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**The Value Co-creation of Private Equity Fund in
China**

-- Customer Participation, Virtual Vehicle and Service System

By

Wenchen Zheng

Supervisor

Dr. Frankie Chau

**A Thesis Submitted to Durham University in Fulfilment of the
Requirements for the Degree of Doctorate in Business Administration**

DURHAM UNIVERSITY

BUSINESS SCHOOL

2020

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Abstract

In China, based on the existing and dominant management method of private equity fund (PE), a general partner (GP) takes full responsibility for the running of PE. This entails a closed management style for all activities of the fund, such as investment, fundraising and management. GP creating value and limited partner (LP) sharing value is still the current mainstream management method. However, in recent years, due to the change of the whole economic structure and environment in China, the profit rate and the project survival rate of PE under the management of GP has declined dramatically necessitating consideration of alternative methods of management to respond to these challenges.

Academic research on customer participation and value co-creation under a Service-dominant logic (S-D) framework has been studied for many years in China and worldwide. However, there has been less research on customer participation value co-creation under service dominant logic, especially as evidenced by empirical evidence from China's PE industry. Research on this issue can have a positive impact on dealing with the current problems faced by China's PE industry. Therefore, this thesis explores these basic and important problems. According to the service dominant logic, this study focuses on customer participation value co-creation, value co-creation vehicle and value co-creation service system. Value co-creation is an important part of S-D logic, which is created value jointly by the customer and the enterprise. Value co-creation could increase the perceived value and the loyalty of customer. Therefore, based on S-D logic, this thesis tries to illustrate a new pathway to solve these problems for China's PE funds in a logical manner combining theoretical insights with empirical evidence.

The research questions that this thesis addresses are as follows. Firstly, the hypothesis is verified that the value co-creation of customer participation has a significant positive impact on customer perceived value. Moreover, the complete mediation effect of customer participation in value co-creation of PE on customer perceived value is explored. Secondly, using actual PE (APE) to build a special vehicle, which is a virtual PE (VPE) which provides a platform for customer participation in PE value co-creation processes. It demonstrates that customer participation (engagement) has a partial mediation effect in value co-creation processes. Thirdly, APE and VPE jointly carry out value co-creation, this interaction process not only makes the high-level integration and optimization of resources possible but will also bring unexpected creativity to PE. This needs to be supported by the service system.

In the constructed service system, this thesis focuses on researching customer demand preference discovery and Clustering modeling, in order to determine potential customer demand and value propositions; it also studies collaborative filtering recommendation and decision-making and discusses collaborative decision-making mechanisms for PE. Finally, this thesis focuses on PE equity assets monetization and transaction method. Further, it emphasizes that the fair value of PE equity assets should not be the scalar algebraic sum of the initial value + expected excess return value, but the vector sum (module) - composite value of the complex number. This thesis provides recommendations and conclusions for management strategies for those working in the Chinese PE industry to pursue in strengthening all aspects of value co-creation.

Declaration

The ideas and material within this thesis are the sole ownership of me, the author. Please do not quote without my consent.

I declare that this thesis is my own and has not been submitted to any other institution for credit or another degree.

Disclaimer

This thesis is the author's property and, as such, any omissions or errors are my sole responsibility. I retain the right to modify and change the material here or in future research papers or whenever I feel it is necessary.

Dedication

*To my loving parents, for teaching me
the boundless importance of knowledge and love,
and for raising me to be a decent person.*

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I express my sincerest gratitude to my supervisors, Dr. Frankie Chau for his guidance, support and patience throughout the DBA process. I am grateful to Dr. Sarah Xiao and Dr. Paul McCarthy as well. I also gratefully acknowledge the support of the DBA office.

-Chapter One-

Introduction

1.1 Research Background and Significance

- **Research Background**

China's reform and opening--up has helped propel Chinese economic development and has enabled it to make great achievements in the world since the 1980s. However, there have been numerous problems and contradictions during China's development, such as an irrational economic framework, unbalanced industrial structure; excessive reliance on exports, too many investments from the government, these features directly restrict the sustainable economic development of China (Zhang, 2011). The Chinese economy has maintained a sustained and rapid growth since 2002, but along with the impact of the global financial crisis, the original development policy pursued by China has arguably then led to the emergence of a number of problems with the possibility of blocking further growth and development in the economy. Therefore, an adjustment of economic structure, changing the mode of economic development has become a very important task at this time (Zhu, 2014).

Finance is at the core of the modern economy; financial development plays a significant role in promoting real economic development. Private equity funds have developed rapidly since the early 1900s and they occupy a very important position in the capital markets in developed countries. Moreover, in the US private equity financing amount was more than IPO financing, which shows the huge influence in 2006 before the worldwide financial crisis. Researchers have emphasized how private funds have improved greatly in the switch from an analysis of general financial instruments to studying system innovation at the financial level.

Private equity investment fund (PE) refers to equity capital fund that raises a large amount of funds through non-public methods, the funds formed as a result are managed

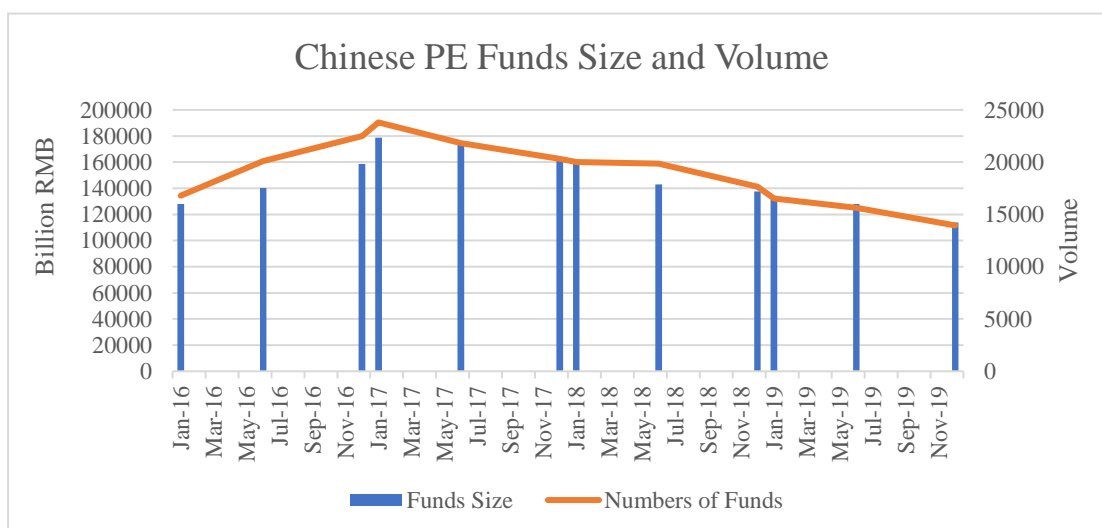
by a fund general partner (GP). The fund GP provides long-term financing to non-listed but high growth enterprises in exchange for equity through "expert collection financing". PE funds invest in securities through negotiation, after achieving added-value, PEs can realize investment profit by selling listed-enterprise equity in the stock market to exit (Bance, 2004). Private equity funds are mostly a partnership structure, general partner (GP) is an executive partner, and limited partner (LP) (natural person or legal enterprise) who is a normal partner who provides capital for the GP to invest. The limited partner, is a customer as well as a partner, utilizing their investment to purchase shares in the PE's product, i.e. shares and profit returns on the various investments managed by the GP. Partnership activities such as investment, financing, management and withdrawal are led by the general partner, and a close management style and level of involvement is usually implemented for 5-7 years.

Private equity funds have value creation capabilities; this is different from traditional financial intermediaries. it also will involve the supervision of management, which not only reduces the agency risk, is also effective in reducing the investment process to manage risk and market risk, it is reflecting the financial intermediation function of value creation. Private equity funds were established by the random mechanism, signaling mechanisms and contractual arrangements, effective control and moral hazard arising from asymmetric information. These functions and operation mechanism put PE in an advantageous position in the capital market. In practice, the venture capital PE to promote technological innovation, with buyout PE funds to accelerate industry consolidation. These are the driving forces which the PE industry is currently facing in this industrial structural adjustment and upgrading period.

The General partner of the PE leverages their long-term investment experience, professional knowledge and skills in order to gain benefits for LP customers. LP's investment interests are based on the GP's ability and due diligence carried out on potential investments. Although the GP will have a professional team also with rich investment and financing experience, the backdrop of continued development of information technology and various R & D means new products and new formats emerge and the investment and financing environment has become more and more

complex and uncertain as a result. The traditional PE relies on the resources of the GP and their professional team. It is difficult to cope with the needs of fast changing and technological cross integration, and the framework of the strong role of information asymmetry and the continuous promotion of the market in the financial field of China. The ineffective space of the market is decreasing; at the same time, the changes in the external environment, especially the information society, have laid out a multi perspective evaluation on the operation of the LP. As a result, evaluation, requirements and expectations for PE funds have grown in complexity and success is measured by PE's ability to address all the challenges noted above. Therefore, it is easy to see that there is decreasing in Chinese PE industry in recently years.

