general

managers) and 11.1% (deputy general managers).

In the categorization, the industries which the enterprises within the Group belong to is mainly divided into four categories accordingly. Among them, the largest number of companies with hydropower and shipping as the main business accounted for 37.1% of the total. The proportion of companies with port logistics as the main business also reached 18.5%. And 25.9% of the companies belonged to water-based integrated development. The remaining 18.5% belonged to construction, power supply and property management and so on. From the industry distribution of companies within the Group, we can see that the industries involved in the Group's business are mainly hydropower and shipping, supplemented by the comprehensive development of port logistics and water-based integrated development, and the industry involves many aspects.

According to the relevant statistics of the assets of the enterprise and the number of enterprise employees, the enterprises in the Group whose assets reach more than one hundred-million-yuan account for 85.1% of the Group, but the enterprises with more than 90 employees account for only 18.5%. It can be concluded that the common commercial mode of the whole enterprises is larger assets combined with smaller human resources.

Through the survey of enterprises' years of establishment (YE), it can be seen that the enterprises that have been established no more than 5 years account for 33.3% of the Group, and those more than 15 years account for only 14.8%, which reflects the enterprises' state of age. And thus, the main business strategy of enterprises groups gives priority to development and expansion.

The overall characteristics of the specific sample are detailed in Appendix 1, Table 1-5-4.

Chapter 6: Results about the Relationship between of Enterprise's Role-Capabilities Matching Rate and Enterprise Group Ecosystem Health

Based on the data acquired through the questionnaire, this chapter aims to empirically study the matching rate of role and capability and its relationship with the enterprise group's health performance. This chapter carries out the role identification of enterprises within enterprise group ecosystem first. It is followed by the calculation of matching rate of enterprise role and capability. A regression model is then built about the matching rate of enterprise role and capability and ecosystem health performance. After that, the relationship between the matching rate of enterprise role and capability and ecosystem health performance is analyzed to verify hypothesis about the relationship between the role-capabilities matching rate and the group ecosystem health.

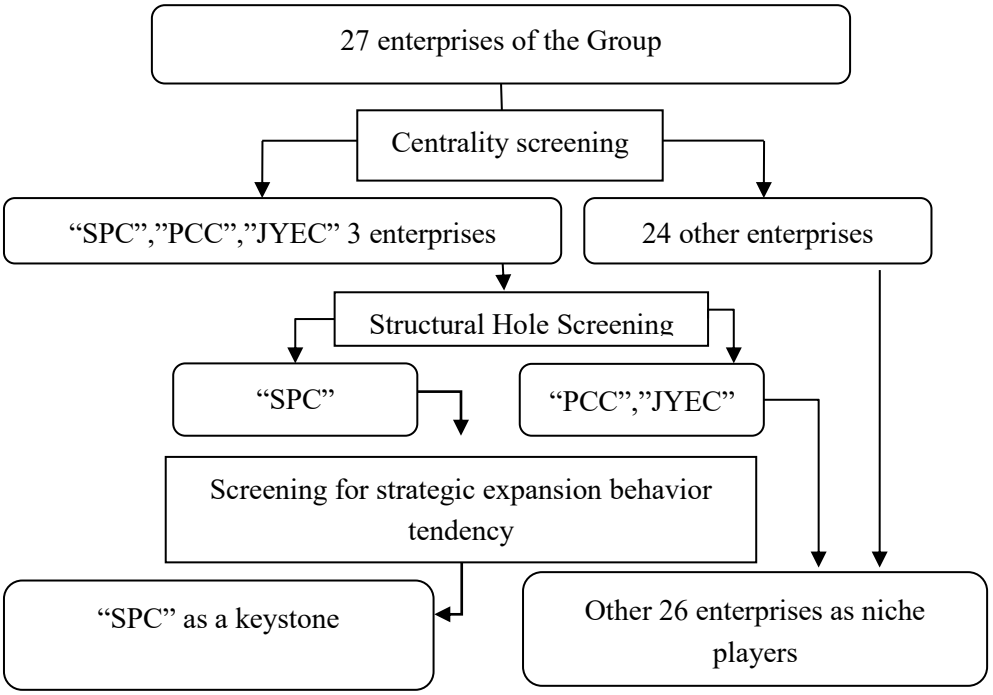
6.1 The role identification of enterprises within enterprise group ecosystem

Based on the selection of the structural dimensions of social networks and the strategic expansion of enterprises, the following steps were adopted to identify the role of enterprises in the ecosystem of the Group.

Firstly, by constructing the social network structure of the internal enterprises of the Group, the social network structural dimensions of each enterprise are obtained; and then the role types of each enterprise are identified respectively through the funnel form, according to the three main dimensions of "centrality", "structural hole" and "enterprise strategic expansion behavior tendency", as Figure 6-1 shows.

In order to facilitate the expression, we will list the names of enterprises and their

abbreviations in Appendix 1, Table 1-6-1., and we will use the abbreviations to represent them after that.



Note: SPC- Sichuan Port and Channel Development Co., Ltd; PCC- Port and Channel Construction Co., Ltd; JYEC- Jiangyuan Engineering Consulting Co., Ltd

Figure 6-1 The Flow Chart of Role Identification of the Enterprise within the Group

6.1.1 Role identification based on centrality

Through a simple 0-1-encoding processing of the collected questionnaires, the 0-1 matrix of the resource relationship between nodes was obtained. Finally, the matrix data were entered into the UCINET software. The network structure of the Group was visualized through the NetDraw of the File-open-UCINET dataset-network, and the following the Group resource network structure figure was obtained.

In Figure 6-2, Figure 6-3 and Figure 6-4, the enterprises, which are connected by one-way arrow, represent there is unidirectional resource relationship between the two. Among them, the enterprise the arrow points to indicates that in the questionnaire it has some related resources exchanges unilaterally acknowledged by the enterprise of the other side. For example, in Figure 6-2, the two enterprises, PCC and the YRCT, are connected by a one-way arrow, and the arrow is directed to YRCT from the PCC. The figure indicates that the PCC in the questionnaire has acknowledged frequent financial exchanges with YRCT, but that is not the case for the YRCT.

Conversely, if both parties acknowledge frequent resources exchanges with each other, then in the corresponding network structure figure the two-way arrows will be used to connect each other. In addition, “Degree” can be selected under “Analysis–Centrality measures–Set Node Sizes by” in the NetDraw attachment. Thus, the size of each enterprise’s centrality is vividly exhibited by the size of the node. The three specific network structures of resources exchanges are shown below.

In brief, the analysis of the above figures shows that in Figure 6-2 about network structure of financial resources exchanges, the two enterprises of SPC and PCC occupy a more obvious central position and have a higher network centrality which means they occupy a better ecological position. In Figure 6-3, similarly, these two enterprises have a higher network centrality; however, in Figure 6-4, it is not difficult to find that SPC is obviously superior to other enterprises in terms of network centrality.