Figure 1.1: Chinese PE Funds Size and Volume



Source: Association of Chinese Security and PE Investment Fund (2019)

● **The Theoretical Significance of Research**

At present, the operational model of PE is that the GP is the provider of PE products (projects) and the creator of the PE's value, playing the leading role; whereas the customer is the receiver of products and product value, playing the supporting role. The value of PE is created by the GP alone in the process of financing, investment, post investment management and exit functions they initiate and conduct. These processes follow the law of enterprise value creation under the good dominant logic.

However, service dominant logic defines "service" in a new and innovative way which is that service is an activity process in which one party applies special abilities (knowledge and skills) to benefit others or oneself. This is different from the corresponding service dominant logic proposed by G-d. Value is co-created between customers and enterprises (Vargo & Lusch, 2004). The latest research on service cognition is regarded as an important feature of service. Paying attention to customer participation in value creation can not only significantly improve an enterprise's organisational efficiency and enable quicker response times to opportunities and challenges. It can also enhance an enterprise's customization ability, which is significantly different from traditional competitiveness enterprise attributes and lead to the development of a new core competitiveness for organisations (Zhang & Chen, 2009).

For example, in the video and computer game industry, value co-creation is very common, every game enterprise has its own virtual online community, you can connect it from computer, mobile phone, ipad and many other forms of electrical equipment. Customers could involve in the process of product design and testing from the very beginning. Enterprise and customer could work together to integrate resources, exchange services, and create value together, in order to make the game better and achieve customer's expectation. The consequences of value co-creation here, which are customer get more perceived value because customer involved the game design and game enterprise sells more copies. Another example is Xiao Mi, a famous Chinese electronic device company. First of all, it establishes an entrepreneurial platform to communicate with entrepreneurs and customers to achieve value consensus; secondly, it gives full play to the strengths of the participants through this platform, and integrates resources with participants under the determined product direction. Finally, through this virtual platform and exchanges Services in the interactive process, it realizes value co-creation and sharing for all participants, and constructs a value co-creation ecological organization with Xiao Mi. The shift from an enterprise led perspective to co-creation is not a small change in the traditional system but is rather a much more fundamental change in the understanding of value creation (Prahalad & Ramaswamy, 2004).

This thesis applies the service dominant logic (S-D logic), combining theory

with empirical research, studies the LP participation in the PE value co-creation process, explores the relationship between customer participation in PE value co-creation and the continuity between the customer and PE, determines how GP value can provide innovation for the present PE, and provide ideas for the strategic positioning and management improvement of PE; On this basis, the thesis further studies the practicality of value co-creation - introducing a virtual PE as a vehicle to solve the problem of customers who have not yet become LP participating in value creation.

Therefore, it further needs to study the relationship between GP and LP in the virtual vehicle. In order to protect this value co-creation process, we need support system. Then this thesis will establish a service system to make the value co-creation processing run smoothly. Finally, this thesis takes the service dominant logic as the theoretical point of departure, combines the current PE development model, and finds out the PE improvement and innovation ideas and methods, uses the value co-creation service system to build the PE value creation system, and provides a more systematic and practical thinking and method for the PE industry from theory and practice.

1.2 Objectives of Thesis

Conflicts between GP and LP are more and more common in private equity funds. This problem cannot be solved only through investment or operation method of PE (Beaton & Smith, 2011). There needs to be a new perspective to observe this changing world, so service-dominant logic is a one of the new perspectives with potential insights to offer in responding to the challenges faced by PE funds.

In an increasingly complex business environment and increasingly fierce competition environment, S-D clarifies how to use the service dominant strategy to formulate resource integration and co-creation value with simple and innovative logical relationship. Through the interaction of value exchange and co-creation value in the process of service, it can expand the depth and breadth of resource integration, acquire resources and obtain the relationship between participants which can determine the core competition nowadays. As a trustee of equity investment service enterprise - PE, it is

necessary to use S-D to study its development strategy. It is not enough to form corporate culture and emphasize customer orientation. Enterprises need to create value together with customers and meet their demands (Prahalad & Ramaswamy, 2000). PE need to create value together with LPs and meet their demands.

The following chapter provides more details on why there is a positive impact with LP as customers joining PE value co-creation process. The path of research from motivation of customer participation in value co-creation, customer participation methods and finally comes to customer perceived value, which includes economic value, support value and technology / core in this process. It contributes to existing literature by finding out the intermediate functions of customer participation in value co-creation processes, which is derived theoretically from the Vargo and Lusch (2004) S-D logic.

The third chapter takes the approach of conducting empirical research on value co-creation processes, which is to introduce virtual private equity fund as a vehicle to provide a value co-creation platform for GP and LP. It also tries to solve the problem of customers' participation in value co-creation process that has not yet become LP (potential customer), and further studies the relationship between customer engagement and value co-creation in virtual vehicle. It contributes to existing literature based on demonstrating the necessity and importance of customer's participation in PE value creation process and provide a virtual PE framework for empirical research.

Finally, the fourth chapter argues that because customer participation in PE value co-creation involve many participants and in dynamic interaction backgrounds, in order to ensure the effectiveness of value co-creation, it needs a support system (service system) to guarantee optimum results. Therefore, this thesis will also study the service system to ensure the effectiveness of value co-creation processes. In this way, the interaction process of customer participation in PE value co-creation processes exists between customers and participants, and between an actual PE and virtual PE. As such in the chain of service systems value co-creation system consists of actual PE + virtual PE + service system.

Overall, the objective of this thesis, through each of the chapters, is to shed light

onto why existing studies still cannot agree on the nature of this very important relationship. This thesis is based on the theory of service-dominant logic, illustrate the current PE management structure, finds out the ideas and methods of PE development and innovation methods. Then, it builds a PE value co-creation system by applying S-D logic and provides systematic ideas and methods for PE managers from theory and practice facing today’s economic environment.

1.3 Research Method and Process

PE originated and developed in the context of the goods dominated logic period. Its characteristics conformed to the dominant logic of goods (the appellation of the corresponding service dominant logic - Vargo and Lusch, 2004), and can be clearly delineated and identified.

Figure 1.2: Comparison Between PE and Enterprise Operation Method



Moussa and Touzani (2010) argue that in the past ten years, one of the most influential contributions in service science is the introduction of the S-D logic. S -D logic is an evolution, not a revolution, grounded in the observations of intangible, dynamic resources, inputs for co-created value, relations, economic and social processes values (Gummesson, 2010). According to much of the S-D literature research, it has been shown that the introduction of S-D may bring about changes in the table shown below as evidence of the types of changes.

Table 1.1: The Difference Between G-D PE and S-D PE

	G-D PE	S-D PE
LP Role	A consumer of value	Participation in PE value co-creation
Value Driven	Exchange value	Use value
The way of value creation	GP create by itself	GP and LP create value together
Resources used	GP's professional knowledge and skills, products and other operant resources.	LP's knowledge, skills and operant resources are the fundamental sources of competitive advantage.
The process of value creation	GP embeds value in the work process for products provided by LP.	GP and LP cooperate to propose value proposition. LP provides operant resources to participate in PE value creation.
Resource integration	GP is a resource integrator	GP and LP both are resource integrator
Value meaning and its Determinant	Value is determined by GP. LP passively accepts commodity value in exchange.	Value is always determined by the phenomenological method of beneficiaries. LP is aware of value in participating in value creation and exchange.
Relationship with customers	Dyadic bonds represented by trust and commitment Long-term patronage – repetitive transactions	LP participates in the process of value creation and service-based exchange. Interaction and reciprocity bring about the deepening of relationship and continuity of relationship.

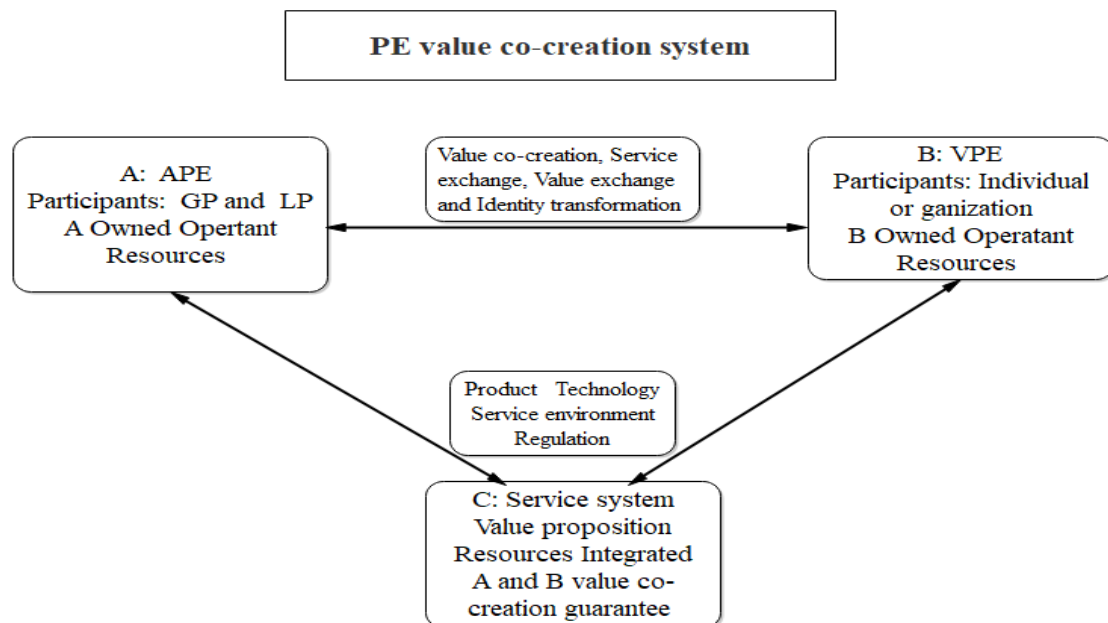
Firstly, this thesis studies the necessity of "customer participation in value co-creation". Starting from the theoretical insights derived from the service dominant logic of value co-creation, it focuses on methods of customer participation and the perceived value of participation in value co-creation processes. The thesis aims to construct a theoretical model of customer participation in PE value co-creation. This added to by the thesis generating an empirical evidence base to support the conclusions made in relation to implementation of the S-D logic in PE and fund development.

Secondly, this thesis studies the effectiveness of value co-creation. In order to achieve this a virtual VPE community is built for customers who have not participated in PE previously to participate in a PE value co-creation process. Through this the effectiveness of customer engagement and value co-creation is investigated. Starting from the theory of value co-creation, the research focuses on exploring the psychological states and behaviors of customer participation in value co-creation processes. Through utilizing social research and the subsequent analysis of research

results, the thesis seeks to demonstrate the relationship and possible results derived from customer engagement in value co-creation activities. In order to help enterprises, achieve customers engagement and engagement in value co-creation the results are used to synthesize and promote management methods which emphasize value co-creation processes.

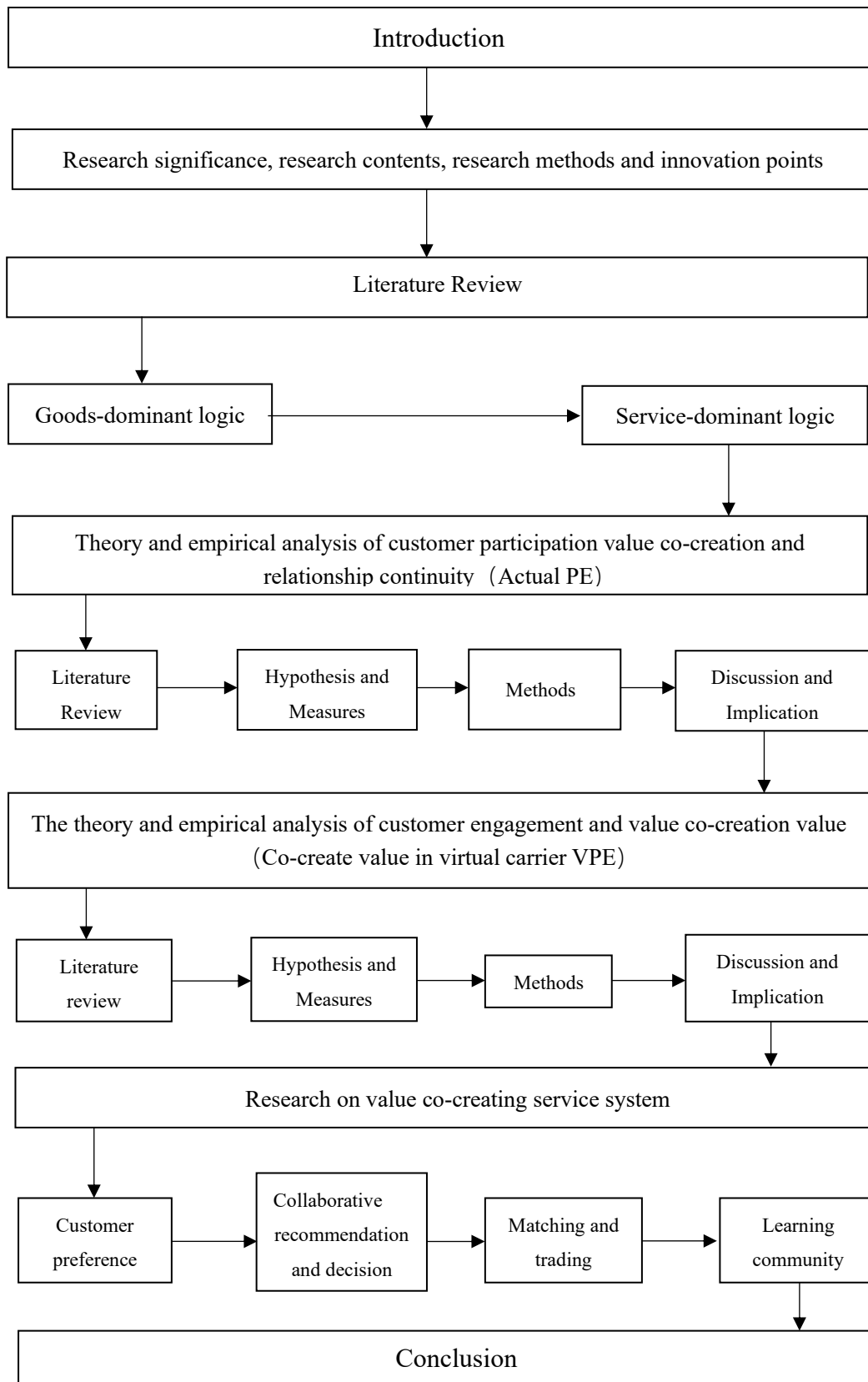
Thirdly, this thesis will focus on exploring the practical operations involved in value co-creation processes. Arguably, value co-creation must realize an effective interaction between the actual APE -virtual VPE, and customers -participants. It aims to leverage resource integration and value co-creation in an interactive process. A service system is needed, in order to guarantee the orderly and effective development of value co-creation processes. The theoretical and empirical results of this thesis will correspond to the main functional components of the research service system.

Figure 1.3: Service System and PE Value Co-creation System with VPE and APE



To sum up, this thesis is based on the theory of service-dominant logic, it studies from the necessity of customer participation in value co-creation, to study the effectiveness of customer engagement, and then service system is the following part. The research route from APE to VPE and finally to service system, the value co-creation system of APE + VPE + service system is formed. It is much clearer to understand the whole steps of thesis in following figure.

Figure 1.4: Research Flowchart



1.4 Contributions of the Thesis

It is believed that one of the most influential contributions in service science has been the introduction of S-D logic over the past ten years, (Moussa & Touzani,2010). S -D logic is an evolution, not a revolution, resulting in "intangible, dynamic resources, inputs for co-created value, relations, economic and social processes values" (Gummesson, 2010). According to S-D literature and associated research, it has been claimed that the introduction of S-D may bring about changes in private equity funds as illustrated in Table 1.1. Kaczor and Kryvinska (2013) also believed that the service-dominant logic (S-D) has developed into the main way of understanding and conducting contemporary service science. However, no matter where researchers stand in terms of perspective in S-D, one thing is clear from the current published papers, which is that there is insufficient empirical evidence to robustly support such claims (Brown & Patterson, 2010).

Most of the research thus far conducted has focused on qualitative discussion, lacks the measurement of customization ability in different circumstances, and almost no empirical analysis of the interaction mechanisms with key factors in the process of co-creating value has been conducted. This makes the potentially transformative idea suffer from a lack of empirical support for value co-creation. (Zhang & Chen, 2009). The motivation, process and results of value co-creation need to be studied systematically, in order to provide practical guidance (Li et al., 2013). In short, empirical research results based on service-dominant logic are still relatively weak (Guan et al., 2017). Saarijärvi (2013) clearly pointed out that there are three aspects which must be clarified in value co-creation process, what kind of value for the customer and for the firm? what kind of resources? And through what kind of mechanisms can the logic be implemented?

Based on the systematic study of service dominant logic and related value co-creation theory, this paper studies the necessity, effectiveness and practice of customer participation in value co-creation theory and empirical research. Doing so comprises of the following objectives and elements of research set out below.

- a) Derived from extensive studies of service dominant logic, this thesis constructs a research model of PE value co-creation process for customer participation. Utilising empirical study, it attempts to verify that the value co-creation of customer participation with operant resources has a significant positive impact on customer perceived value. Moreover, it finds out that customer participation factor has complete mediation function of PE service based on its operant resources on customer perceived value. Thus, it seeks to illustrate an effective pathway for PE services for customer participation in value co-creation. APE that provides service based on operant resources is the antecedent of customer participation in the value co-creation process, and customer perceived value is the result of customer participation.

And "complete mediation" means that PE can change customer perceptions of its original value to perceived value after customer participation in value co-creation process has occurred. That is, customer can get a perception of value in the context of participation in value co-creation process. Therefore, PE should focus on providing effective services for customer participation, creating value and perceived value together with customers, rather than GP making any perceived value alone. This argument gives a theoretical and empirical contribution to the application of service logic in PE industry, especially provides an empirical evidence for changing from the original GP makes value alone to customer perceived and customer participation value co-creation process.

- b) Second, demonstrating the necessity and importance of customer's participation in PE value process, this thesis initially studies the framework of value co-creation vehicle of customer, which is the value co-creation platform for all participant including customer (LP and not yet LP). The virtual Private Equity VPE with specific goals is constructed by an actual PE, or APE, which can be regarded as the mirror of the APE, as the vehicle of value co creation, as well as the vehicle for APE and VPE resource integration, serving for value exchange and id

transformation. APE can obtain more operant resources of participants through VPE, not only as a complement of resources, but also through the interaction and new combination of operant resources.