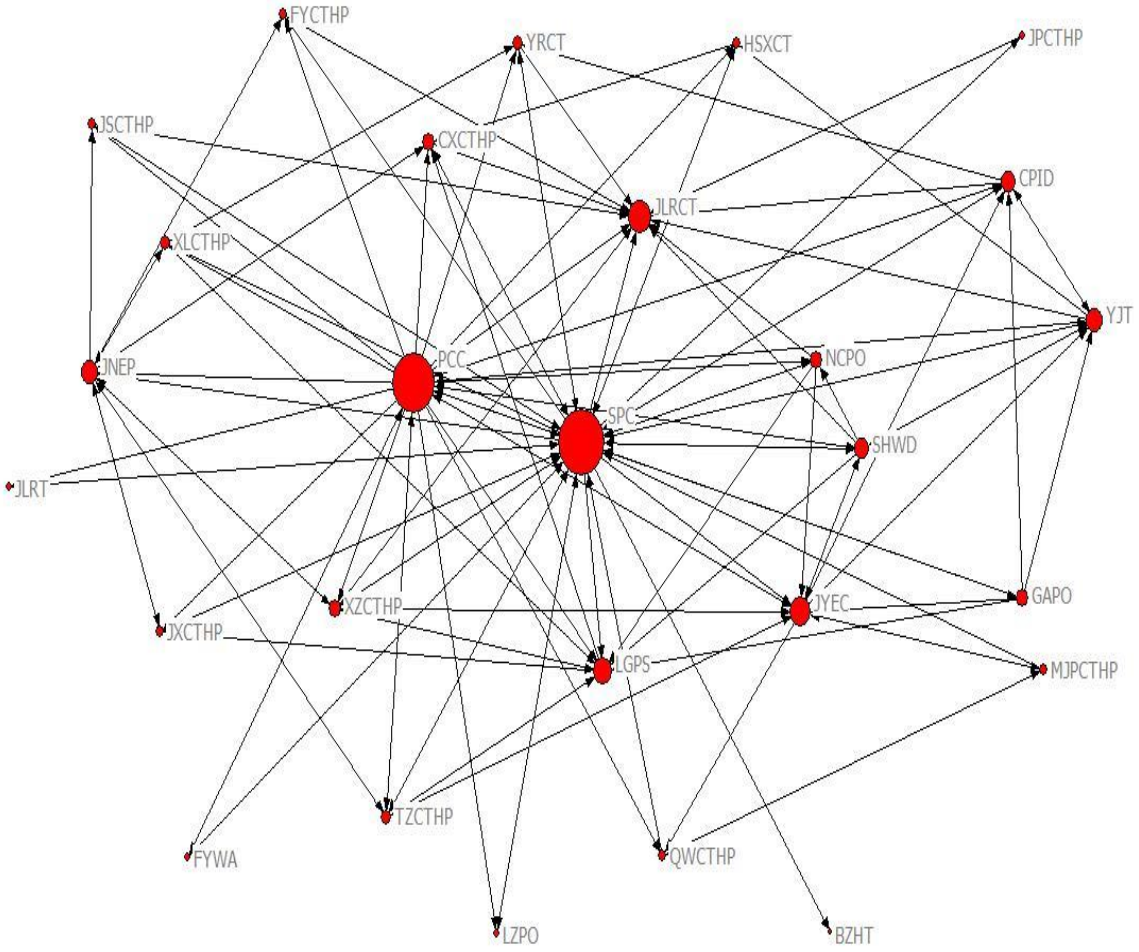


Figure 6-2 Network Structure of Financial Resources Exchanges

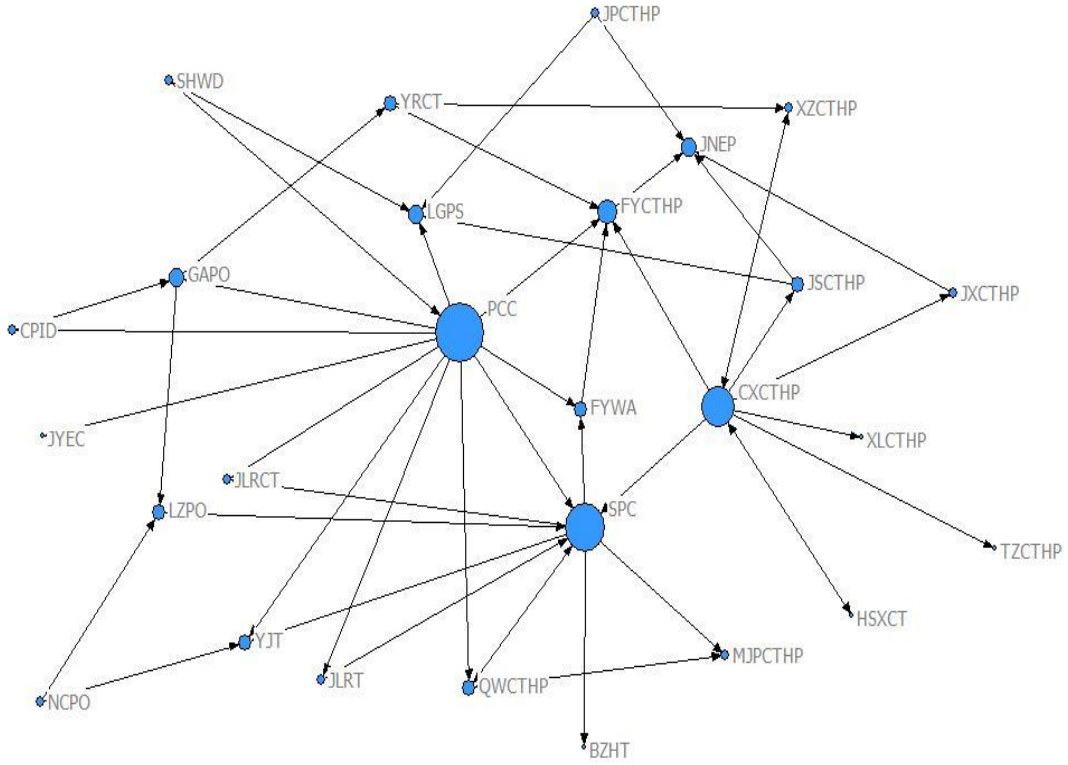


Figure 6-3 Network Structure of Physical Resources Exchanges

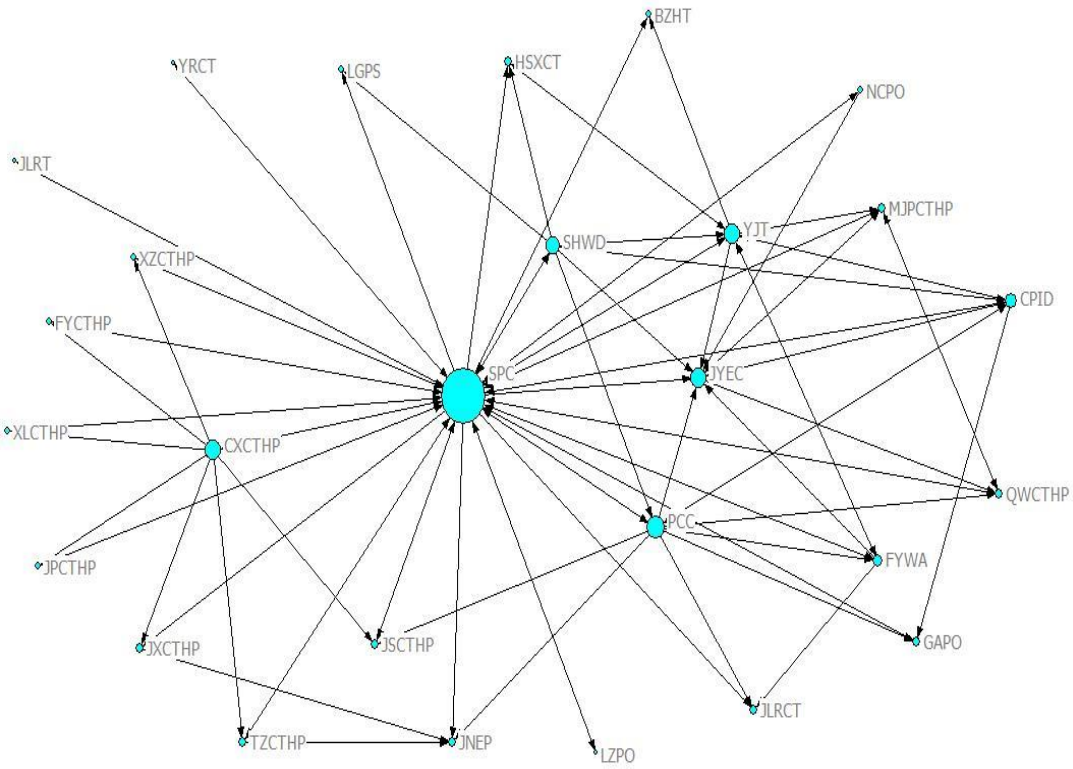


Figure 6-4 Network Structure of Technical Resources Exchanges

6.1.2 Role identification based on structural hole

In order to measure the network structural hole of the Group, social network analysis was employed in this thesis to analyze the group's overall network structure. As previously mentioned, the limit index is usually used to measure the number of node structural holes. It is necessary to point out that based on the individual net instead of the whole networks, the structural cavity index measurement, given by Burt, refers to the limits of the individual in the network. It is put forward in the relevant literature that the limit index is more widely used in the measurement of the structural hole of the net for more accuracy. However, based on the measurement of the index, the UCINET software can also be used to calculate the structural hole, such as the limit index of the nodes in the whole network (Liu, 2009). To be more specific, the 0-1 matrix obtained by encoding the collected questionnaire date was entered into UCINET software. First, Minimum was selected under Symmetrizing method along the Transform-Symmetrize operation path for symmetric transfer. The basis for choosing the minimum value substitution transfer here was that, in our 0-1 matrix, the minimum value "0" just illustrated that there were no resource exchanges between the enterprises. By means of the symmetric transfer of the minimum value substitution, the unilateral selection between enterprises was completely eliminated. And the existing "1" in the symmetric matrix indicated that the enterprises must choose each other to have frequent resource exchanges. Through the symmetric processing of the matrix, the fitness of the limit index in the enterprises group network was resolved. Finally, the measurement of the structural hole of each enterprise was achieved by selecting Whole Network Model under Method along the Network-Ego Networks-Structural Holes operation path. In this way, the number of structural holes could be learned by obtaining the limit index.

Table 1-6-2, Table 1-6-3 and Table 1-6-4 in Appendix 1 show the four main dimensions of the structural hole measurement from left to right. The column of Effsize is listed as the effective scale of each node and the column of Efficie stands for the efficiency of each node, while the column of Constra refers to the dimension of limit of each node, which is also the main dimension for the size of structural hole of each node. The last Hierarc column shows the hierarchical size of each node. For the limit index (Constra), the value of the column is always

between 0 and 1. The minimum value of "0" indicates that the network limit index of the node is very low, whereas the maximum value of "1" indicates the opposite. The rest values from 0 to 1 reveal the corresponding range of nodes of the network. And the limit index signifies the node in its own network has the ability to use the structural hole. And for the same network, the closer the node is to the network center, the less the network limit it has and hence the more structural holes it bears (Zhang & Zhang, 2016).

By analyzing the data about the dimension of limit of each node (the column of Constra) in the tables (Table 1-6-2, Table 1-6-3 & Table 1-6-4 in Appendix 1) and excluding the node data that obviously does not have the validity (such as LGPS in Table 1-6-2. The main dimensions of its corresponding multiple structural holes are 0), conclusion can be drawn as follows: firstly, in the physical resource network of the Group, the data about the dimension of limit of each enterprise do not have good directivity; in addition, in the network of financial resources within the Group, we have found that the 0.129 dimension of limit of the SPC is the lowest in all valid enterprises. Thus, it has a rich structural hole in its fund resource network. And in its technical resource network, the dimension of limit of the SPC goes down to 0.080, which is fairly low. Conversely, it also can be deduced that the SPC is very rich in structural holes in its technical resource network.

Through the analysis of the above two important steps, it could be tentatively seen that with the higher network centrality and the most network structural holes in three kinds of resource networks, SPC could be regarded as the keystone in the enterprises group network. However, as mentioned in the previous chapter, in order to have a more precise definition about the role of the members in the enterprises group network, further inquiries into the strategic expansion behavior of each enterprise are still quite necessary through questionnaires.

6.1.3 Role identification based on strategic expansion behavior tendency

The last step of the enterprise role identification in the enterprises group is based on the data about the enterprise strategic expansion behavior tendency. The data about the enterprises strategic expansion behavior tendency is show in Appendix 1, Table 1-6-5.

As SPC has already been regarded as the keystone in the previous part based on the

relevant dimensions, this thesis focuses on the rating of SPC. With the relevant data of Table 1-6-5, it is noticed that the rating of SPC is lower than the average value of these two sets of data and the median, that is, the integration tendency of the enterprise goes below the overall level of the Group. The result vividly shows that the enterprise does not have a strong integration tendency in the strategic expansion, which is consistent with the role design as a network keystone in the previous part of this thesis. So, it could finally be proposed that the SPC is the keystone of the Group.

6.2 Role-capabilities matching rate of enterprise

The pattern of portfolio departure is the key solution to enhancing the research in this thesis. As for the overall construction of the matching model of role-capabilities, the steps are as follows:

6.2.1 The data of actual enterprise business ecological strategic capabilities in all dimensions

The data of the questionnaire was preliminarily processed. It mainly included generating the original questionnaire into Excel database and get the arithmetic average of the data of each item of questions so as to obtain the measurement of that variable. The initial data with variables as the criterion for distinction could be achieved in Table 6-1.

Descriptive statistical is used to analysis actual enterprise business ecological strategic capabilities. The statistics of business ecological strategic capabilities in Table 6-2 show that the average of the dimensional of the business ecological strategic capabilities are very close to 4. It also reflects the concentration of the data of business ecological strategy capability are approaching 4. Likert scale is used to collect part of the data concerning business ecological strategy capability in the questionnaire. The design of the questionnaire reveals that the central tendency of variable of business ecological strategy capabilities shows that interviewees from the enterprises are more likely to agree with relative conformity. In addition, judging from the standard deviation and extreme of independent variables, the difference between extreme is relatively small (2 to 2.75), while the standard deviations are generally smaller (0.56 to 0.69)

and even far less than the average number. Thus, it is also deduced that the dimensional data of business ecological strategic capabilities also have a clear Gaussian distribution.

Table 6-1 The Data of Actual Enterprise Business Ecological Strategic Capabilities

	Independent variable			Mediator variable	Dependent variable
	Network competence	Innovation capability	Resource integration	Resource sharing	Ecological
SPC	3.60	5.00	3.75	4.00	4.00
MJPCTHP	3.00	3.25	4.00	4.00	3.35
QWCTHP	4.60	4.25	4.75	5.00	4.25
JLRCT	3.00	3.25	3.25	3.00	3.00
CXCTHP	4.20	4	4.25	4.50	4.15
JSCTHP	4.20	4.5	3.00	4.00	3.72
XZCTHP	3.40	3.25	3.75	4.00	3.40
JXCTHP	4.00	4.00	3.50	4.00	4.00
FYCTHP	3.60	3.00	4.00	4.00	3.82
XLCTHP	4.00	4.00	4.00	4.00	4.00
TZCTHP	3.80	3.00	5.00	5.00	4.53
JPCTHP	3.80	3.50	3.75	5.00	4.08
LZPO	4.00	4.00	4.00	4.00	4.05
NCPO	3.80	3.25	3.50	4.00	3.88
GAPO	3.80	4.00	4.00	4.00	3.30
YRCT	4.00	3.00	3.00	3.50	3.10
YJT	4.00	4.00	3.50	3.00	3.22
FYWA	4.00	4.00	4.00	4.50	4.85
BZHT	3.80	2.75	4.50	3.50	3.90
SHWD	5.00	4.75	5.00	5.00	4.70
CPID	3.60	2.25	3.75	4.00	3.52
HSXCT	5.00	3.75	4.25	4.00	4.00
JLRT	4.40	4.25	4.25	4.00	4.15
PCC	5.00	4.75	5.00	5.00	4.63
JYEC	5.00	3.00	4.50	2.50	3.98
JNEP	3.60	3.50	4.00	3.50	3.88
LGPS	5.00	2.75	4.50	5.00	4.62

Table 6-2 Descriptive Statistics of Business Ecological Strategic Capabilities

		Network competence	Innovation capability	Resources integration capability	Resource sharing intention
N	Effective	27	27	27	27
	Missing	0	0	0	0
Average		4.0444	3.6667	4.0278	4.0741
Mode		4.00	4.00	4.00	4.00
Standard deviation		.58001	.69338	.55614	.66076
Minimum		3.00	2.25	3.00	2.25
Maximum		5.00	5.00	5.00	5.00

6.2.2 Calculation of enterprise's role-capabilities matching rate

Based on the previous research, the data of four dimensions of network competence, innovation capability, resource integration capability and resource sharing will be selected as the dimensions of the enterprise business ecosystem strategic capabilities. In order to facilitate subsequent calculation of the matching rate of role-capabilities of each enterprise, according to the Euclidean Distance measurement algorithm, it is necessary to calculate and obtain the extrema of the respective dimensions and the mean value and other related data.

Table 6-3 The Summary of Each Dimensions date

	Network competence	Innovation capability	Resource Integration	Resource Sharing
N	27	27	27	27
Valid				
	0	0	0	0
Missing				
Mean	4.0444	3.6667	4.0278	4.0741
Minimum	3.00	2.25	3.00	2.50
Maximum	5.00	5.00	5.00	5.00

As shown in Table 6-3, by calculation, we have obtained the extrema and the mean of each dimension. Based on the related theoretical foundation and network structure analysis, SPC has

been selected in the previous part as the keystone in the group network, while the remaining 26 enterprises constitute the niche players in the group network.

According to the construction of the matching model in Section 3.2.2 above, the Euclidean Distance measurement algorithm for SPC should be:

$$\sqrt{(\mathbf{Xnc} - \mathbf{Xnc_{max}})^2 + (\mathbf{Xrs} - \mathbf{Xrs_{max}})^2} \tag{6.1}$$

For the remaining 26 niche players, Euclidean Distance measurement algorithm should be:

$$\sqrt{(\mathbf{Xic} - \mathbf{Xic_{max}})^2 + (\mathbf{Xri} - \mathbf{Xri_{max}})^2} \tag{6.2}$$

The Euclidean Distance value of role-capabilities of each enterprise can be calculated by the formula above. In order to facilitate the follow-up analysis, the Euclidean Distance value is properly transformed here because the matching rate is inversely proportional to the Euclidean Distance value: MD = Ln | 5-ED |, and finally the standardized matching rate of each enterprise is shown in Appendix 1, Table 1-6-6.

6.2.3 Descriptive statistical analysis of role-capabilities matching rate

First of all, the distribution histogram of the role-capabilities matching rate of 27 enterprises presents the matching rate of enterprise within the entire group, which shows a relatively standard normal distribution. Intuitively, the role-capabilities matching rate of each enterprise within the group is low as a whole, which indicates the role of the enterprise within group ecosystem and its corresponding business ecological strategic capability do not bear a good matching. However, from the Figure 6-5 we easily see that there are more enterprises with higher matching rate than the ones with lower matching rate (the number of enterprises on the right side of the histogram is larger than that on the left).

Second, in regards to the specific matching rate of 27 enterprises, the enterprises that best match their roles and capabilities are SHWD and PCC, whose matching value is as high as 1.56, followed by QWCTHP, CXCTHP and JLRT, which also claim relatively high matching rate; in contrast, the worst matching goes to CPID, with a matching value of only 0.68, after which are YRCT, JLRCT and several other enterprises with relatively low matching. The details are as below in Figure 6-6.

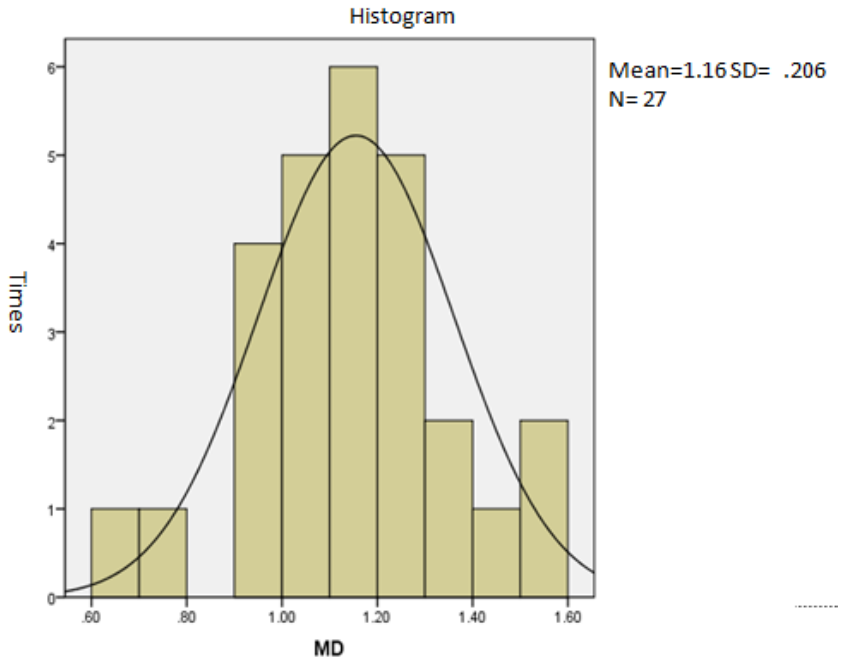


Figure 6-5 Histogram of Enterprise's Role-Capability Matching Rate Distribution

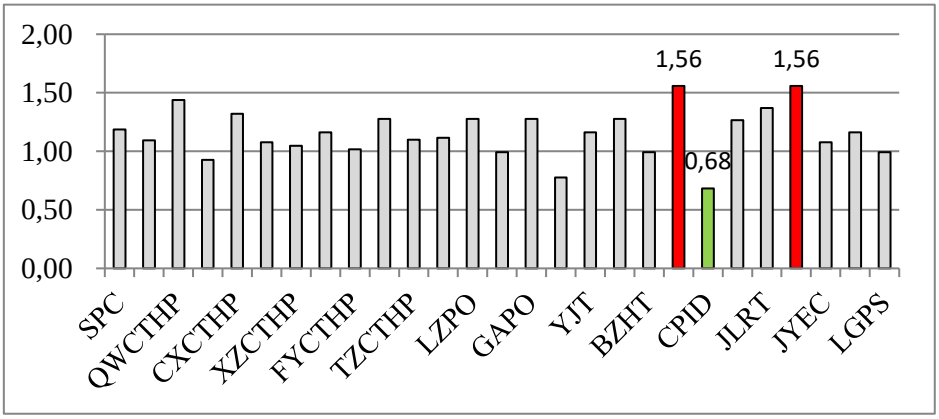


Figure 6-6 Enterprise's Role - Capabilities Matching Rate

In order to further explore the matching between enterprises' role and their capabilities, the enterprises that have more attributes of network structure are summarized here based on the research in Section 6.1. For details, see Table 6-4, which is a list of enterprises that have the highest degree of centrality and structural holes in terms of capital, physical resources and technical resources. The findings in Table 6-4 and Figure 6-6 suggest that none of the enterprises with the most network structure attributes match well. In other words, a node that occupies a favorable network position in the group network but does not have the corresponding business ecological strategic capability may restrict its own development and the overall health of the group.