- c) It also enables the high-level integration and optimization of resources, and continuous combination and integration may generate unexpected creativity to PE funds. The mirror image relationship between the VPE and APE enables value co-creation to be carried out in the VPE in advance or in collaboration with concomitant processes in the APE. This system can run non-ownership and ownership value co-creation transactions; moreover, it gives customers more choices across a wider range, attracts more customers to participate in value creation, integrates more resources, and establishes stronger and long-term relationships with customers through interactions. During the non-ownership value co-creation process, APE and customers do not have a strict legal relationship in the VPE vehicle, which can be more favorable for a PE in approaching customers.

With the support of advanced technology and equipment, we can have in-depth exchanges and interactions in knowledge, skills, experience and other aspects between PE (APE+VPE) and customers, which can improve the effectiveness of the value proposition initiated by enterprises and reduce the negative impacts of uncertainty. This thesis conducts further research on customer engagement for the effective development of value co-creation. Through empirical study, we seek to explore the contention that customer engagement has a significant positive impact on value co-creation activities initiated by PEs (enterprises) and customers. In addition, PE through customer engagement has a significant positive impact on PE value acquisition and value co-creation initiated by customers and PEs themselves.

This argument suggests that not only is the value co-creation initiated by PE effective through the path of customer engagement and customer initiation, but also shows that the value propositions initiated by PE are all derived from the potential or known value propositions of customers. It is the customers value propositions that have been co-created and which are supporting. The relevant theories of

service dominant logic have been evidenced from the results of the empirical research. At the same time, it also explores and demonstrates the "partial mediation effect" of value co-creation initiated by customers on customer engagement and customer participation in value co-creation processes initiated by PEs (enterprises). The research confirms that value co-creation initiated by customers is realized by enterprises, which is the supplement and increment of value co-creation independently initiated by current enterprises.

The initiation of value co-creation should be initiated by enterprises cooperating with customers, which is not only the response to customer's value proposition, but also the main responsibility of enterprises. This is the right way to initiate value co-creation and is also an effective way to carry out value co-creation. Therefore, based on the value co-creation initiated by customer engagement in the service-dominant logic, this thesis makes contributions in theory and implementation pathways for PEs.

- d) The APE and VPE needs support from a service system to carry out value co-creation processes. According to the results of the empirical research, this thesis focuses on research dealing with customer demand preference discovery and Clustering modeling in the constructed service system, in order to find out the potential customer needs and their value propositions. This process can identify and reveal the accuracy of value co-creation. Moreover, this thesis also studies collaborative filtering recommendations and decision-making and discusses effective value co-creation processes for PE in this collaborative decision-making mechanism. Therefore, several questions need to answer in this research, such as how to monetize the value of co-creation, how to measure the value of PE equity and how to trade are also within the scope of this thesis. Aiming at understanding the monetization exchange of value co-creation, this thesis researches the matching and transaction of customer PE equity assets. This is the core point of customer participation in value co-creation and also the challenge that the PE industry has been trying to solve.

This thesis proposes and argues that the "fair value" of PE equity assets

should not be the scalar algebraic sum of the current initial value + expected excess return value, but the vector sum (module) - composite value of the complex number. The fair value of equity assets expressed as a complex number is not only more scientific, but also more informative, which is beneficial for customers to make decisions. According to this argument, it is trying to determine a tokenization of the value of equity asset based on internet server physical isolation, information and communication technology, blockchain technology and encryption technology. Moreover, with the support of third-party authorized intermediaries as technology and credit investigation, the current input value of control input is calculated dynamically, and the composite value and the number of tokens are transferred as individuals or as a whole with the "fair value" of transaction.

The target is to build a trading system of customer value exchange in the process of value co-creation. Applying the transfer method by token transactions of equity assets, the customer identity changes between APE and its mirror VPE, so that the APE life cycle can continue. The resulting continuity is conducive to the continuous integration and optimization of GP and customer operant resources at a high level. The continuity of value co-creation activities and customer relations, plus the accumulation of value co-creation and service capital can enable and provide the foundation for further efficient development of the Chinese PE industry. This thesis discusses equity asset securitization in theory and practice with more scientific, convenient and reliable methods, which lays a solid foundation for enabling customers to participate in PE value co-creation processes more securely.

- e) Finally, this research constructs a value co-creation system which has a new perspective. From customer participation in value co-creation to value co-creation instigated by customers, this thesis conducts theoretical research and empirical research, and then constructs a virtual VPE with specific objectives as the vehicle for customer participation in value co-creation processes outside the APE and a service system to guarantee the value co-creation between the APE and VPE. Moreover, this research applies and explores the service dominant logic in the

formation, motivation and logical development sequence of value co-creation systems constructed by APE + VPE + service system. It provides theoretical research, empirical evidence and effective development and deployment pathways for value co-creation processes. It aims to verify and support the relevant theories of service dominant logic but also seeks to establish a new perspective on understanding and supporting the systematic development of value co-creation. It is also a study based on the theory of value co-creation and its practicality in the Chinese PE industry. Although PE is the research object, it is still of reference and evidential value to other industries in China as well.

-Chapter Two-

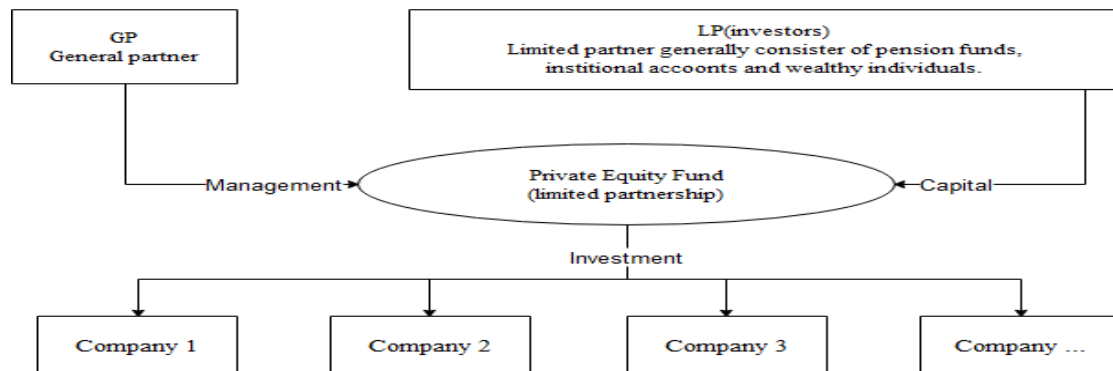
Customer Participation in Value Co-creation

2.1 Introduction

Private equity investment is a general term for all kinds of alternative investments, including equity investment, venture capital, large-scale or medium-sized leveraged buyout, mezzanine debt, mezzanine equity investment in unlisted companies, and real estate investment; in addition, private equity fund also invest in public equity (listed company). In China, a private equity investment fund usually refers to the equity investment made by PE to unlisted enterprises. In the process of transaction, the exit method is considered at the same time. PEs generate profit through selling investment shares and M & A or management buyback (Zhang, 2011).

There are three kinds of organization forms of PE fund, which are companies, limited partnership system and trust systems. Limited partnership PE are the main organization form of private equity investment fund. In the United States, about 85% of the total funds of PE adopt a limited partnership form. General partner (GP) takes charge of the PE. See the figure below for PE management framework.

Figure 2.1: GP Management Framework

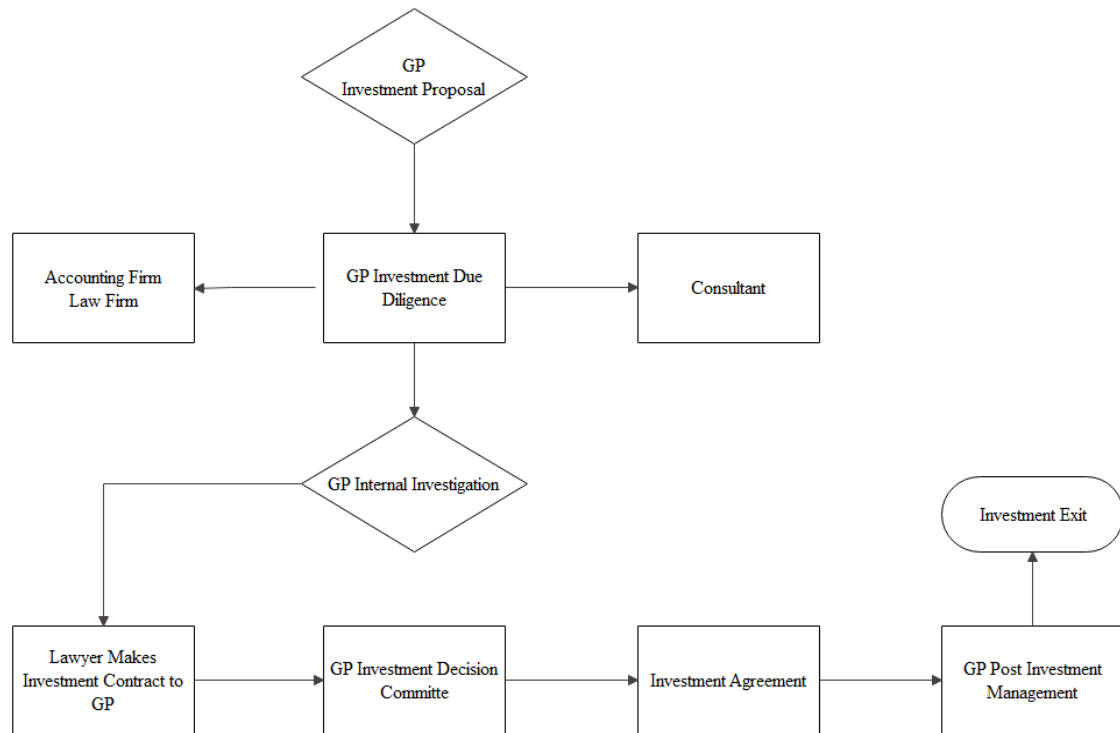


The limited partnership PE is composed of general partner and limited partner. Both parties sign a limited partnership agreement to stipulate the rights and obligations

of both parties, and jointly establish a limited partnership to carry out equity investment business. According to the limited partnership agreement, the limited partners should take limited liability depending on their investment capital, LP also can share interests and investment income of PE but could not participate in the daily operation and management of the PE. The general partner (GP) takes unlimited liability for PE and responsibility for the operation and management of the PE as well. GP have the right to execute partnership affairs and retain independent investment decision-making power, have the right to distribute the investment income of the limited partnership, and be responsible for the debts incurred by the PE. The duration of the PE is generally 7-10 years, which can be extended appropriately according to the specific investment situation. Upon the expiration of the period, the assets and investment income of the partnership will be fully liquidated (Chen et al., 2015).

The investment process of PE is usually proposed by GP based on his due diligence (DD). During this investment process, GP organizes relevant investment manager to make DD, and hire accountant and law agencies to make professional investment advice. It also consults relevant industry experts if needed. After the completion of coordination and professional consultation, GP will designate relevant personnel or departments for internal approval. After internal approval, GP will designate investment manager and lawyer to prepare investment plan and submit it to the investment decision-making committee for approval. After making the project investment decision, GP and the investment enterprise sign an investment agreement; after the investment is completed, GP designates relevant personnel or departments to be responsible for the post investment management, and makes the decision of exit when GP thinks it is appropriate. See the table below for GP's management process of investment projects. Therefore, this thesis wants to provide a new pathway for PE management method through applied service dominant logic.

Figure 2.2: Framework of GP Management Process Flow



In the traditional manufacturing economy, tangible goods are the vehicles of value exchange, so goods are in the core position and services are in the subordinate position, while services are intangible they possess secondary or auxiliary means to complete commodity transactions and they are the surplus over and above tangible goods. The definition of services is based on how its characteristics are different from goods. In the market activity, service is related to goods, the trade of service and trade of goods represent two different categories.

At the end of the 20th century, the information revolution had impact on the social economy in a multitude of ways. With the development of the modern service industry, a large number of researchers have studied it from various perspectives such as relationship marketing (Berry et al., 1983), service quality management (Parasuraman et al., 1985; Hauser & Clausing, 1988), service marketing (Grönroos, 1994), resource management (Hunt & Morgan, 1995) and other emerging fields. This research has shown that in the era of an information economy, especially in the network environment, the relationship and boundary between goods and services has become

blurred, and it is often difficult to establish whether it is goods or services that are provided by enterprises to the market. With the development of the information society, the competitiveness of enterprises no longer solely depends on their ability in terms of product research and development, design and manufacturing, but also includes their level of ability in market research through to after-sales service and even in providing customers with all-round services. Service has become an important way of adding value to products.

In order to improve their profitability, many multinational manufacturing companies have shifted their strategic focus away from product manufacturing to provision of customer service. For example, GE and IBM in the United States have expressed their intention to shift from being manufacturing enterprises to service enterprises (Sawhney et al., 2004). The industrial economy with product manufacturing as the core is gradually developing and shifting to the service economy. The connotation and extension of the concept of service have significant changes so it is necessary to define what is meant by service.

Much research has found defects in "neoclassical economic tradition", which expresses "manufacturing logic" or "old enterprise logic" (Hunt, 1999; Normann, 2001; Zuboff & Maxmin, 2002). On the basis of much research, Vargo and Lusch (2004) classified it as being primarily a goods dominant logic (G-d), and put forward an alternative service dominant logic (S-D), which gave a new definition of service: service is one party's application of specialized capabilities (knowledge and skills) to benefit others or one's own processes. It is argued that the provision of services is the basis of all economic exchange and marketing, products are only the vehicle or tool of resource transfer and application, and economic exchange is a service exchange service. The pioneering research of Vargo and Lusch (Ravald & Grönroos, 2006; Vargo & Lusch, 2005, 2007, 2008, 2011; Payne et al., 2005, 2008; Gummesson et al., Edvardsson et al., 2005) argued that service is not only an activity, but also a process. It is a perspective which seeks to understand and manage the value creation process. Grönroos (2006) defined service as an input of resources, providing facilitation and support for value creation for consumers, and proposed a broader service concept in

the service dominant logic.

With the further research on S-D logic and the development of new service paradigm, research has focused on the theory of customer participation and value co-creation. As a discipline, management began to realize that value co-creation is an important and neglected field through consumer participation, which has a profound impact on management strategy (Priem, 2007). Sampson and Froehle (2006) in their unified service theory, suggested that the most important feature of service is that customers participate in the production process, and inputs are controlled by customers, almost all the characteristics of service production come from this. Value is created by the customer and the enterprise together. (Vargo, 2011; Zhong et al., 2014).

Grönroos and Ravald (2011) point out that value is contained in all resources in consumers using process, and these resources are provided to consumers through services to create value, which is based on marketing concepts. The expression of Service Logic (S Logic) is more appropriate. Customers are cooperative producers and are always involved in the process of value production. On this basis, the concept of service ecosystem has been put forward. The service ecosystem is regarded as been composed of social and economic entities with value proposition (Vargo, 2011). In this research, the object of value creation has been further expanded, which covers element such as consumers, service employees, service enterprises and relevant beneficiaries. In addition, Spohrer and Maglio (2008) point out that service is a human centered open complex system in their research on service science system. The customer is not only the provider of the resource element, but also the beneficiary. The prominent feature revealed here is the customer utilizes their skills and knowledge in the process of production.

Despite its widespread use however, S-D logic does not have significant practical concepts in its framework. In Kryvinska's (2013) research, key factors are illuminated, and the research points out the broad applicability of S-D Logic. This thesis originates from an analysis which serves as practical evidence confirming the argument of S-D Logic and puts forward the view that customer participation and value co-creation have become the latest research perspectives on S-D logic and which are regarded as an

important feature of service. Moreover, it is greater than before in terms of an expanded research focus on S-D logic applying it in many different industries and emphasizing the importance of a currently dominant view on service exchange and value co-creation.

The prevailing hypothesis is that this attempts to improve the content of goods and services both in theory and practice (Kaczor & Kryvinska, 2013). S-D logic is an evolution rather than a revolution. Its foundation is "invisible and dynamic resources, value co-creation, and actors' inputs, relationships, economic and social process" (Gummesson, 2010). One of the most important contributions in the field of service science was the introduction of S-D logic over the last decade (Moussa & Touzani, 2010). It should be said that the service dominant logic has been improved based on a large number of previous studies, and the published research results are also very valuable in terms of providing insights. However, in many ways, further research and studies are needed in respect of the following points.

Although service dominant logic is the most representative service argument in recent years, there is no specific explanation for the process of value co-creation within this important perspective. At the highest level of abstraction - both the customer and the service provider are in some capacity part of a value creating process, customers are always co-creator of value is a correct observation, indeed. However, this is too simplistic to allow for theoretical development or practical decision making in any meaningful way (Grönroos, 2011). Research on service dominant logic and value co-creation lacks sufficient empirical support and evidence. No matter where the researchers stand in terms of their position on S-D logic, from the current published papers, one thing is clear: the empirical evidence is insufficient (Brown & Patterson, 2010). The research ideas remain at the stage of conceptual research and consumer goods case studies, and there is a lack of operable key constructive and empirical conclusions for value co-creation (Payne et al., 2009). Many studies focus on qualitative discussion, have a lack of measurement of customization capability, and almost no empirical analysis on the interaction mechanism of the key factors in the process of co-creation is reported (Zhang & Chen, 2009).

To address this problem, I empirically explore a research model in section 2.3.3 to

analyze value co-creation process in the PE industry. Customer participation in the process of PE value co-creation, seeing PE as the vehicle of service exchange, on the one hand, PE inputs resources are required for service; but on the other hand, it provides services for the integration of resources brought by customers; Finally, customers receive perceived value which includes economic value, support value and technology/core during this process. Through this process, the goal is to find out the relationship between PE's operant resources, customer participation and customer perceived value and the interplay between these three factors. The hypothesis postulated in this chapter has been proved through this research, which suggests it is a positive impact for the Chinese PE industry practically to apply S-D logic, especially in terms of customer participation and value co-creation perspectives.