Table 6-4 Enterprises with More Attributes of Network Structure

	Capital Resources	Physical Resources	Technical Resources
Centrality	SPC	PCC	SPC
	PCC	SPC	JYEC
	JLRCT	CXCTHP	YJT
Structural Hole	SPC	*	SPC
	JNEP	*	YJT
	PCC	*	MJPCTHP
* Each enterprise's physical resource structure hole indicators are not valid enough			

6.3 Empirical analysis on the relationship between the enterprise role-capabilities matching rate and enterprise group ecosystem health

In the econometric model of the empirical analysis of the relationship between "role-capability" and enterprise group ecosystems, we use the ecosystem health performance as a dependent variable and the role-capability matching degree of the enterprise as an independent variable, enterprise asset, number of employees, and year of establishment serve as control variables for this model.

6.3.1 Descriptive statistical analysis of enterprise group ecosystem health

First of all, according to the statistics of enterprise group ecosystem health in Table 6-5, the mean value and the mode value of five dimensions of the enterprise group ecosystem health are very close to 4, which reflects that the enterprise group ecosystem health variables are all approaching 4. Likert scale is used to collect the data of variables of enterprise group ecosystem health in the questionnaire. The design of questionnaire reveals that the central tendency of variables of enterprise group ecosystem health shows that interviewees from the major sample enterprise are more likely to agree with 'Relative conformity'. In addition, from the standard deviation value and the extreme value of the dependent variable, the difference between the extreme values is relatively small (1.75 to 2.25), and the standard deviation value is generally

small (0.48 to 0.63) and even far less than the mean value, from which we can infer that the data of enterprise group ecosystem health variables have a clear Gaussian distribution.

Table 6-5 Statistics of Ecosystem Health

		Operational mechanism attribute	Value sharing attribute	Function attribute	Ecological attribute	Relational attribute
N	Effective	27	27	27	27	27
	Missing	0	0	0	0	0
Average		4.0463	3.7285	3.9167	4.0278	3.9259
Mode		4.00	4.00	4.00	4.00	4.00
Standard Deviation		.62802	.51545	.57596	.57735	.47946
Minimum		3.00	3.00	2.75	3.00	3.00
Maximum		5.00	5.00	5.00	5.00	4.75

6.3.2 Descriptive statistical analysis of control variables

Since the relevant data of the control variables are all taken from the official reports of the sample companies and are not standardized in the statistics herein, it can be seen that the extreme differences of the three sub variables under the control variables are relatively large and so is the standard deviation. So the distribution of the control variable data fluctuations is more intense. However, it can be seen from the related histograms (Figure 2-6-1, Figure 2-6-2 & Figure 2-6-3 in Appendix 2) that the data of the control variables still reveal a certain degree of normal distribution.

The statistical data of the control variables are shown in Appendix 1, Table 1-6-7.

6.3.3 Variable correlation analysis

Since the control variables of the research model have been set, namely the three sub-variables: the assets, the number of employees and the years of establishment of the enterprise, a partial correlation analysis is employed. Each variable is entered through the “analysis-correlation-partial correlation” path in SPASS to get correlation matrix between the group ecosystem health and the enterprise's role-capabilities matching rate, as shown in Appendix 1, Table 1-6-8.

From Table 1-6-8, it can be seen that there is a significant correlation between enterprise role-capabilities and group ecosystem health (β= 0.659, p = 0.000 <0.05). That is, the higher the matching rate of the enterprise's role-capacities is, the better the ecosystem health of the entire group is.

6.3.4 Regression analysis

In this thesis, multiple regression models are used to conduct a deeper empirical analysis of the relationship between the role-capabilities matching rate of 27 sample companies in the Group and the ecosystem health of the Group. The statistics of the related variables and their codes in the model are shown in Appendix 1, Table 1-6-9.

Firstly, the following multiple regression equations 6.3 and 6.4 are constructed. Among them, equation 6.3 involves dependent variable, constant term and control variables, while the matching rate of independent variable is added to equation 6.4 based on equation 6.3.

$$\mathbf{GEH} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_2\mathbf{EA} + \boldsymbol{\beta}_3\mathbf{NE} + \boldsymbol{\beta}_4\mathbf{YE} \quad (6.3)$$

$$\mathbf{GEH} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1\mathbf{RMR} + \boldsymbol{\beta}_2\mathbf{EA} + \boldsymbol{\beta}_3\mathbf{NE} + \boldsymbol{\beta}_4\mathbf{YE} \quad (6.4)$$

Table 6-6 The Overall Regression Results of the Model

Model	R	R squared	R square after adjustment	Standard skew error	Change statistics					Durbin-Watson
					R square-change	F value-change	df1	df2	Significant F-value change	
1	.334[a]	.112	-.004	.49428	.112	.964	3	23	.426	
2	.705[b]	.497	.406	.38013	.386	16.889	1	22	.000	2.126

a. Predictive value: (constant), years of establishment, total assets, the number of employees

b. Predictive value: (constant), years of establishment, total assets, the number of employees, matching rate

c. Dependent variables: Group ecosystem health

SPASS22.0 statistical software is used to run equation 6.3 and equation 6.4 separately along the path of the analysis-regression-linear operation. In another word, regression fitting, by means of the ordinary least square (all entering method), is conducted in the model of dependent variable and control variables, as well as in the model of dependent variable, independent variable and control variables. The regression results are shown in Table 6-6 above.

First of all, a summary of the overall regression results in Table 6-6 shows that after the

independent variables are added, the adjusted R-square value of the model increases from -0.004 to 0.460 and the R-square changes from 0.112 to 0.386. Meanwhile, the value of F in Model 1increases from 0.964 to 16.889, with a significant change in F value ($p = 0.000 < 0.05$). Therefore, it can be seen that the addition of independent variables will have a huge influence on the whole model. That is to say, the matching rate of role-capabilities in this thesis is significant in the study of the independent variables that affect the group ecological.

Since the Durbin-Watson (DW) value = 2.126 in Table 6-6 falls within the acceptable standard range from 1.5 to 2.5, it can be concluded that there is no serious autocorrelation issue of the synthetic model in this study (in general, there is little possibility that such issue exists in cross-section data). In addition, according to the collinear statistics in Table 6-6 above, the VIF values for all variables are less than 5, so there is no significant multi-collinearity among the variables in the model.

In Table 6-6, the R-square and the adjusted R-square of Model 2 reach 0.497 and 0.406 respectively, meanwhile the F-value is also significant. Therefore, it can be concluded that the overall fitting degree of the regression model 2 analyzed above is relatively accurate, which proves the validity of the model. Then, the normalized coefficients of each variable in model 2 in Table 1-6-10 (in Appendix 1) are plugged into equation 6.4, and the following complete regression equation is obtained:

$$\mathbf{GEH = 0.633RMR - 0.433EA - 0.077NE + 0.119YE} \quad (6.5)$$

$$\mathbf{(4.11) \quad (-2.612) \quad (-0.453) \quad (0.647)}$$

It can be seen that there is a positive correlation between the enterprise role-capabilities matching rate and enterprise group ecosystem health. In addition, the p-value of the matching rate coefficient between role-capabilities and group ecological of sample firms is $0.000 < 0.05$, which means the matching rate of sample firm's role-capabilities has a significant positive effect on group ecological.

Therefore, hypothesis 1 is verified, that is the higher the role-capabilities matching rate is, the better the group ecosystem health will be. This conclusion confirms Iansiti and Levien (2002) and Iansiti and Levien (2004) view that an ecosystem should be healthy if all members in the ecosystem are positioned correctly (that is occupying the right location). However, my research

not only further validates this view by empirical quantitative method based the enterprise business ecosystem, but also describe quantitatively the meaning of occupying the right location in the ecosystem using role-capabilities matching rate.

Chapter 7: Results about the Relationship Between the Business Ecological Strategic Capabilities of Niche Player and Enterprise Group Ecosystem Health

In order to further analyze the impact of dimensions of the business ecological strategic capabilities of enterprise of the Group on the ecosystem health of the group, the niche players are chosen as samples. As is known, there are 26 niche-type enterprises in the Group, which are the fundamental basic units of the group's network. Therefore, it is necessary to do a further verification and analysis of the structural dimensions of the business ecological strategic capabilities of niche players in relation to the ecosystem health of the Group, as well as a verification of the impact mechanism of this capability on group ecosystem health.

In this part of the study, the enterprise group ecosystem health is taken as the dependent variable, while the dimensions of actual business ecological strategic capabilities of niche player are taken as independent variables, enterprise asset, number of employees, and year of establishment serve as control variables for this model.

7.1 Correlation analysis of variables

Since the control variables of the research model in this thesis have been set, that is, the three control variables including the total assets of the enterprise, number of employees and the establishment of the enterprise, the partial correlation analysis method is selected in this thesis when the correlation analysis is carried out. Enter each variable through the analysis-correlation-partial correlation path in SPASS to get a correlation matrix of all the variables, as is shown in Table 7-1.

From the correlation between the variables shown in Table 7-1, some conclusions can be summarized as follows:

(1) There is a significant positive correlation between the innovation capability of sample

enterprises and the group ecosystem health (β = 0.478, p = 0.021 <0.05). That is, when the innovation capability of sample enterprises is strong, the group ecosystem health is better. This is also consistent with the supposition of our research hypothesis 2.

(2) There is a significant positive correlation between capability in integrating resources of sample enterprises and the group ecosystem health (β = 0.728, p = 0.000 <0.05). That is, when the sample enterprise's capability in integrating resources is higher, the ecosystem health of the entire group is better. This is also in line with the supposition of the research hypothesis 3.

(3) There is a significant positive correlation between sample enterprises' resource sharing and group ecosystem health (GEH) (β = 0.779, p = 0.000 <0.05). That is, the more the resources sharing of a sample enterprise is, the better the ecosystem health of the entire group becomes.

(4) There is no significant correlation between the innovation capability of sample enterprises and their capability in integrating resources (β = 0.202, p = 0.356> 0.05). That is, there is no significant correlation between independent variables, which provides some evidences to verify that the regression model does not have multiple collinear problems.

(5) There is also no significant correlation between sample enterprises' innovation ability and their resource sharing (β = 0.292, p = 0.176> 0.05). That is, there is no significant correlation between independent variables, which still provides a basis for the later verification that the regression model does not have multiple collinear problems.

(6) There is a significant positive correlation between the capability in integrating resources of sample enterprises and their resources sharing (β = 0.573, p = 0.008 <0.05). That is, the higher the capability in integrating resources of sample companies is, the more the resources sharing of enterprises has.

The results of correlation analysis show that the innovation capability and capability in integrating resources of sample enterprises are significantly correlated with the group ecosystem health, and this result is basically consistent with the previous hypotheses 2 and 3. However, in order to verify the results, a further regression analysis is needed.

Table 7-1 Correlation Matrix of Variables (Without Control Variables)

Control variable			Innovation capability	Resources Integration capability	Resource sharing willingness	Group ecosystem Health
Assets Number of employees Years of establishment	Innovation capability	Correlation	1.000			
		Significance (Two-tailed)				
		Df	0			
	Resources integration capability	Correlation	0.202	1.000		
		Significance (Two-tailed)	0.356			
		Df	21	0		
	Resource sharing willingness	Correlation	0.292	0.537	1.000	
		Significance (Two-tailed)	0.176	0.008		
		Df	21	21	0	
	Group ecosystem health	Correlation	0.478	0.728	0.779	1.000
		Significance (Two-tailed)	0.021	0.000	0.000	
		Df	21	21	21	0

7.2 Regression analysis

In this thesis, the multiple regression models is adopted to perform a further empirical analysis of the four dimensions that characteristically attribute high values to the capability of niche players in developing and implementing business ecological strategy: innovative capability, resource integration capability, resource sharing capability and ecological health.

The statistics of the related variables and their codes appearing in the model are summarized in Appendix 1, Table 1-7-1.

7.2.1 The relationship between every dimensions of business ecological strategic capabilities of niche players and the ecosystem health of group

The following multiple regression equations 7.1 and 7.2 are constructed. Equation 7.1 only includes dependent variables, constant term, and controlled variables; and Equation 7.2 adds three independent variables based on Equation 7.1.

$$\mathbf{GEH} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_4\mathbf{TA} + \boldsymbol{\beta}_5\mathbf{NE} + \boldsymbol{\beta}_6\mathbf{YE} \tag{7.1}$$

$$\mathbf{GEH} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1\mathbf{IC} + \boldsymbol{\beta}_2\mathbf{RI} + \boldsymbol{\beta}_3\mathbf{RS} + \boldsymbol{\beta}_4\mathbf{TA} + \boldsymbol{\beta}_5\mathbf{NE} + \boldsymbol{\beta}_6\mathbf{YE} \tag{7.2}$$

With the application of SPASS 22.0 statistical software, equations 7.2.1 and 7.2.2 are computed separately according to the analysis-regression-linear operation path. That is, the model including dependent variable, control variable as well as model including dependent variable, independent variable and control variable are respectively fitted by the regression method with the ordinary least square method (all entering method). The regression results are shown in the following Table 7-2.

Table 7-2 Model Overall Regression Results

Model	R	R square	Adjusted R-square	Standard skew error	Change statistics					Durbin-Watson
					R-square change	F-value change	df1	df2	Significant F-value change	
1	.380[a]	.144	.028	.49585	.144	1.236	3	22	.321	
2	.911[b]	.829	.776	.23822	.685	25.439	3	19	.000	2.206

a. Predictive value: (constant), Years of establishment, Total assets, Number of employees

b. Predictive value: (constant), Years of establishment, Total assets, Number of employees, Resource sharing, Enterprise innovation capability, Resource integration capability

c. Strain: GEH

Summary of the overall regression results in Table 7-2 shows that the adjusted R-square

value of the model increases from 0.028 to 0.776 and the R-square changes from 0.144 to 0.685 after the independent variables are added. At the same time, F value also increases from 1.236 in Model 1 to 25.439, which is a significant change in F value (p=0.000 <0.05). Therefore, it can be preliminarily confirmed that the addition of independent variables will exert a major impact on the whole model. In other words, it is of great significance to select three dimensions of IC, RI and RS as the independent variables of studying the ecosystem health of the group.