In recent years, the PE industry has already realized that traditional operational methods are not going to ensure PE funds keep generating profit. There has been a realization of the need to provide more pathways to let LP and potential LP join the value co-creation process. For instance, customers (Limited partner and investor) of Private equity fund have become more sensitive to money liquidity and have sought to find new ways to increase returns. Beaton and Smith (2011) put forward the argument that private equity co-investment is the process of simultaneous investment in portfolio companies by a limited partner alongside funds managed by a general partner (GP). Hence an LP has not only a commitment to the GP's fund but also a direct investment in a portfolio company on the same terms as the GP's fund. Co-investment provides the PE's customers an opportunity to build a portfolio of attractive investments with leading GPs without paying fees. It is a method of customer participation in PE value co-creation. Although this paper determined that LP join value co-creation can increase profit for GP and LP, it shows that there is a lack of fundamental research as to why LP has positive impacts for PE value co-creation at a theoretical level. In this chapter, empirical research is carried out to answer and explain that customers using their operant resources (knowledge and skill) to join the value co-creation process can increase returns for PE funds. The path of research from motivation for customer participation in value co-creation, customer participation methods and finally come to

suggest the result of customer participation in terms of PE fund performance.

This chapter further argues that the relationship between general partner's (GP) and limited partner (LP) is a complex one. Figge et al. (2010) argue that the conflict between GP and LP has become more intense. They examined the impact of private equity (PE) fund-level dynamics on the PE fund's GP divestment decisions and whether these decisions are to the detriment of the PE fund's limited partners, indicating a moral hazard problem. This paper focusses on the stages of PE financing and closing, where the conflict originates from profit loss for LPs in these two periods. However, it is hard to believe that this is the only reason that the relationship worsens between GP and LP. Therefore, in this thesis, based on the S-D logical value perspective, it is attempted to illustrate the customer (LP) and GP interacting in the process of value co-creation, and that this process could establish a strong and long-term cooperative relationship.

The remainder of this second chapter is organized into seven sections: section 2.2 provides a review of the literature on the S-D logic and relevant theories about customer participation, value co-creation, customer perceived value and long-term and strong relationship between GP and LP. Section 2.3 illustrates the whole research framework and hypothesis postulated between each variable. The empirical research forms Section 2.4 and shows the research method adopted for this thesis and Section 2.5, Section 2.6 provide more details and further explanation of this research. Finally, Section 2.7 conclude the second chapter.

2.2 Literature Review

2.2.1 Private Equity Fund Industry

Previous studies on the PE industry in China and worldwide has mostly focused on the following aspects:

(1) Research on PE Organization System

According to research, limited partnership is a kind of institutional innovation, and China should adopt it in a gradual way to transition from limited liability

company systems to limited partnership systems (Bao, 2003). Deriving from this it is argued that the development of PE funds in China should be based on private equity frameworks with a legal status being given to private funds that are large in scale. The limited partnership fund does not have the status as a normal legal person. It means PE fund doesn't belongs to the first level tax system in China, PE funds do not have to pay taxes themselves. The management fee contract is determined, and the cost control is relatively easy (Zhu, 2014).

(2) PE Investment and Financing Method

Cumming (2003) studied the investment strategy, structure and strategy of American funds. Carver (2012) studied various evaluation methods for venture capital funds. Stowell (2010) studied the business operation, profit model and risk management of investment banks, hedge funds and PE. All of them focused on the current investment and financing mode, there have not been many studies conducted on innovation in modes of financing and funding.

(3) Risk Control of PE Investment and financing

Kressel (2010) studied the investment behavior of venture capital dynamic markets in the digital area. Cendrowski et al. (2012) studied the history, governance and operation of PE investment. They studied the monitoring of funds and made recommendations based on this. Zhang et al. (2002) concluded that the agency cost and risk could be reduced by proper institutional arrangement. They also applied game theory and agency theory to study the contract mechanism between investors and fund managers, fund managers and entrepreneurs.

(4) PE reputation and Impact on Enterprises Investment

Nahatu (2008) researched the reputation and investment performance of venture capital. Gompers (2010) believed that having a good reputation can help a GP raise more funds, have greater negotiating power in profit distribution and obtain access to better and more projects. Hill (2012) studied the impact of investment management on venture capital performance. Hu (2002) studied the contractual arrangement in the process of venture capital investment and also researched the human capital characteristics of fund managers and entrepreneurs

and their interrelations.

Moreover, Lai (2012) explored the entrepreneur's entrepreneurship and innovation motivation, the impact of PE Investment on enterprise innovation and development, and the social and economic effects by constructing a utility theory model of relevant actors of enterprises with PE investment background. Xiang (2010) analyzed the impact of PE Investment on corporate value and determined that PE investment can help SMEs improve their corporate value as well as corporate performance. He also argued that PE's equity investment behavior has brought an optimization of corporate financing structures. Gong (2014) conducted an empirical study on the impact of private equity funds on the value of Listed Companies in China's small and medium-sized exchange, and believed that the development of private equity funds was conducive to improving the value of small and medium-sized enterprises.

(5) Relationship Between PE and Investors

Feng et al. (2000) investigated the incentive and contractual arrangements between investors and GPs, GPs and target entrepreneurs. Chen and Xu (2002) explored the measures of staged investment, market reputation incentive and equity setting. Wang and Zhou (2003) conducted research on the functions of venture capitalists' clients, such as options, contracts and supervision, and also studied the fund distribution model of PE. Zhu (2014) researched the compensation coordination mechanism of investors and fund managers under PE partnerships. Moreover, Beaton and Smith (2011) put forward the theory that private equity co-investment could solve the conflict between GP and LP, especially in the period of fund raising and closing.

(6) Previous Research on PE Value Creation

Based on the management method of PE, all activities of PE such as investment, financing, management and exit are led by a GP. The GP generates profits for the PE and their LPs through their long-term investment experience and professional knowledge. One of the factors for high returns for PE is the strong incentive for PE investment managers and operation managers of enterprises

(Barber & Goold, 2007). The investment income of LP all depends on the GP's responsibility and professional ability. Therefore, the research of PE value creation is carried out around the GP. On the one hand, some studies focus on how to stimulate the GP to perform a better role and create more value for PE; On the other hand, due to the fact that limited partners generally are not involved in the executive power of partnership affairs, there are serious information asymmetries and moral risks between the GP and LP in the actual operation process of the PE, and it is also the focus of the study to restrict the power of fund managers to make investment decisions. There seems to be a contradiction between the two directions (McCahery & Vermeulen, 2015). Therefore, along with the single direction deeper research, we have to consider the balance of the two directions research, we must consider the balance of the two directions in terms of research as well.

Moreover, Feng et al. (2000) has examined the contractual arrangements between investors and GP, and between GP and target entrepreneurs. Zhu (2014) studied the reward coordination mechanism between LP and GP of PE and believed that the optimal contract should encourage GP to maximize LP's expected profit; at the same time, the constraint conditions of GP need to be set. Zhang (2008) applied game theory and agency theory to study the contract mechanism between LP and GP, fund managers and entrepreneurs. A new set of incentive contract arrangements was designed, which takes the ability and effort level of venture capitalists as parameters. It enables high-capacity LP to choose projects with high return and risk, lower income LP to choose lower return and risk investment project. At the same time, in view of the possible adverse selection behavior of LP, a contract model is established with transfer constraints as variables.

Under the framework of GP leading PE value creation, Spenser (2019) studied the method of applying financial tools to create value for PEs. Barber and Goold (2007) proposed how to use debt and portfolio tools as advantages for PEs without too many regulations compared with listed companies. It is the best strategy to achieve short and medium-term value creation. Jiang (2015) studied the evaluation method of PE investment target assets in China and proposed an

evaluation hypothesis based on game theory to help PE protect investment benefits. Wang (2015) studied the characteristics of small and medium-sized science and technology enterprises in China. In order to protect the investment benefits of PE, he proposed a model of obtaining compound options by stages, and made an empirical analysis based on case studies.

Finally, through previous research it is easy to see that the management framework of PE is based on a GP independent operational model. That is to say, the research is carried out in a closed-loop or isolated system under the management of the GP. In order to create more value for PE, we need to give more authority and incentives to GP; yet a GP's greater authority and incentive may cause greater risk to PE or LP. Hence, research needs to be carried out on the relationship between GP authority and risk. Changing PE from a closed system to open system, or at least a limited open system, is a new method to solve the current problem of PE. In some studies, we can see this development. For example, based on 112 investment samples from Denmark, Johnston et al. (2011) empirically analyzes that all partners participating in value creation is one of the more high-yield and important factors for PE. Tian (2011) shows that for some positive LPs, PE's current management method can't synergies with their willingness to pay equal attention to investment and management aspects.

To sum up, research on PE industry has been based on various kinds of research carried out under the current prevailing GP independent management PE model. Moreover, it has mainly been based on theoretical work with less empirical research.

2.2.2 Service Dominant Logic

It is recommended that a-new S-D logic be employed to re-examine the goods dominant logic within enterprise development strategy (Vargo & Lusch, 2004). This theory has been the source of heated discussion in academic and business fields and has produced rich research results, after S-D logic was developed and published. In 2005, at the Otago

forum held by Otago University in New Zealand, the participants discussed S-D from their respective research perspectives and put forward many useful suggestions for the development and improvement of S-D in 2006. So far, the research around S-D is still on-going.

It should be noted that G-D theory was gradually formed under the specific background and contexts occurring in societies during the industrial revolution. At that time, the factory was the basic production unit of the global economy, visible goods were the basic source of national wealth and goods were the key vehicle of value exchange with service as a secondary source. The producer creates value alone, which is value creation under the G-D theory of industrial society (Vargo & Lusch, 2004). According to G-D theory, enterprises integrate resources independently to decide value creation processes, and then become the value creator alone, while customers are just consumers and destroyers or consumers of value (Liu & Tan, 2010).

For producers, consumers only represent the market demand, it is the enterprise service which targets groups, consumers through market exchange to get their needed goods and services; they are passive receivers of value, who don't contribute to value creation, and are excluded from the value creation process. Production and consumption are two independent processes, and the boundaries between producers and consumers are very clear, and they are only interactive in places of market exchange (Figure 2.3). Enterprises and customers play different roles independently in value creation. Enterprises create value and transmit them linearly to customers in the value chain. Customers are the users of value (Figure 2.4).

Figure 2.3: G-D logic centricities

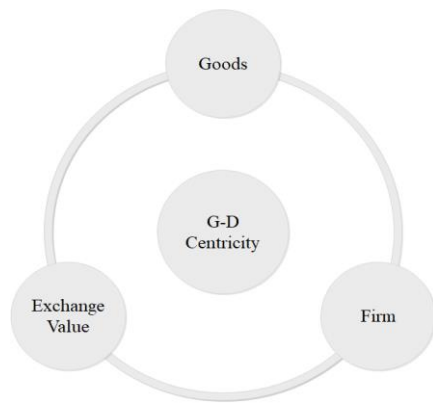
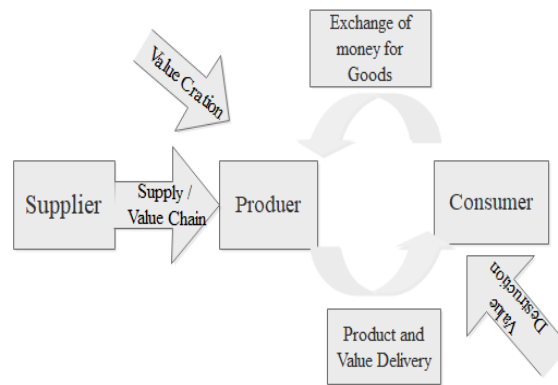


Figure 2.4: G-D lens



Source : Lusch and Vargo (2014)

According to G-D theory, economic activities focus on tangible goods, enterprises only focus on products and meet the demands of the market as their main purpose. This arguably deviates from the correct way of value creation, which is to put it all together from individual participants in an interactive way; (for example, by the company or organization), cooperation, integration of resources contribution, participants skills, knowledge and innovation ability and entrepreneurial ability to create value. G-D theory focuses on the tangible and exchange of goods, which adapted to the social environment of the industrial revolution, but during the development of information technology and economic globalization environment, service is rapidly increasing in developed countries and international trade status, making G-D gradually lose its credibility. In order to adapt to new economic environments, more and more scholars suggest that a new S-D (Service Dominant Logic) be used instead of traditional G-D to understand today's economic exchange and value creation processes, and guide enterprise strategy formulation and industry cultivation (Vargo & Lusch, 2004). What we need is a logic, not to abandon G-D theory, but to transcend and evolve it, to recognize service as the primary position of human resources for serving others (Lusch & Vargo 2014).

Many scholars have carried out studies on S-D in different fields. Such as strategic management (Madhavaram & Hunt 2008), brand research (Brodie et al., 2006), customer behavior (Tronvoll, 2007; Aitken et al., 2008) and inter firm relationships (Liu,

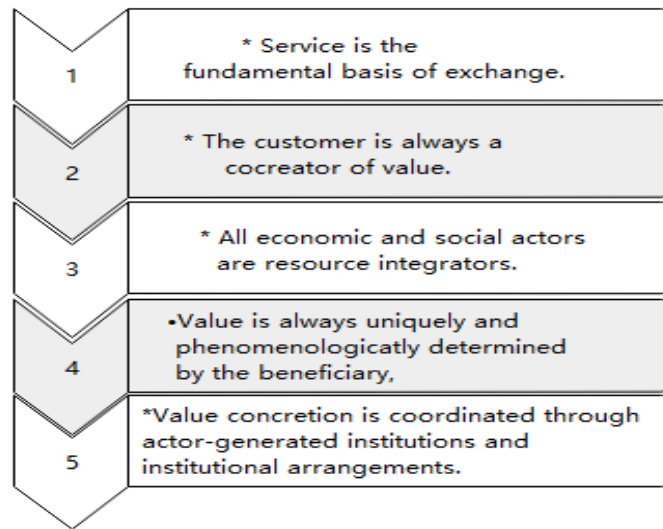
2014). In 2010, experts from the American Academy of marketing science discussed S-D and aimed to classify the value of co-creation under S-D as one of the priority research directions for the coming years. Based on these studies, many researchers followed the insights offered by a new S-D logic to re-examine goods and services, placing two factors in service dominate logic area, and rethinking the fundamentals of market transaction and value creation. Then they focused on the principle of co-creation within S-D theory. S-D research has been deepening with improvements in management disciplines and business disciplines. Vargo and Lusch also repeatedly modified S-D assumptions and formed the 10 basic propositions of service logic, and summed up 4 basic principles; 2016, further derived form 11 basic propositions of service logic (table 2.1), and summed up 5 basic principles (table 2.2). It should be said that Vargo and Lusch start from the view of operant resources, based on multiple studies on these hypotheses and propose 11 basic hypotheses of S-D theory, which has built the theoretical framework of S-D logic.

Table2.1: Eleven Basic Propositions of S-D Logic

Foundational Premise	
FP1	Service is the fundamental basis of exchange.
FP2	Indirect exchange masks the fundamental basis of exchange.
FP3	Goods are distribution mechanisms for service provision.
FP4	Operant resources are the fundamental source of strategic benefit.
FP5	All economics are service economics.
FP6	Value is cocreated by multiple actors, always including the beneficiary.
FP7	Actors cannot deliver value but can participate in the creation and offering of value propositions.
FP8	A service-centered view is inherently beneficiary oriented and relational.
FP9	All social and economic actors are resource integrators.
FP10	Value is always uniquely and phenomenologically determined by the beneficiary.
FP11	Value concretion is coordinated through actor-generated institutions and institutional arrangements.

Source: Stephen L. Vargo and Robert F. Lusch (2015)

Table 2.2: Five Basic Principles of S-D Logic



Source: Stephen L. Vargo and Robert F. Lusch (2015)

Axiom in S-D logic

In S-D logic, there are five axioms represent the basic principles showed above.

Axiom1: Service is the fundamental basis of exchange

This axiom is based on S-D's definition of services: meaning applying the operant resources (knowledge and skills) for the benefit of another participant. In other words, service is exchanged for service. This means: (1) goods are vehicles of service providing; (2) all enterprises are service industries, (3) all the economy is the service economy. It also shows that the essence of the society and the common ground of its participants is the exchange of services.

In G-D logic, tangible goods are the basis of market transactions. After the 1980s, with the rapid development of ICT (Information Communication Technology), the dissemination of knowledge, skills and other operant resources was promoted; it also plays a more important role across industry. People have gradually realized that knowledge and skills have become the most important resource, moreover, they are the fundamental factors of market transactions. In the process of market transaction, what the customer really cares about is service, which is provided by the enterprise and which can bring convenience and utility for him. That means customer perceptions of these

factors will determine the final value of market transactions, which is generated by knowledge and skills during the service process.

Today, producing processes are more specialized and divided, market participants' skills are not enough to ensure their survival needs under today's economic system by themselves. Using their knowledge and skills to participate in the service exchange process helps market participants to enhance their survivability in the system. Therefore, all economic exchange in essence is "service to service" economic exchange, and all the economy is a service economy, which is the "entity or other entity for its own interests, the use of professional ability, through action processes and behaviors (knowledge and skills) process (Vargo & Lusch, 2004)." Under S-D logic, services become a common form of exchange rather than a specific form (Payne et al., 2008). Obviously, the connotation of service is no longer the action or supply of the producers in the traditional sense to meet the needs of the consumer. Exchange services is in order to get service. The process definition of service is the most essential and core content of S-D.

The purpose and content of all economic exchanges is singular, which is service, but the essential feature of such an economic exchange of service to service is often concealed by indirect exchange (FP2). As the services supported by knowledge and skills are sometimes not directly used in transaction processes, they need to be attached to certain vehicles, usually using goods as a vehicle. The role of goods in S-D is considered only as a distribution mechanism provided by the service, not the priority element of value creation and exchange (FP3). Value perception is not only through the transaction object (goods), but also through the transaction process and it is influenced by the relationship between the supplier and the customer (Grönroos, 2008).

Axiom 1 clarifies that service is the basis of the exchange, which is an exchange of services in order to receive a service; hypothesis 2 illustrates the indirect exchange cover exchange foundation factors, it is still the exchange service; hypothesis 3 tells us that the goods distribution mechanism to provide services entails that customers receive direct or indirect service value through using goods. Furthermore, all the economy is a service economy. Therefore, the difference between goods and services dominant logic

is direct and indirect services are provided under S-D. Moreover, the subjects involved in the exchange process in G-D have usually two dimensions, which is that they are divided into producers and customers. In S-D logic this is multivariate, all participants are actors. Service is the basic element of economic activities, and the service process is formed around economic activities. In the service process, service and service can be exchanged, so that participants have the opportunity to enhance their viability. In the activities of these service exchange services, a solution that can be found is to provide solutions to the problems of customers, that is, to adapt to the needs of customers through a complex combination of providing direct and indirect services. It should be said that S-D has shown a broad application prospect relevant to the strategic development of enterprises.