Table 7-3 Regression Coefficient Statistics and Variables Collinearity

Model	Non-standardized coefficient		Standardized coefficient	T	Significance	Collinear statistics	
	B	Standard error	Beta			Tolerance	VIF
1 (constant)	5.306	.826		6.427	.000		
TAs	-.114	.066	-.354	-1.724	.099	.921	1.086
NE	-.026	.112	-.051	-.235	.816	.810	1.234
YE	-.005	.021	-.058	-.255	.801	.758	1.319
2 (constant)	2.021	.583		3.466	.003		
TAs	-.139	.034	-.433	-4.130	.001	.816	1.226
NE	-.036	.056	-.070	-.637	.532	.750	1.333
YE	.007	.010	.076	.677	.507	.711	1.405
IC	.192	.081	.249	2.362	.029	.807	1.239
RI	.355	.103	.399	3.455	.003	.670	1.493
RS	.334	.087	.477	3.855	.001	.668	1.497

a. Strain/: GEH

Since the DW value = 2.206 in Table 7-2 above and falls into the acceptable standard range of 1.5-2.5, it can be concluded that there is no serious autocorrelation problem in the model fitting in this study (In general, cross-sectional data is also less likely to be self-correlated). In addition, according to the colinearity statistics in Table 7-3 above, the VIF values of the expansion factors for each variable are less than 5, hence there is no significant multicollinearity among the variables in the model.

In the above Table 7-2, the R-square and the adjusted R-square of model 2 are 0.829 and 0.776 respectively, and the F-value is also significant. Therefore, the overall fitting degree of the above Regression Model 2 is good, and the model can play a sufficient role in explaining.

Then, the normalized coefficients of each variable in Model 2 in Table 7-3 are substituted into Equation 7.2 to obtain the following complete regression equation:

$$\mathbf{GEH = 0.249IC + 0.399RI + 0.447RS - 0.433TA - 0.070NE + 0.076YE} \quad (7.3)$$

(2.362) (3.445) (3.855) (-4.130) (-0.637) (0.677)

First of all, it can be seen that there is a positive correlation among IC, RI, RS and GEH of niche players. Secondly, it can be seen that the RS of niche players has a greater impact on GEH than RI on GEH (0.447> 0.399), and the effect of RI on the GEH is greater than the influence of IC on GEH (0.399> 0.249). In addition, p=0.029 <0.05, that is, IC has a significant positive impact on GEH. Similarly, the p value of RI of niche players and the relationship coefficient between RS and GEH are 0.003 and 0.001 respectively, which are less than 0.05. That is to say, resource integration capability and resource sharing of niche players also have significant positive effects on group ecosystem health. So far, the hypotheses of 2, 3, 4 have been fully verified.

7.2.2 The mediating effect of resource sharing intention on resource integration capability

According to Baron and Kenny (1986), four conditions should be met to fulfill the mediating effect. First, there should be significant influence between independent variables and dependent variables. Secondly, the independent variables should have significant influence on the mediating variables. Thirdly, it is necessary for the mediating variables having a significant influence on the dependent variables. Finally, the mediating effect needs to be verified. Since the empirical analysis in the preceding section has confirmed the first condition mentioned above, as there is significance between independent and dependent variables, this section will continue to test whether the subsequent conditions are met.

7.2.2.1 The multiple regression analysis on RI and RS of niche players

Firstly, the following multiple regression equations 7.4 and 7.5 are constructed. The equation 7.4 only brings into RS as the dependent variable, the constant term and the controlled variable. Based on it, RI is added into equation 7.5 as the independent variable.

$$\mathbf{RS} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_2\mathbf{TA} + \boldsymbol{\beta}_3\mathbf{NE} + \boldsymbol{\beta}_4\mathbf{YE} \quad (7.4)$$

$$\mathbf{RS} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1\mathbf{RI} + \boldsymbol{\beta}_2\mathbf{TA} + \boldsymbol{\beta}_3\mathbf{NE} + \boldsymbol{\beta}_4\mathbf{YE} \quad (7.5)$$

Using SPASS 22.0 statistical software, equations 7.4 and 7.5 are computed separately following the analysis-regression-linear operation path. That is, the dependent variable and the controlled variable model as well as the dependent variable, the independent variable and the controlled variable model are respectively fitted by the regression method by the ordinary least square method (all entering method). The regression results are shown in Appendix 1, Table 1-7-2.

Table 7-4 The Statistics of Regression Coefficients and the Case of Collinearity

Model		Non-standardized coefficient		Standardized coefficient	T	Significance	Collinear statistics	
		B	Standard error	Beta			Tolerance	VIF
1	(constant)	3.498	1.188		2.9	.008		
	TA	.040	.095	.093	.422	.677	.921	1.086
	NE	.056	.161	.082	.350	.730	.810	1.234
	YE	-.009	.030	-.071	-.292	.773	.758	1.319
2	(constant)	.327	1.494		.219	.829		
	TA	.062	.082	.145	.759	.456	.913	1.095
	NE	.115	.140	.168	.818	.422	.794	1.260
	YE	-.003	.026	-.025	-.117	.908	.754	1.326
	RI	.656	.225	.549	2.919	.008	.945	1.059

a. Strain/: Resources Sharing

Foremost, the abstracts of the overall regression results in Table 1-7-2 demonstrate the following results. Since the independent variable is added, the change of the R square in the model is increased from 0.012 to 0.285. Meanwhile, the change of F value is also increased from 0.090 in Model 1 to 8.523, which yields more obvious significance ($p=0.008<0.05$).It can be preliminarily proved that the addition of RI, the independent variable, has a huge impact on the whole model. That is, it is significant for this model to select RI as the independent variable when studying the enterprise RS.

Moreover, due to DW =2.343 in Table 1-7-2, within the acceptable standard range of 1.5 to 2.5, it can be concluded that there is no serious autocorrelation problem in the fitting model of this study. In addition, according to the collinearity statistics in Table 7-4, the expansion factor VIF of each variable is less than 5. Therefore, there is no obvious multicollinearity among variables in this model.

When the normalized coefficient of the variables of Model 2 in Table 7-4 are substituted into Equation 7.5, the following complete regression equation could be derived.

$$\mathbf{RS = 0.549RI + 0.145TA + 0.168NE - 0.025YE} \quad (7.6)$$

$$\mathbf{(2.919)\quad (0.759)\quad (0.818)\quad (-0.117)}$$

It can be observed that there is a positive correlation between RI and RS in niche players. Moreover, the correlation coefficient between RI and RS of niche players is p value =0.008<0.05, which means Resource integration capability exerts a significantly positive impact on Resource sharing of the enterprises.

7.2.2.2 Multiple regression analysis on RS of niche players and GEH

Based on the previous hypothesis 3, the multiple regression equations 7.7 and 7.8 are constructed as follows. Equation 7.7 only introduces constant, controlled variable and GEH as dependent variable. Based on it, the enterprise RS is added into equation 7.8 as independent variable.

$$\mathbf{GEH = \beta_0 + \beta_2 TA + \beta_3 NE + \beta_4 YE} \quad (7.7)$$

$$\mathbf{GEH = \beta_0 + \beta_1 RS + \beta_2 TA + \beta_3 NE + \beta_4 YE} \quad (7.8)$$

Following the analysis-regression-linear operation path, equation 7.7 and 7.8 are respectively computed in Spss22.0, by which, the regression fitting is performed separately on the model of dependent variable and controlled variable, the model of dependent variable, independent variable and controlled variable by means of ordinary least squares (total entry method). The regression results are shown in Appendix 1, Table 1-7-3.

First, the key points of the Overall regression results in Table 1-7-3 demonstrate that, since injecting the resources sharing situation as independent variable, the value of R Square has been increased from 0.028 to 0.600, while the change of R square from 0.144 to 0.520.

Simultaneously, the change of F has been uplifted from 1.236 in Model 1 to 32.511, with more remarkable significance (p=0.000<0.05). This can be preliminarily confirmed that the addition of the independent variable has a great influence on the whole model. That is to say, it is significantly meaningful to investigate enterprise RS as the independent variable affecting GEH relationships.

Table 7-5 Statistics of Regression Coefficients and Variable Collinearity

Model	Non-standardized coefficient		Standardized coefficient	T	Significance	Collinear statistics	
	B	Standard error	Beta			Tolerance	VIF
1(constant)	5.306	.826		6.427	.000		
TA	-.114	.066	-.354	-1.724	.099	.921	1.086
NE	-.026	.112	-.051	-.235	.816	.810	1.234
YE	-.005	.021	-.058	-.255	.801	.758	1.319
2 (constant)	3.412	.625		5.459	.000		
TA	-.135	.042	-.422	-3.189	.004	..914	1.095
NE	-.057	.072	-.111	-.790	.438	.806	1.241
YE	-.001	.013	-.006	-.042	.967	.755	1.324
RS	.541	.095	.725	5.702	000	.988.	1.012

a. Strain/: Ecosystem health of group

Since the value of DW=1.670 in Table 1-7-3, within the acceptable standard scope of 1.5-2.5, it can be concluded that there is no serious autocorrelation problem in the model fitted in this study (In general, cross-sectional data are also less likely to be self-correlated). In addition, according to the colinearity statistics in Table 7-5 above, the VIF values of the expansion factors for each variable are less than 5, so there is no significant multicollinearity between the variables in the model.

When the normalized coefficient of the variables of Model 2 in Table 7-5 is substituted into Equation 7.8, the following complete regression equation could be derived.

$$\mathbf{GEH = 0.725RS - 0.422TA - 0.111NE - 0.006YE} \quad (7.9)$$

$$\mathbf{(5.702) \quad (-3.189) \quad (-0.790) \quad (0.042)}$$

It can be observed that there is a positive correlation between RS of niche players and

GEH. Moreover, the correlation coefficient between RS of niche players and the GEH is p value =0.000<0.05, indicating that RS of the niche players has a significantly positive impact on GEH.

7.2.2.3 The mediating effect of RS of niche players

Based on the previous Hypothesis 4, the following multiple regression equations 7.10 and 7.11 are constructed. Equation 7.10 only brings into the constant term, the controlled variable, GEH as dependent variable and RI as independent variable. Based on it, RS is added into equation 7.11 as the mediating variable.

$$\mathbf{GEH} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1\mathbf{RI} + \boldsymbol{\beta}_3\mathbf{TA} + \boldsymbol{\beta}_4\mathbf{NE} + \boldsymbol{\beta}_5\mathbf{YE} \quad (7.10)$$

$$\mathbf{GEH} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1\mathbf{RI} + \boldsymbol{\beta}_2\mathbf{RS} + \boldsymbol{\beta}_3\mathbf{TA} + \boldsymbol{\beta}_4\mathbf{NE} + \boldsymbol{\beta}_5\mathbf{YE} \quad (7.11)$$

With the adoption of SPASS 22.0 statistical software, equations 7.10 and 7.11 are computed separately according to the analysis-regression-linear operating path. That is, the dependent variable and the controlled variable model as well as the dependent variable, the independent variable and the controlled variable model are respectively fitted by the regression method employing the ordinary least square method (all entering method). The regression results are shown in Appendix 1, Table 1-7-4.

Table 7-6 The Statistics of Regression Coefficients and Variable Collinearity

Model		Non standardized coefficient		Standardized coefficient	T	Signifi -cance	Collinear statistical data	
		B	Standard error	Beta			Tolerance	VIF
1	(constant)	2.320	.844		2.750	.012		
	TA	-.092	.046	-/288	-1.992	.060	.913	1.095
	NE	.029	.079	.056	.363	.720	.794	1.260
	YE	7.262E-05	.015	.001	.005	.996	.754	1.326
	RI	.618	.127	.693	4.869	.000	.945	1.059
2	(constant)	2.196	.641		3.425	.003		
	TA	-.116	.036	-.362	-3.251	.004	.889	1.125
	NE	-.015	.061	-.029	-.241	.812	.769	1.300
	YE	.001	.011	.013	.110	.914	.754	1.327
	RI	.369	.114	.414	3.320	.004	.672	1.488
	RS	.379	.094	.508	4.054	.001	.703	1.423

a. Strain/: Ecosystem health

First, the key points of the Overall regression results in Table 1-7-4 demonstrate that, since adding RS as mediating variable, the value of R Square has been increased from 0.521 to 0.724. Simultaneously, the change of F has been lifted from 7.809 in Model 1 to 16.432, with more obvious significance ($p=0.001<0.05$). This can be preliminarily confirmed that the addition of the mediating variable has a great influence on the whole model. That is to say, it is significantly meaningful to investigate the enterprise RS as the mediating variable between RI and GEH.

Moreover, due to DW =2.343 in Table 1-7-4, within the acceptable standard range of 1.5 to 2.5, it can be concluded that there is no serious autocorrelation problem in the fitting model of this study (In general, cross section data is less likely to be autocorrelated.). In addition, according to the collinearity statistics in Table 7-6, the expansion factor VIF of each variable is less than 5. Therefore, there is no obvious multicollinearity among variables in this model.

The following analysis could be obtained.

Firstly, with the control variable added, this study introduces independent variable (RI) into regression equation 7.2.2 to analyze the effect of an enterprise's capability in resources integrating on the GEH of the group. It is shown that RI has a positive impact on GEH ($\beta=0.399$, $p=0.003<0.05$). That is, the first condition of mediating effect is verified. Secondly, after adding the controlled variable and putting dependent variable (RI) into regression equation 7.5 to analyze the effect of an enterprise's capability in resources integrating on the resource sharing of the company, it can be seen that RI has a positive impact on RS ($\beta=0.549$, $p =0.008<0.05$), so the second condition of mediating effect is verified. Thirdly, after adding the controlled variable, this thesis injects the mediating variable (RS) into the regression equation ⑥ to analyze its impact on GEH. The results prove that the third condition of mediating effect is verified as RS has positive impacts on GEH ($\beta=0.725$, $p =0.000<0.05$). Having added control variables and independent variables (RI), the thesis analyses the regression model 7.11 by adding mediating variable (RS) so as to verify the common effects on variable GEH which are exerted by RI and RS of enterprise. The results show that the role of mediating variable RS is still significant ($\beta=0.508$, $p =0.001<0.05$) while the role of independent variable RI weakens, but still has the significance (β decreased from 0.693 to 0.414, while P increased from 0 to 0.004, but still less than 0.05). That is to say, RS of a niche enterprise plays an intermediary

role in part between RI and GEH. So far, the Hypothesis 5 in the earlier part of the thesis, that RS has a mediating effect on the relationship of RI and GEH, is well verified.

7.3 Summary

Since the basic attribute of network competence of niche players is low, this thesis, on the basis of relevant theories, excludes the network competence from the enterprise business ecological strategic capabilities dimension of enterprise when choosing variables in the empirical study. This thesis mainly studies the relations of innovation capability, resources integrating capability, resources sharing with ecosystem health of group, on which the hypothesis of this research is put forward. After that, with the adoption of multiple linear regression equations and Spass22.0, the relationship of hypotheses in theoretical research is validated. Through the correlation analysis and regression analysis of the sample data, test results are obtained as shown in Table 7-7, in which four main research hypotheses have been verified.

Table 7-7 Summary of The Hypotheses Validation

Hypothetical	Content	Verification
H2	The stronger the dimension of innovation capability of the niche players is, the better the health of the group ecosystem will be.	support
H3	The stronger the dimension of resource integration capability of the niche player is, the better the health of the group ecosystem will be.	support
H4	The higher the dimension of resource sharing intention of niche players is, the better the health of the group ecosystem will be.	support
H5	The dimension of resource sharing is a mediator between the dimension of resource integration capability and the health of the group ecosystem.	support

Base on the data from Sichuan Port and Channel Development Enterprise Group, the innovation capabilities of niche players positive correlation with ecosystem health has been found. And resource integration capability and resource sharing intention also have positive correlation with ecosystem health, further the resource sharing play a mediator role between the dimension of resource integration capability and the health of the group ecosystem. Here, through the analysis of relationship between the business ecological strategic capabilities of

niche player and enterprise group ecosystem health, the mechanism of the impact of the components of the business ecological strategic capabilities on the performance of the business ecosystem is found.

Chapter 8: Conclusions, Suggestions and Research Prospects

8.1 Conclusions

From the perspective of business ecosystem, taking Sichuan Port and Shipping Development Enterprise Group as a sample, this thesis does the empirical studies about the relationship between enterprise's business ecological strategic capabilities and enterprise group's ecosystem health. Based on business ecological perspective, social network analysis method and enterprise capability theory, the author develops a method to identify the role of an enterprise within enterprise group ecosystem in the perspective of business ecosystem and summarizes the basic business ecological strategic capabilities, practical business ecological strategic capabilities, as well as its dimensions. On this basis, according to the deduction of relevant theories, the author puts forward the theoretical hypotheses about the relationship between enterprise's business ecological strategic capabilities and enterprise group's ecosystem health, between every dimensions of niche player's business ecological strategic capability and enterprise group's ecosystem health. Then, relevant data were obtained by questionnaires, and the hypotheses were verified by multiple regression methods. Finally, the following conclusions are drawn.

Firstly, based on the data from Sichuan Port and Shipping Development Enterprise Group, it is found that the higher the enterprise's role-capabilities matching rate was, the better the enterprise group's ecosystem health would be.

Secondly, based on the data from Sichuan Port and Shipping Development Enterprise Group, it is found that the every dimensions of the business ecological strategic capability of niche players have a positive impact on group's ecosystem health. However, each dimension exerts influences in a different manner on group's ecosystem health. For example, the dimension of innovation capability has direct positive effect on group's ecosystem health, but, resource integration capability exerts indirect influences on group's ecosystem health through

the mediating role of resource sharing intention.

8.2 Management practice and suggestion

With the combination of the construction of matching model in the previous chapters and related research results, the thesis argues that there are two main reasons for the low matching rate of role-capabilities within the internal of Sichuan Port and Shipping Development Enterprise Group. Firstly, the enterprises which occupy a better network location in the group ecosystem, namely they are of high complexity (the center and the dimension of the structural hole are very high), do not have the corresponding better business ecological strategic capabilities. Secondly, in the group ecosystem, enterprises with better business ecological strategic capabilities do not have the suitable network position. Therefore, based on the perspective of business ecosystem, enterprises group should balance the relationship between the role of enterprise in group and its business ecological strategic capabilities. For Sichuan Port and Shipping Development Enterprise Group, this dissertation puts forward the relevant development proposals:

The first proposal is for some enterprises which occupy high degree of complex network node with poor business ecological strategic capabilities, such as Sichuan Port and Channel Development Co., Ltd and Port and Channel Construction Co., Ltd, the thesis suggests that Sichuan Port and Shipping Development Enterprise Group should take some action to adjust their role-capabilities matching rate because the low role-capabilities matching rate have damaging effect on enterprise group ecosystem health. For example, on one hand, restrict its resource association with other enterprises and on the other hand, improve its business ecological strategic capabilities.

The second proposal is for some enterprises which occupy low degree of complexity network node, such as Shanghewan Development Co., Ltd and Qianwei Channel Transport and Hydroelectric Power Development Co., Ltd, the thesis suggests that Sichuan Port and Shipping Development Co., Ltd should take some action to strengthen their network relationship with other enterprises, so as to improve their degree of complexity network node. Not only should

such kinds of enterprises improve the complexity of network relations, but also improve the network governance mechanism with others.

8.3 Limits and prospects

Although this thesis is based on the perspective of the business ecosystem networks, through the integration of social network analysis methods and business ecology theory, the author systematically studied the impact of the role-capability matching of enterprise on the group's network efficiency. It also studied the structural dimension of the business ecosystem strategic capabilities of the niche player enterprises and its influence and mechanism of the group's network efficiency. It has also expanded the application of the business ecology theory in the study of enterprise groups and has deepened the research of the business ecology theory from the quantitative perspective.

In the process of research, no matter whether it is research design, data acquisition, or data analysis, we tried to avoid deficiencies. However, this thesis still has the following limitations:

First, the dimensions of variables. At present, although the academic literature has discussed the strategic capabilities that enterprises should have from the perspective of the business ecosystem network (see Section 3.1.1), it does not systematically integrate the capabilities of the enterprise from the perspective of the enterprise business ecological strategy. This thesis exploratively proposes the "business ecological strategic capability" and systematically integrates the enterprise's relevant capabilities from a business ecological perspective. Such an integrated refinement is based on the results of comprehensive induction from existing literature and has not been thoroughly demonstrated. Secondly, the sample is limited. This study is based on the sample of Sichuan Port and Channel Development Enterprise Group. The number of its subsidiaries is not large, resulting in a small sample size. On the other hand, this article only investigated a group enterprise of Sichuan Port and Channel Development Enterprise Group. Third, this article uses “ecosystem health” to measure the network performance of the group. Yet, this concept and its measurement indicators are still in the exploration phase.

In view of the deficiencies in the above research, follow-up research can be carried out in the following aspects: First, further study of the connotation and extension of the enterprise's business ecological strategic capabilities and its constituent dimensions. The author is looking forward to more influential theoretical research results. Second, enrich the quantity and quality of the sample, increase the scope of application of the research results, and increase its theoretical value. Third, combine the latest research literature to further improve the “ecosystem health” measurement indicators, so that the empirical results are more persuasive.

Bibliography

Bai, L. (2013). Strategy of selecting core business platform based on business ecosystem for niche Enterprises. *Market Weekly (Disquisition Edition)*, 01, 12-14.

Barney, J. B. (1991). Firm resources and sustainable competitive advantage. *Journal of Management,* 17, 99-120.

Barney, J. B. (1995). Looking inside for competitive advantage. *Academy of Management* Executive, 9 (4), 49-61.

Baron, R. M. & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51 (6), 1173-1182.

Barton, D. L. (1992). Core capabilities and core rigidities: a paradox in managing new product development. *Strategic Management Journal*, 13, 111-125.

Baum, J. A. C., Calabrese, T., & Silverman, B. S. (2000). Don't go it alone: alliance network composition and startup's performance in Canadian biotechnology. *Strategic Management Journal*, 6, 267-294.

Beven, K. (2006). A manifesto for the equifinality thesis. *Journal of Hydrology*, 320 (1), 18-36.

Borgatti, P. & Foster, P. C. (2003). The network paradigm in organizational research: a review and typology. *Journal of Management,* 29 (6), 991-1013.

Borgatti, S. P. & Everett, M. G. (1999). Models of core/periphery structures. *Social Networks*, 4, 206-223.

Burt, R. S. (1980). Autonomy in a social topology. *American Journal of Sociology*, 85 (4), 892-925.

Burt, R. S. (1992). *Structural Holes: The Social Structure of Competition.* Cambridge, MA: Harvard University Press.

Burt, R. S. (2004). Structural holes and good ideas. *American Journal of Sociology*, 110 (2), 349-369.

Chen, H. E., Ding, X., Ding, D. H., & Li, Y. H. (2004). A study on enterprises' selection in expansion strategy. *Management World*, 02, 143-144.

Chen, W., Peng, C., & Yang, B. (2016). Cross-enterprise knowledge sharing, knowledge leaking and innovation performance: empirical study based on perspective of supply chain. *Technology Economics*, 35 (6), 1-7.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology,* 94 (94), 95-120.

Conner, K. R. & Prahalad, C. K. (1996). A resource-based theory of the firm: knowledge versus opportunism. *Organization Science*, 5 (9-10), 477-501.

Di, Z. L. (2013). Discussion on the management strategy of core enterprises in commercial ecosystems. *Value Engineering*, 32 (30610), 141-143.

Dong, B. B., Ge, B. S., & Wang, K. (2011). The process of resources integration, the dynamic capability and the competitive advantage: the mechanism and the path. *Management World*, 03, 92-101.

Dou, G. S. (2008). Study on the mechanism of business ecosystem strategic evolution. *Reform & Strategy*, 09, 43-45.

Duan, H. Y. & Zhong, W. Z. (2008). The causes of interlocking directorates in China from the network perspective---an empirical study based on Shanghai and Guangdong. Accounting Research, 11, 69-75.

Estrada, I., Faems, D., & Faria, P. D. E. (2015). Coopetition and product innovation performance: the role of internal knowledge sharing mechanisms and formal knowledge protection mechanisms. *Industrial Marketing Management*, 53 (2), 56-65.

Fan, B. Q. (2005). The competitive way of business ecosystem and its enlightenment. *Commercial Economy and Management*, 11, 3-7.

Freeman, J. (1999). *Venture Capital as An Economy of Time Corporate Social Capital and Liability*. Boston: Kluwer Academic Publishing.

Freeman, L. C. (1977). A set of measures of centrality based on betweenness. *Sociometry*, 40 (1), 35-41.

Freeman, L. C. (1979). Centrality in social networks: conceptual clarification. *Social Networks*, 1, 215-239.

Gawer, A. & Cusumano, M. (2002). *Platform Leadership*. Cambridge, MA: Harvard Business School Press.

Gereffi, G. (1993). *Commodity Chains and Global Capitalism*. Westport, CT: Praeger.

Gong, L. M. & Jiang, S. S. (2016). Strategic management research frontier of platform-based business ecosystems: perspective and themes. *Foreign Economics & Management*, 38 (6), 38-50.

Gothlich, S. E. (2003). *From Loosely Coupled Systems to Collaborative Business*. University of Kiel.

Govindarajan, V. (1988). A contingency approach to strategy implementation at the business-unit level: integrating administrative mechanisms with strategy. *Academy of Management Journal*, 31 (4), 828-853.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, 78 (6), 1360-1380.

Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. *American Journal of Sociology*, 91 (3), 481-510.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, 17, 109-122.

Guo, W., Sun, J., Zheng, Q., & Shao, H. (2014). Study on evaluation index system of ecosystem health of manufacturing enterprises. *Statistics and Decision*, 414 (18), 18-21.

Hakansson, H. (1987). *Understanding Business Markets*. New York: Croom Helm.

Han, Q. X. & Wang, S. W. (2006). On the construction of commercial ecosystem. *Contemporary Economics*, 08, 42-43.

Iansiti, M. & Levien, R. (2002). *Keystones and Dominators: Framing Operating and Technology Strategy in a Business Ecosystem*. Cambridge, MA: Harvard Business School Press.

Iansiti, M. & Levien, R. (2004). Strategy as ecology. *Harvard Business Review*, 82 (3), 68-78.

Iansiti, M. & Levien, R. (2006). *The Impact of a Win-Win Business Ecosystem on Corporate Strategy, Innovation, and Sustainability.* Beijing: Beijing Commercial Press.

Iansiti, M. & West, J. (1997). Technology integration: turning great research into great products. *Harvard Business Review*, 75 (3), 69-79.

Inkpen, A. C. & Tsang, E. W. K. (2005). Social capital, networks, and knowledge transfer. *Academy of Management Review*, 30 (1), 146–165.

Ji, H. F. & Gu, L. G. (2012). Enterprise strategic collaboration based on business ecosystem. *Corporate Management*, 36602, 98-99.

Jiang, F. X., Zhang, M., & Liu, Z. B. (2008). Mergers and acquisitions or self-investment: the choice of expansion of listed companies in China. *World Economy*, 08, 77-84.

Kapoor, R. & Agarwal, S. (2017). Sustaining superior performance in business ecosystems: evidence from application software developers in the iOS and Android smartphone ecosystems. *Organization Science*, 28 (3), 531-551.

Li, G. F. & Zhao, Z. Y. (2013). Study on the relationship between control, innovation and performance of joint ventures. *World Economic Research*, 04, 73-79 + 89.

Li, G., Chen, J. J., & Yang, X. (2017). Relationship research on network competence, knowledge acquisition and enterprise service innovation performance: the moderating effect of network size. *Business Review*, 02, 59-68+86.

Li, J. Y. & Ruan, P. N. (2010). Effect of core enterprise in strategic network evolution. *Science & Technology Progress & Policy*, 27 (25612), 86-89.

Li, Q. & Jie, X. W. (2012). Research on a new enterprise strategy model based on commercial ecosystem. *Journal of Management*, 9 (6502), 233-237.

Li, Q. & Jie, X. W. (2013). An empirical study on information technology business ecosystem health, strategic conduct and enterprise value. *Chinese Journal of Management*, 06, 824-830.

Li, Y. H. & Hu, H. X. (2011). Construction of low cost aviation business ecosystem in China based on international comparison. *Inquiry into Economic Issues*, 34504, 146-150.

Li, Y., Guo, Q. L., & Lin, J. J. (2014). How the business conglomerates leading industrial innovation and upgrading: an analysis in the perspective of networking ability. Nankai Business Review, 17 (6), 96-105.

Lian, T. H., Yu, C. H., & Zong, Q. J. (2012). Study on the network structure of China's tourism websites - based on social network analysis. *Tourism Science,* 06, 80-88.

Liang, Y. W. & Tan, L. W. (2005). Business ecosystem value structure, corporate roles and strategic choices. *Nankai Management Review,* 01, 57-63.

Lin, N., Ensel, W. M., & Vaughn, J. C. (1981). Social resources and strength of ties: structural factors in occupational status attainment. *American Sociological Review*, 46, 393-40.

Liu, J. (2009). *Overall Network Analysis Handouts: Guide to Using UCINET Software.* Shanghai: Gezhi Publishing House.

Liu, J. (2014). *Overall Network Analysis (Second Edition)*. Shanghai: Shanghai People's Publishing House.

Lu, L. (1996). A brief discussion on the principles of enterprise ecology. *World Science,* 3, 44-46.

Lyles, M. A. & Salk, J. E. (1996). Knowledge acquisition from foreign parents in international joint ventures: and empirical examination in Hungarian context. *Journal of International Business Studies,* 27 (5), 877-903.

Marsden, P. V. (1987). Core discussion networks of Americans. *American Sociological Review,* 52 (1), 122-131.

Miles, R. E. & Snow, C. C. (1994). *Fit, Failure and the Hall of Fame: How Companies Succeed or Fail.* New York: Free Press.

Möller, K. K. & Halinen, A. (1999). Business relationships and networks: managerial challenge of network era. *Industrial Marketing Management,* 28 (5), 413-427.

Moore, J. F. (1993). Predators and prey: the new ecology of competition. *Harvard Business Review*, 74 (3), 75-83.

Moore, J. F. (1996). *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystem*. Boston: John Wiley & Sons Ltd.

Moore, J. F. (1998). The rise of a new corporate form. *Washington Quarterly*, 21 (1), 167-181.

Naeem, S., Thompson, J., Lawler, S. P., Lawton, J. H., & Woodfin, R. M. (1994). Declining biodiversity can alter the performance of ecosystems. *Nature,* 368, 734-737.

Niederkofler, M. (1991). The evolution of strategic alliances: opportunities for managerial influence. *Journal of Business Venturing*, 6 (4), 237-257.

Nooy, W., Mrvar, A., & Batagelj, V. (2005). *Exploratory Social Network Analysis with Pajek.* New York: *Cambridge University Press.*

Peltoniemi, M. & Vuori, E. (2004). *Business Ecosystem as the New Approach to Complex Adaptive Business Environments*. Finland, Tampere: Frontiers of E-Business Research.

Penrose, E.T. (1959). *The Theory of the Growth of the Firm*. New York: John Wiley.

Polanyi, K. (1968). The Economy as Instituted Process. New York: Holt, Rinehart and Winston.

Porter, M. E. (1979). How competitive forces shape strategy. *Harvard Business Review*, 57 (2), 137-145.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Simon and Schuster.

Power, T. & Jerjian, G. (2001). *Ecosystem: Living the 12 Principle of Network Business*. London: Pearson Education Ltd.

Prahalad, C. K. & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, 5 (6), 79- 91.

Qiao, J. X. & Gu, L. G. (2008). Empirical analysis of business strategy based on ecosystem theory. *Reform & Strategy*, 07, 37-39.

Ren, H. (2005). *Research on enterprise knowledge resource management*. Doctoral Dissertation, Nanjing University.

Ren, H., Zhu, M. R., & Gao, W. H. (2015). Connotation, efficiency and measurement: a review of the research on innovative network structure. *Journal of Information*, 12, 192-199.

Ren, S. G., Meng, Y., & Wang, L. W. (2011). The measurement of firm network competence and empirical research. *Chinese Journal of Management*, 04, 531-538.

Ritter, T. & Gemünden, H. G. (2003). Network competence: its impact on innovation success and its antecedents. *Journal of Business Research*, 56 (9), 745-755.

Ritter, T. & Gemünden, H. G. (2004). The impact of a company's business strategy on its technological competence, network competence and innovation success. *Journal of Business Research*, 57 (5), 548-556.

Ritter, T. (1998). *Innovationserfolg durch Netzwerk-Kompetenz: effektives Management von Unternehmensnetzwerken*. Wiesbaden: Gabler.

Ritter, T. (1999). The networking company: Antecedents for coping with relationships and networks effectively. *Industrial Marketing Management*, 28 (5), 467-479.

Ritter, T., Wilkinson, I. F., & Johnston, W. J. (2002). Measuring network competence: some international evidence. *The Journal of Business & Industrial Marketing*, 17 (2/3), 119.

Schilling, M. A. (2013). *Strategic Management of Technological Innovation*. New York: McGraw-Hill Education.

Song, L. & Gu, L. G. (2010). Research on the relationship among members in enterprise ecosystem. *China Management Informationization*, 13 (18915), 95-98.

Song, X. Z., Li, J. L., & Xu, N. (2008). *Dynamic game analysis on knowledge-sharing and knowledge-spillover in competitive alliance.* Proceeding of the 2008 International Conference Computer Science and Software Engineering, 12 (15), 783-786.

Song, Z. H., Chen, S., & Fan, L. B. (2010). An empirical investigation on the relationship between knowledge characteristics, knowledge sharing and enterprises' innovation capability. *Studies in Science of Science*, 04, 597-604+634.

Szeto, E. (2000). Innovation capacity: working towards a mechanism for improving innovation within an inter-organizational network. *The TQM Magazine,* 12 (2), 149-157.

Teece, D. J. & Pisano, G. (1994). The dynamic capabilities of firms: an introduction. *Industrial and Corporate Change*, 3 (3), 537-556.

Teece, D. J. (1992). Competition, cooperation and innovation: organizational arrangements for regimes of rapid technological progress. *Journal of Economic Behavior & Organization*, 18 (1), 1-25.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28 (13), 1319-1350.

Teece, D. J., Pisano, G., & Shuen, A. (1997a). A resource- based view of the firm. *Strategic Management Journal*, 5, 171-180.

Teece, D. J., Pisano, G., & Shuen, A. (1997b). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18 (7), 509-533.

Tichy, N. M., Tushman, M. L., & Fombrun, C. (1979). Social network analysis for organizations. *Academy of Management Review*, 4 (4), 507-519.

Tong, X. & Yu, L. Y. (2014). Research on the coupling mechanism of technology innovation and business model innovation based on business ecosystem. *Scientific and Technological Progress and Countermeasures*, 31 (35212), 17-22.

Venkatraman, N. (1989). The concept of fit in strategy research: toward verbal and statistical correspondence. *Academy of Management Review*, 14 (3), 423-444.

Wasserman, S. & Faust, K. (1994). *Social Network Analysis: Methods and Applications.* Cambridge: Cambridge University Press.

Wenerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5, 171-180.

Wheten, D. (1982). *Issues in Conduction Research*. Ames: The Iowa State University Press.

White, H. C. (1981). Where do markets come from? *American Journal of Sociology*, 87 (3), 517-547.

Wu, X. Y. & Sun, X. L. (2010). The strategic choice of enterprises joining the business ecosystem. *Enterprise Reform and Management,* 17906, 5-8.

Xiao, L. & Li, S. M. (2009). Business ecosystem: analysis of connotation, structure and behavior. *Management Science (Academic Edition)* 01, 43-49+78.

Xing, Y. (2007). A view of the firm from the niche to the ecosystem. *Corporate Vitality*, 26301, 80-81.

Xu, H., Feng, Y. C., & Xu, S. R. (2014). Construction and evolution of relationship between vendor and key customer based on dynamic matching: a case study of Lishen's development of 12 key customers. *Management World*, 04, 107-123+188.

Xue, Q. Z. & Yi, S. (2014). Environmental strategy, business strategy and performance-from a profile deviation perspective in strategy alignment. Research on Economics and Management, 10, 99-108.

Yu, M. (2011). The study on the relationships between individualism/collectivism orientation and knowledge sharing intention: the moderating effect of affectual knowledge. *Nankai Management Review*, 06, 149-157.

Yu, Y. (2001). The nature of the enterprise: the elaboration of competence theory. *Economic Science*, 06, 92-94.

Zhang, B. J., Sun, G. Q., Pei, M. D., & Qi, P. H. (2015). Network capacity, network structure, entrepreneurial performance-based on the empirical study of incubation industry. *Nankai Management Review*, 02, 39-50.

Zhang, H. L. & Zhang, M. (2016). Estimation of network node importance based on structural hole index. *Journal of Computing Technology and Automation*, 01, 101-103.

Zhang, L. & Wang, H. M. (2005). Research on enterprise orientation and strategy based on value ecosystem, *Industrial Technology Economy*, 24 (5), 84-86.

Zhao, X. L. & Chen, G. Y. (2007). The future new business model-commercial ecosystem. *Economic Review*, 708, 79-81.

Zhao, X. L. & Wang, N. (2008). Research on the performance evaluation of the core enterprise of business ecosystem. *Statistics and Decision*, 07, 72-75.

Zhou, Y. H. & Song, G. H. (2014). The dynamic evolution of venture capital network in China. Systems Engineering-Theory & Practice, 34 (11), 2748-2759.

Appendix 1

Additional Reference-Tables

Table 1-5-1 Reliability Statistics (without Control Variables)

		Networking Capacity	Innovation Ability	Resource Integration	Resource Sharing	Network Performance
Cronbach's α coefficient	0.924	0.899	0.874	0.883	0.881	0.931

Table 1-5-2 Exploratory Factor Analysis of Variables (without Control Variables)

		Networking Capacity	Innovation Ability	Resource Integration	Resource Sharing	Network Performance
KMO Sample Detection		0.851	0.749	0.726	0.5	0.855
Bartlett's Sphericity Test	Approximate Chi Square	74.83	54.6	58.64	26.75	100.9
	Degree of Freedom	10	6	6	1	10
	Significance	0	0	0	0	0

Table 1-5-3 Summary of Reliability and validity Analysis

	Variable	Scale	Factor Load	Cronbach's α
Independent Variable	Enterprise Networking Capacity (NC)	nc1	0.780	0.899
		nc2	0.790	
		nc3	0.930	
		nc4	0.800	
		nc5	0.710	

	Enterprise Innovation Capacity (IC)	ic1	0.860	0.874
		ic2	0.720	
		ic3	0.810	
		ic4	0.830	
	Resource Integration Capacity (RI)	n1	0.850	0.883
		n2	0.890	
		n3	0.740	
		n4	0.780	
Mediating Variable	Resource Sharing (RS)	rs1	0.850	0.881
		rs2	0.960	
Dependent Variable	Group Ecosystem Health (GEH)	Operation performance	0.910	0.931
		Financial performance	0.840	
		Function performance	0.830	
		Ecosystem performance	0.900	
		Correlation performance	0.800	

Table 1-5-4 Overall Characteristics of Samples

1. Respondent's position	Quantity	Proportion	2. Industrial distribution	Quantity	Proportion
Chairman	4	14.8%	Hydropower and shipping	10	37.0%
General manager	20	74.1%	Port logistics	5	18.5%
Deputy general manager	3	11.1%	Water-based integrated development	7	25.9%
			Others	5	18.5%
Total corporate assets (million)	Quantity	Proportion	Number of employees (people)	Quantity	Proportion
≤ 10000	4	14.8%	≤ 30	6	22.2%
10000~100000	10	37.0%	30~60	10	37.0%
100000~200000	10	37.0%	60~90	6	22.2%
> 200000	3	11.1%	> 90	5	18.5%
Year of establishment (years)	Quantity	Proportion			
≤ 5	9	33.3%			
5~10	6	22.2%			
10~15	8	29.6%			
> 15	4	14.8%			

Table 1-6-1 The Names and Abbreviations of Enterprises within the Group

No.	Name of Enterprises	Abbreviation		No.	Name of Enterprises	Abbreviation
1	Sichuan Port and Channel Development Co., Ltd	SPC		15	Guang'an Port Operations Co., Ltd	GAPO
2	Minjiang Port Channel Transport and Hydroelectric Power Development Co., Ltd	MJPCTHP		16	Yangtze River Channel Transport Co., Ltd	YRCT
3	Qianwei Channel Transport and Hydroelectric Power Development Co., Ltd	QWCTHP		17	Yongjing Tourism Development Co., Ltd	YJT
4	Jialing River Channel Transport Development Co., Ltd	JLRCT		18	Fengyiwan Agricultural Development Co., Ltd	FYWA
5	Cangxi Channel Transport and Hydroelectric Power Development Co., Ltd	CXCTHP		19	Baizhanghu Tourism Development Co., Ltd	BZHT
6	Jinsha Channel Transport and Hydroelectric Power Development Co., Ltd	JSCTHP		20	Shanghewan Development Co., Ltd	SHWD
7	Xinzheng Channel Transport and Hydroelectric Power Development Co., Ltd	XZCTHP		21	Chengping Investment and Development Co., Ltd	CPID
8	Jinxi Channel Transport and Hydroelectric Power Development Co., Ltd	JXCTHP		22	Hanshuixiucheng Tourism Development Co., Ltd	HSXCT
9	Fengyi Channel Transport and Hydroelectric Power Development Co., Ltd	FYCTHP		23	Jialing River Tourism Development Co., Ltd	JLRT
10	Xiaolongmen Channel Transport and Hydroelectric Power Development Co., Ltd	XLCTHP		24	Port and Channel Construction Co., Ltd	PCC

11	Tongzihao Channel Transport and Hydroelectric Power Development Co., Ltd	TZCTHP		25	Jiangyuan Engineering Consulting Co., Ltd	JYEC
12	Jinpanzi Channel Transport and Hydroelectric Power Development Co., Ltd	JPCTHP		26	Juneng Electric Power Co., Ltd	JNEP
13	Luzhou Port Operations Co., Ltd	LZPO		27	Ligang Property Service Co., Ltd	LGPS
14	Nanchong Port Operations Co., Ltd	NCPO				

Table 1-6-2 Capital Resource Structure Hole

Indicators / Enterprise	Effsize	Efficie	Constra	Hierarc
SPC	14.875	0.930	0.129	0.191
MJPCTHP	2.000	1.000	0.500	0.000
QWCTHP	1.000	1.000	1.000	1.000
JLRCT	0.000	0.000	0.000	
CXCTHP	1.000	1.000	1.000	1.000
JSCTHP	1.000	1.000	1.000	1.000
XZCTHP	2.000	1.000	0.500	0.000
JXCTHP	2.000	1.000	0.500	0.000
FYCTHP	0.000	0.000	0.000	
XLCTHP	1.000	1.000	1.000	1.000
TZCTHP	2.333	0.778	0.374	0.003
JPCTHP	0.000	0.000	0.000	
LZPO	1.000	1.000	1.000	1.000
NCPO	1.000	0.500	0.591	0.001
GAPO	1.000	0.500	0.591	0.001
YRCT	1.000	1.000	1.000	1.000
YJT	1.500	0.375	0.521	0.042
FYWA	1.000	0.500	0.591	0.001
BZHT	0.000	0.000	0.000	
SHWD	2.000	0.500	0.448	0.035
CPID	1.000	0.333	0.550	0.007
HSXCT	1.000	1.000	1.000	1.000
JLRT	1.000	1.000	1.000	1.000
PCC	6.778	0.753	0.329	0.231
JYEC	2.333	0.778	0.422	0.015
JNEP	4.000	1.000	0.250	0.000
LGPS	0.000	0.000	0.000	

Table 1-6-3 Physical Resource Structure Hole

Indicators / Enterprise	Effsize	Efficie	Constra	Hierarc
SPC	2.000	1.000	0.500	0.000
MJPCTHP	1.000	1.000	1.000	1.000
QWCTHP	2.000	1.000	0.500	0.000
JLRCT	0.000	0.000	0.000	
CXCTHP	2.000	1.000	0.500	0.000
JSCTHP	0.000	0.000	0.000	
XZCTHP	1.000	1.000	1.000	1.000
JXCTHP	0.000	0.000	0.000	
FYCTHP	0.000	0.000	0.000	
XLCTHP	0.000	0.000	0.000	
TZCTHP	0.000	0.000	0.000	
JPCTHP	0.000	0.000	0.000	
LZPO	1.000	1.000	1.000	1.000
NCPO	0.000	0.000	0.000	
GAPO	0.000	0.000	0.000	
YRCT	0.000	0.000	0.000	
YJT	0.000	0.000	0.000	
FYWA	0.000	0.000	0.000	
BZHT	0.000	0.000	0.000	
SHWD	0.000	0.000	0.000	
CPID	0.000	0.000	0.000	
HSXCT	1.000	1.000	1.000	1.000
JLRT	0.000	0.000	0.000	
PCC	0.000	0.000	0.000	
JYEC	0.000	0.000	0.000	
JNEP	0.000	0.000	0.000	
LGPS	0.000	0.000	0.000	

Table 1-6-4 Technical Resource Structure Hole

Indicators / Enterprise	Effsize	Efficie	Constra	Hierarc
SPC	18.474	0.972	0.080	0.058
MJPCTHP	2.333	0.778	0.484	0.065
QWCTHP	1.000	0.500	0.721	0.039
JLRCT	0.000	0.000	0.000	
CXCTHP	1.000	1.000	1.000	1.000
JSCTHP	1.000	1.000	1.000	1.000
XZCTHP	1.000	1.000	1.000	1.000

JXCTHP	0.000	0.000	0.000	
FYCTHP	1.000	1.000	1.000	1.000
XLCTHP	1.000	1.000	1.000	1.000
TZCTHP	1.000	1.000	1.000	1.000
JPCTHP	1.000	1.000	1.000	1.000
LZPO	1.000	1.000	1.000	1.000
NCPO	1.000	1.000	1.000	1.000
GAPO	1.000	1.000	1.000	1.000
YRCT	1.000	1.000	1.000	1.000
YJT	3.800	0.760	0.391	0.192
FYWA	1.000	0.500	0.637	0.012
BZHT	0.000	0.000	0.000	
SHWD	1.000	0.500	0.637	0.012
CPID	1.667	0.556	0.567	0.103
HSXCT	1.000	1.000	1.000	1.000
JLRT	1.000	1.000	1.000	1.000
PCC	1.000	0.500	0.721	0.039
JYEC	1.000	1.000	1.000	1.000
JNEP	0.000	0.000	0.000	
LGPS	0.000	0.000	0.000	

Table 1-6-5 Enterprises Strategy Expansion Behavior Tendency Rating

Enterprise	Horizontal Integration Behavior Tendency	Vertical Integration Behavior Tendency
SPC	2	2
MJPCTHP	3	3
QWCTHP	4	4
JLRCT	3	3
CXCTHP	4	4
JSCTHP	3	4
XZCTHP	2	3
JXCTHP	4	4
FYCTHP	3	3
XLCTHP	3	3
TZCTHP	2	2
JPCTHP	2	2
LZPO	4	4
NCPO	4	4
GAPO	4	3
YRCT	4	4

YJT	2	2
FYWA	2	2
BZHT	4	4
SHWD	3	3
CPID	4	3
HSXCT	5	5
JLRT	4	4
PCC	5	5
JYEC	4	3
JNEP	3	4
LGPS	1	1

Table 1-6-6 Matching Rate of Enterprise's Role-capabilities

Enterprise	Euclidean Distance	Matching Rate
SPC	1.72	1.19
MJPCTHP	2.02	1.09
QWCTHP	0.79	1.44
JLRCT	2.47	0.93
CXCTHP	1.25	1.32
JSCTHP	2.06	1.08
XZCTHP	2.15	1.05
JXCTHP	1.80	1.16
FYCTHP	2.24	1.02
XLCTHP	1.41	1.28
TZCTHP	2.30	0.99
JPCTHP	1.41	1.28
LZPO	2.83	0.78
NCPO	1.80	1.16
GAPO	1.41	1.28
YRCT	2.83	0.78
YJT	1.80	1.16
FYWA	1.41	1.28
BZHT	2.30	0.99
SHWD	0.25	1.56
CPID	3.02	0.68
HSXCT	1.46	1.26
JLRT	1.06	1.37
PCC	0.25	1.56
JYEC	2.06	1.08
JNEP	1.80	1.16
LGPS	2.30	0.99

Table 1-6-7 Statistics of Control Variables

		Assets (ten thousand Yuan)	Number of employees (people)	Years of establishment (years)
N	Effective	27	27	27
	Missing	0	0	0
Average		144792.0456	81.4074	9.1481
Mode		898.46[a]	60.00[a]	5.50
Standard deviation		264112.58192	86.64706	5.84053
Minimum		898.46	9.00	.50
Maximum		1412105.27	319.00	21.00

Table 1-6-8 Correlation Matrix of Variables (without control variables)

Control variables			Group ecosystem health	Enterprise's role-capabilities matching rate
Assets Number of employees Year of establishment	Group ecosystem health	Correlation	1.000	
		Significance (Two-tailed)		
		Df	0	
	Enterprise's role-capabilites matching rate	Correlation	0.659	1.000
		Significance (Two-tailed)	0.000	
		Df	22	0

Table 1-6-9 Variables and Definitions in Regressions

Variable	Variable definition	Variable code
Dependent variable	Group ecosystem health	GEH
Independent variable	"Role-capabilities" matching rate	RMR
Control variable	Enterprise asset	EA
	Number of employees	NE
	Year of establishment	YE

Table 1-6-10 Regression Coefficient Statistics and Co-Linearity of Variables

Model	Non-standardized coefficient		Standardiza-tion factor	T	Signifi-cance	Collinear statistics	
	B	Standard error	Beta			Tolerance	VIF
1 (constant)	5.105	.794		6.429	.000		
total assets	-.097	.063	-.327	-1.532	.139	.850	1.177
the number of employees	-.029	.111	-.058	-.264	.794	.802	1.247
years of establishment	-4.338E-05	.020	-.001	-.002	.998	.696	1.437
2 (constant)	3.647	.706		5.165	.000		
total assets	-.128	.049	-.433	-2.612	.016	.829	1.206
the number of employees	-.039	.086	-.077	-.453	.655	.801	1.248
years of establishment	.010	.015	.119	.647	.524	.678	1.474
matching rate	1.514	.368	.633	4.110	.000	.963	1.039

a. Dependent variables\: Group ecosystem health

Table 1-7-1 Variables and Their Code Statistics

	Variable	Code
Independent variables	Innovation capability	IC
	Resource integration capability	RI
Mediation variables	Resource sharing	RS
Dependent variables	Group ecosystem health	GEH
Control variables	Total assets	TA
	Number of employees	NE
	Years of establishment	YE

Table 1-7-2 The Overall Regression Results of the Model

Model	R square	Adjusted R square	Change statistics					
			R square change	F value change	df1	df2	Significant F-value change	Durbin-Watson
1	.012	.123	.012	.090	3	22	.965	
2	.297	.164	.285	8.523	1	21	.008	2.343

a. Predictive value: (constant), Years of establishment, Total assets, Number of employees

b. Predictive value: (constant), Years of Establishment, Total Assets, Number of Employees, Resource Integration Capability

c. Strain: Resources Sharing

Table 1-7-3 The Overall Regression Results of the Model

Model	R square	Adjusted R square	Change statistics					Durbin-Watson
			R square change	F value change	df1	df2	Significant F-value change	
1	.144	.028	.144	1.236	3	22	.321	
2	.664	.600	.520	32.511	1	21	.000	1.670

a. Predictive value: (constant), Years of establishment, Total Assets, Number of employees

b. Predictive value: (constant), Years of establishment, Total Assets, Number of employees, RS

c. Strain: Ecosystem health of group

Table 1-7-4 The Overall Regression Results of the Model

Model	R square	Adjustment of R square	Change statistics					Durbin-Watson
			Change of square	Change of F value	df1	df2	Significant change in F value	
1	.598	.521	.598	7.809	4	21	.001	2.123
2	.779	.724	.181	16.432	1	20	.001	

Appendix 2

Additional Reference-Figures

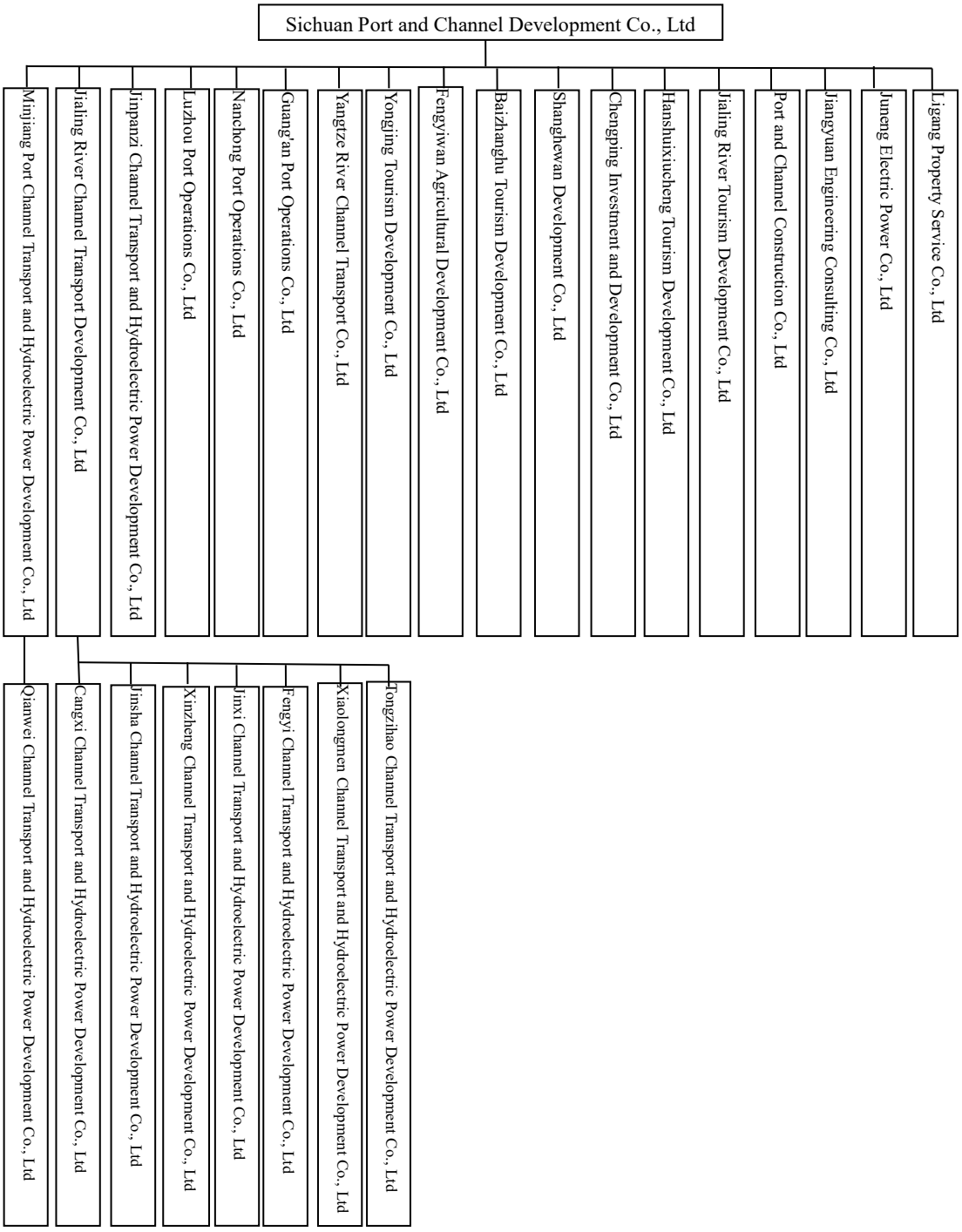


Figure 2-4-1 Sichuan Port and Channel Development Enterprise Group Structure

Figure 2-4-2 Sichuan Port and Channel Development Group's Business Area

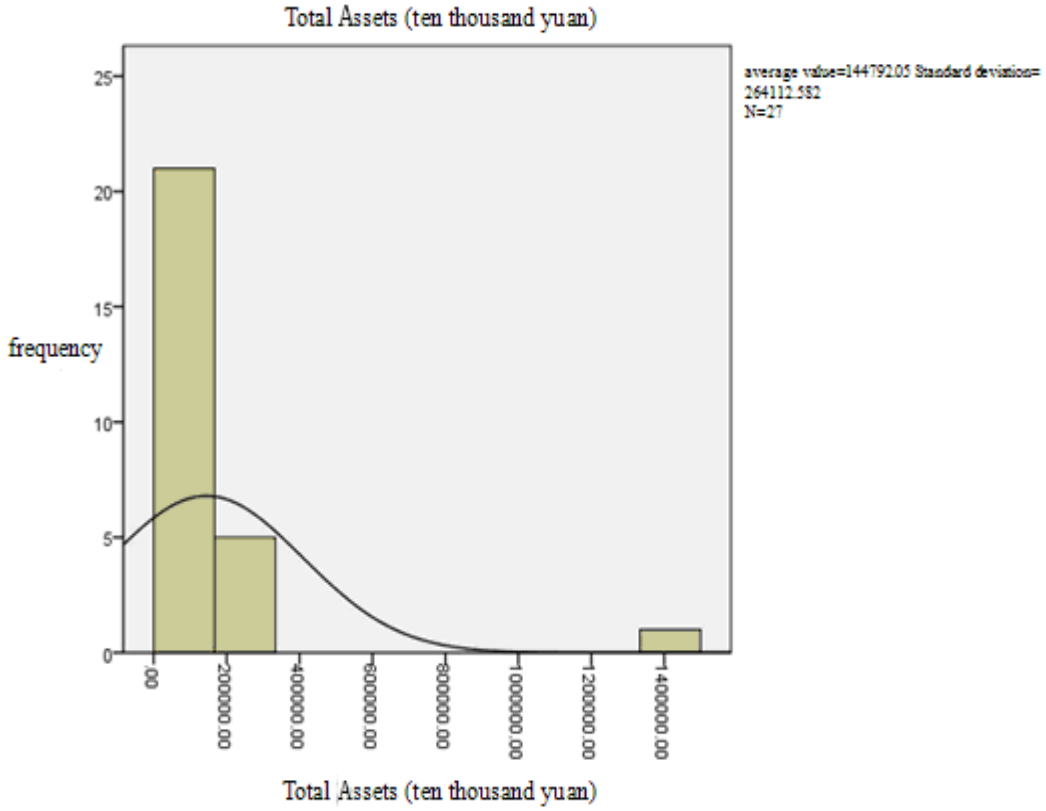


Figure 2-6-1 Histogram of Assets of the Enterprise

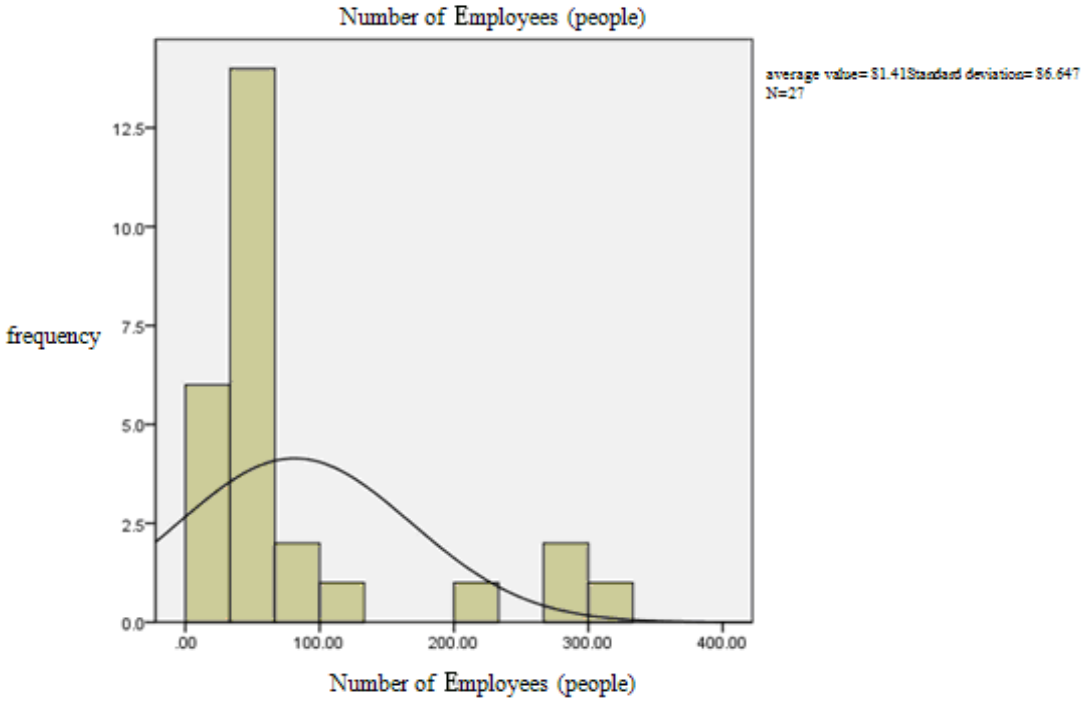


Figure 2-6-2 Histogram of Number of Employees in Enterprise

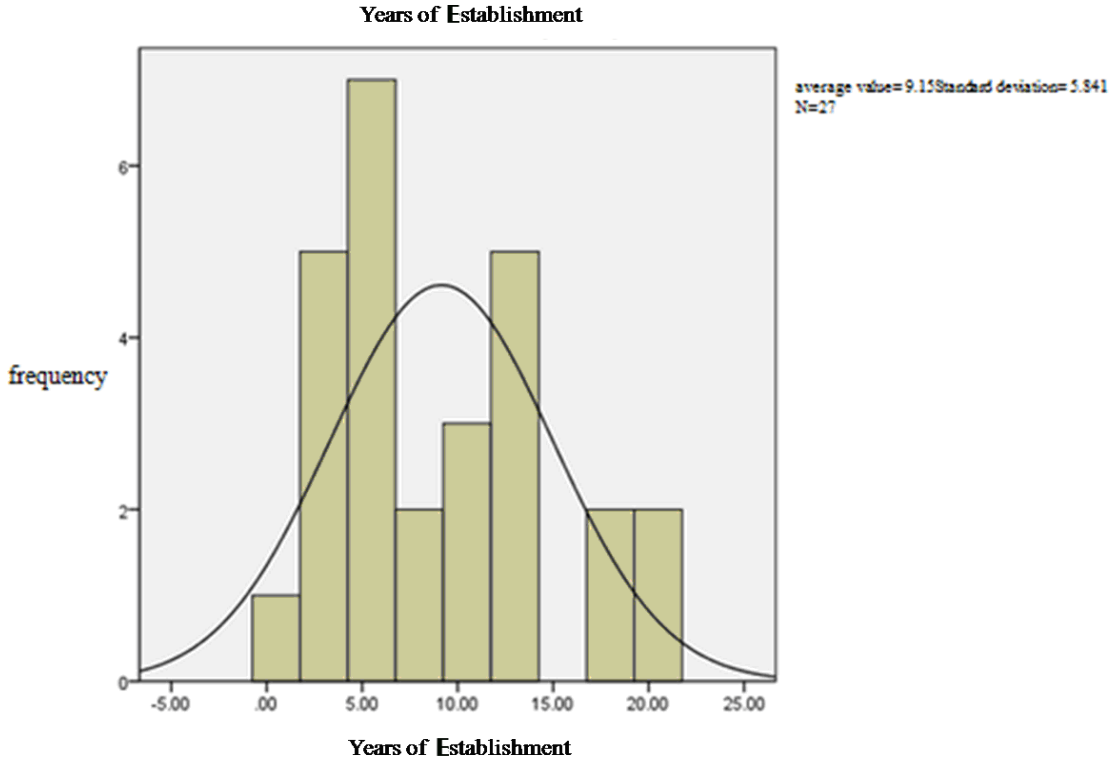


Figure 2-6-3 Histogram of Years of Establishment of Enterprise

Appendix 3

Questionnaire on Business Ecological Strategic Capabilities of Enterprise, Enterprise Group Ecosystem Health

Distinguished ladies and gentlemen,

School of Economics and Management, University of Electronic Science and Technology of China (UESTC) is conducting a study to understand the impact of **business ecological strategic capabilities of enterprise on the enterprise group ecosystem health**. Please kindly help us to complete this questionnaire for your answers are very important to our research. We are grateful for your warm help given your busy schedule!

This questionnaire is purely academic research, and the information received will not be used for any commercial purposes. Please be assured to give your objective answers.

Thank you for your support and cooperation!

★Notes on completing the questionnaire:

1. We hope that you will give an objective answer to each question based on the actual situation in order to obtain an accurate and effective research conclusion.

2. There is no right or wrong answer, please fill in according to the actual situation.

3. To make sure that the targeted respondents have an all-around understanding of the whole enterprise, we hope that the query respondents should be senior executives (e.g. general manager) of your company.

4. If you wish to get the results of this survey, please leave your E-mail:_____

Part One: Basic Information

1. Your company name: [Fill in the blank] [Required answer]

_____

2. Your working years in your company: _____ [Single answer] [Required answer]

A. below 1 year B. 1-3 years C. 4-6 years

D. 7-10 years E. over 10 years

3. Your position in your company: [Fill in the blank] [Required answer]

_____

Part Two: Please choose from the list of companies [multiple choices]

Please fill in 1 in () before the company names to indicate they have transactions with your company on financial resources (for example: capital lending) in last two or three years.

Please fill in 2 in () before the company names to indicate they have transactions with your company on physical resources (Mutual borrowing or leasing of physical resources such as mechanical equipment, production materials and land) in last two or three years.

Please fill in 3 in () before the company names to indicate they have transactions with your company on technical resources (for example, Mutual training of related personnel in industrial technology or management technology) in last two or three years.

（ ） Sichuan Port and Channel Development Co., Ltd

（ ）Minjiang Port Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Qianwei Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Jialing River Channel Transport Development Co., Ltd

（ ）Cangxi Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Jinsha Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Xinzheng Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Jinxi Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Fengyi Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Xiaolongmen Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Tongzihao Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Jinpanzi Channel Transport and Hydroelectric Power Development Co., Ltd

（ ）Luzhou Port Operations Co., Ltd

（ ）Nanchong Port Operations Co., Ltd

（ ）Guang'an Port Operations Co., Ltd

（ ）Yangtze River Channel Transport Co., Ltd

（ ）Yongjing Tourism Development Co., Ltd

（ ）Fengyiwan Agricultural Development Co., Ltd

（ ）Baizhanghu Tourism Development Co., Ltd

（ ）Shanghewan Development Co., Ltd

（ ）Chengping Investment and Development Co., Ltd

（ ）Hanshuixiucheng Tourism Development Co., Ltd

（ ）Jialing River Tourism Development Co., Ltd

（ ）Port and Channel Construction Co., Ltd

（ ）Jiangyuan Engineering Consulting Co., Ltd

（ ）Juneng Electric Power Co., Ltd

（ ）Ligang Property Service Co., Ltd

Part Three: Please tick √ on the appropriate degree number based on the actual situation of your company.

Items	Completely Disagree	Disagree	Uncertain	Agree	Completely Agree
A1. The company is more inclined to expansion by the way of mergers and acquisitions to gain the ownership or control right of our similar competitor enterprises	1	2	3	4	5
A2. The company is more inclined to expansion by the way of mergers and acquisitions to gain the ownership or control right of the upstream and downstream enterprises	1	2	3	4	5

Part Four: Please tick √ on the appropriate degree number based on the actual situation of your company.

Items	Completely Disagree	Disagree	Uncertain	Agree	Completely Agree
A1. The company can incisively find potential cooperation opportunities within the group in market development	1	2	3	4	5
A2. The company actively contacts potential partners with relationship resources within the group	1	2	3	4	5
A3. The company often evaluates the actual effectiveness of cooperation with the partners within the group	1	2	3	4	5
A4. The company continuously deepens and improves the relationship with the partners within the group based on experience	1	2	3	4	5
A5. The company is good at effectively integrating the funds or other resources among multiple partners within the group	1	2	3	4	5

A6. The company is good at distributing company resources reasonably in different cooperative activities within the group	1	2	3	4	5
B1. The company has frequent communication with business partners within the group	1	2	3	4	5
B2. The company has maintained communication with business partners within the group for many years	1	2	3	4	5
B3. The company has established comprehensive cooperation relationships on multiple projects with business partners within the group	1	2	3	4	5
B4. The company has invested a lot of material resources, human resources and social resources into cooperation with business partners within the group	1	2	3	4	5
C1. The company attaches great importance to the cultivation of technical core competence	1	2	3	4	5
C2. The company has the ability to expand core technology to other product areas	1	2	3	4	5
C3. The company's core technology product’ profits accounts for a high proportion of the company's total profits	1	2	3	4	5
C4. The company's core technology has a very good prospect of development	1	2	3	4	5
D1. The company is able to launch new products (or services) faster than its major competitors	1	2	3	4	5
D2. The company is able to open up new markets faster than its major competitors	1	2	3	4	5
D3. The company attaches more importance to R & D investment comparing with its major competitors	1	2	3	4	5

D4. The company's ability to absorb new technology and transform it into new products is stronger than its major competitors	1	2	3	4	5
E1. The company can bind and utilize the resources within the group according to the characteristics of them	1	2	3	4	5
E2. The company can bind and utilize all kinds of resources within the group based on the established target	1	2	3	4	5
E3. The company can enhance efficiency by integrating resources within the group	1	2	3	4	5
E4. The company can utilize the resources within the group to accomplish cross-department tasks	1	2	3	4	5
E5. The company is satisfied with the development and expansion of the resources within the group	1	2	3	4	5
F1. The company is willing to frequently provide funds and other help to partners within the group	1	2	3	4	5
F2. The company is willing to frequently share business experience and know-how with partners within the group	1	2	3	4	5
F3. The company is always willing to provide information that it has under the request of partners within the group	1	2	3	4	5

Part Five: The following describes the situation of your enterprise group when comparing with the major competitors. Please tick √ on the appropriate degree number based on the actual situation.

Items	Completely Disagree	Disagree	Uncertain	Agree	Completely Agree
G1. The enterprise group has a very high level of competition (from price to brand) and a better competition order.	1	2	3	4	5
G2. The enterprise group has a very high ability to resist macroeconomic risks.	1	2	3	4	5
G3. The enterprise group has strong resilience after being subjected to macroeconomic risks	1	2	3	4	5
G4. The enterprise group's industrial life cycle is mature	1	2	3	4	5
H1. Companies that are associated with keystone companies share a high degree of the value created by the keystone companies	1	2	3	4	5
H2. Companies that are associated with keystone companies have a high contribution to the value created by the keystone companies	1	2	3	4	5
H3. The keystone companies contribute a lot to customer value.	1	2	3	4	5
I1. The investment and financing institutions are very enthusiastic about the prospect of the group industry and the investment.	1	2	3	4	5
I2. External scientific research institutes are highly concerned about the history of technology accumulation in the group industry and the future scientific research	1	2	3	4	5
I3. Independent agencies play a great role in promoting group management programs and management level.	1	2	3	4	5
I4. Government agencies provide large policy support for laws and regulations in the group industry.	1	2	3	4	5
J1. The concentration and accessibility of production factors in the group industry are very high.	1	2	3	4	5
J2. The group industry has high factor productivity	1	2	3	4	5
J3. The total number of companies	1	2	3	4	5

within the group maintains a relatively fast growth rate					
J4. The Intra group differentiation, and the proportion of products have maintained a relatively fast growth rate.	1	2	3	4	5
K1.The strategic sense of " value sharing" of keystone companies is clear and long-term	1	2	3	4	5
K2.The "value sharing" of keystone companies is compatible with business opportunities.	1	2	3	4	5
K3. The access to "value sharing" of keystone companies is very convenient	1	2	3	4	5
K4.The keystone companies have the binding mechanism of interest distribution	1	2	3	4	5

***The questionnaire is now to this end. Please check if there are omissions of the questions.**

Thank you again for your support and participation in this study!

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