Axiom2: Value is co-created by multiple actors, always including the beneficiary.

This axiom refutes G-D as being a sole locus of producer and creator of value; on the contrary, it shows that value is always co-created through the interaction of participants, either directly or indirectly through the provision of goods.

In G-D theory, a producer can embed value into goods through a series of production activities, and then trade goods onto the market to locate and satisfy customers and achieve the exchange value of goods. G-D theory not only places customers outside the process of value creation, but also regards them as pure "value consumers" or "value destroyers". However, S-D theory regards value creation as a continuous process and believes that customers perform the "create value" process along with other related participants.

Prahalad and Ramaswamy (2004) argued that "interaction is an important way for enterprises and consumers to co-create value together, and the value of co-creation is formed by the heterogeneous interaction between consumers and the nodes of value network". Only when customers are integrated into the demand satisfaction process can enterprises ensure sustainable competitive advantages (Peppers & Rogers, 1995; Whiteley & Hessian, 1996; Vandermerwe, 2000). This requires the joint creation of value between the enterprise and the customer. The key to future market competition is

to create value by the enterprise and the customer together. Customer participation in creating value is the source of new competitive advantages (Prahalad & Ramaswamy, 2004).

In the process of customer participation in creating value, a continuous learning relationship is established between the enterprise and the customer. This learning relationship is based on two aspects: first, adaptive learning, which makes the enterprise get used to understanding and adapting to the customer's demands; and secondly, gain new knowledge by reviewing old, which suggests the enterprise re-examine existing conditions and standards; in this process of mutual learning, enterprises can better understand and meet customer's demands in order to create conditions for developing new capabilities and competitive advantage (Wikstrom, 1996; Argyris & Schon, 1978; Lundvall, 1993; Prahalad & Hamel, 1990).

Supplier's active influences on customer value processes and the value usage process, implies extensive interactions with customers and is especially prevalent in knowledge intensive service contexts. The value process of buyers and sellers often affects each other directly (Grönroos, 2011). Aarikka-Stenroos and Jaakkola (2012) investigated the knowledge intensive service industry under the situation of five stages of collaborative process to create value.

S-D Hypothesis 7 believes that participants cannot deliver value but can participate in value creating processes in tandem with putting forward value claims. That is, the reciprocal commitment of value, and then transforms resources provided by other actors into specific interests in their respective value processes, in order to realize their value (Lusch et al. 2008).

Axiom3: All social and economic actors are resource integrators.

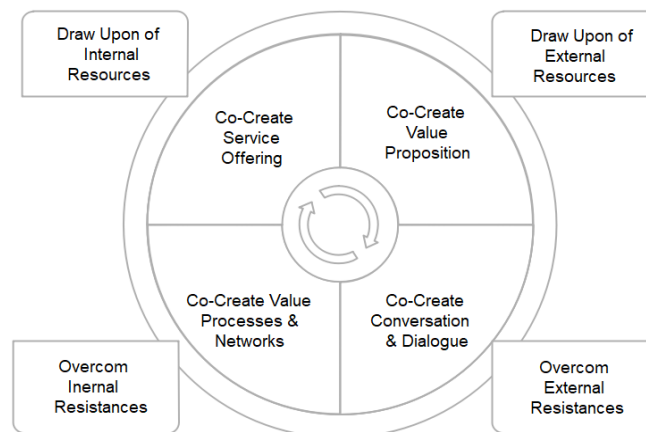
Vargo and Lusch (2008) describe the roles of different actors in the service economy from the macro level, and then put forward the ninth hypothesis of S-D -- all actors in economic activities and social activities are resource integrators. Different subjects participate in various service activities for different economic or social purposes and integrate resources in order to achieve their own goals. The Resource

Interaction Approach believes that economic value depends on the potential and other resources integration method, so as to create effective value, which entails that resource matching is very important, especially the interaction between the members of the network which provides a resource integration platform, enterprises can obtain a competitive advantage through the right combination of their resources and those of other relative enterprises (La-vie, 2006).

Resource interaction is defined as the combination and co-cultivation of resources in Inter Organizational interactions (Håkansson & Waluszewski, 2002). This focuses on how resources interact with each other in interorganizational relationships and network interfaces. Some researchers have used the new enterprise resources interaction perspective to analyze the issues which occur in modern companies, (Ciabuschi, 2012). Cantù et al. (2012) investigated the role of actors and resources integration during the complex goods and services solutions.

Vargo and Lusch (2011) performed further analysis of enterprises in the role of value creation processes, and argued that the enterprise should fully integrate their own resources and partners, to try to break the shackles of various internal and external constraints, communication, and cooperation partners, and jointly proposed the value proposition, the provision of services and construction of value network, to create conditions for the achievement of service value. (see figure below)

Figure 2.5: The Role of Enterprises in Value Co-creation



Supplier's active influence on customer value process and the value using process which is characterized by extensive interaction with customers is especially prevalent in knowledge intensive service contexts. The value process of buyers and sellers often affects each other directly (Grönroos, 2011). Value is not only achieved through transactions, but also through the transaction process itself, so it is impacted by the relationship and interactions between suppliers and customers (Grönroos, 2008).

Resource integration can also be described as the process of innovation. It requires three sets of interrelated ideas to do this: (1) all social and economic actors are resource integrators. (2) Resource integration leads to the creation of resources, (3) Along with the new resource's creation, they are integrated with other resources, the process repeats itself through the process of resources integration and resources creation. Resources and resource integration beget additional resources. These additional resources are often incremental innovations but occasionally they are radical innovations that result in new markets. Stated alternatively, markets are not static or fixed but are unbounded. They are unbounded because the extent of resource integration by human actors is unlimited and, is in fact, ever-expanding because the more resources that are integrated the more resources there are available to integrate (Vargo & Lusch, 2008).

Axiom 3 states that customers and enterprises are resource integrators as participants in the economy, and that integrated resources are the 4 hypothesized operand resources -- knowledge and skills, and operand resources are the fundamental sources of strategic interests.

Constantin and Lusch (1994) divide resources into operand resources and operand resources based on previous research. They believe that operand resources refer to tangible resources, including goods, natural resources and so on; they are usually in a passive position in production activities. Operand resources mainly include knowledge and skills, which are often in an active position in production activities. Therefore, operand resources refer to the original production resources, while operand resources include human, organization, information and relationship resources (Horbel, 2013). It is believed that the two components of an operand resource are knowledge and skills.

In comparison, skills are more important for an organization to build their competitive advantages, because it is difficult for competitors to replicate in the short term. (Vargo & Lusch, 2008) Further, skills can be understood as know-how technology, and skills also focus on issues such as processes and management issues of goods (Capon & Glazer, 1987).

Vargo and Lusch (2004) redefine service as an entity's process of specialization, knowledge and skills through actions, processes and behaviors. In S-D, the theory of resource advantage plays an important role in the development of service paradigms, and the change on the view of resources is the fundamental reason for the birth of S-D. Unlike G-D theory, S-D theory is based on resource advanced theory (Srivastava, 2001) and core competency theory (Prahalad & Hamel, 1990; Day, 1994), these two theories put core competence as the higher order resources for organization survival and development. Higher order resources are a "bundle of knowledge and skill" that integrates a variety of basic resources. Therefore, under S-D theory, the core elements are operant resources represented by knowledge and skills. Operant resources are usually invisible, but dynamic and infinite. In S-D, operant resources include knowledge and skills and serve as a role to explore the value.

According to S-D theory, operant resources play a decisive role in the process of value creation, it is also believed that operant resources are the fundamental source of strategic interests. (Constantin & Lusch. 1994) Customers are the owners of operant resources. They put their knowledge, skills and experience into the process of value creation, which is an important prerequisite for value co-creation. The integration of resources and complementary advantages which comes from customers and enterprises is an important basis for co-creating value. For S-D, value is derived from the profitable use of operant resources, or it can also be transmitted by operand resources or goods. (Vargo & Lusch, 2004). The focus of service dominant (S-D) strategy is to improve the efficiency of resources integration and co-creation in complex dynamic systems through exchange services. The object is customers who own knowledge and skills during resources integration and value co-creation (Spohrer, 2007). Scholars such as Li Lei (2013) based on the resources view believe that goods and other tangible resources

are more important resources under G-D theory, and the operand of S-D resources which are knowledge and skills as the core elements of intangible resources, the change of resource values led to the reconstruction of the dominant logic from G-D to S-D.

In G-D theory, knowledge and skills are regarded as external factors of market competition, and it is considered that operand resources are the main elements of exchange. Market participants can only use them to enhance competitive advantage, and competition itself cannot provide any feedback to knowledge and skills. S-D theory has modified the view above that operand resources such as knowledge and skills are born internally in the competition system, the organization can not only build their competitive advantage through operand resources, but also will generate feedback for operand resources; furthermore, it can also strengthen operand resources. This provides a two-way interactive process and guarantee for enterprises to build sustainable competitive advantages (Li & Zhang, 2013).

The difference between G-D and S-D from the perspective of operand resources and operand resources (Vargo & Lusch, 2004) :

Table 2.3: Contrasting Perspectives

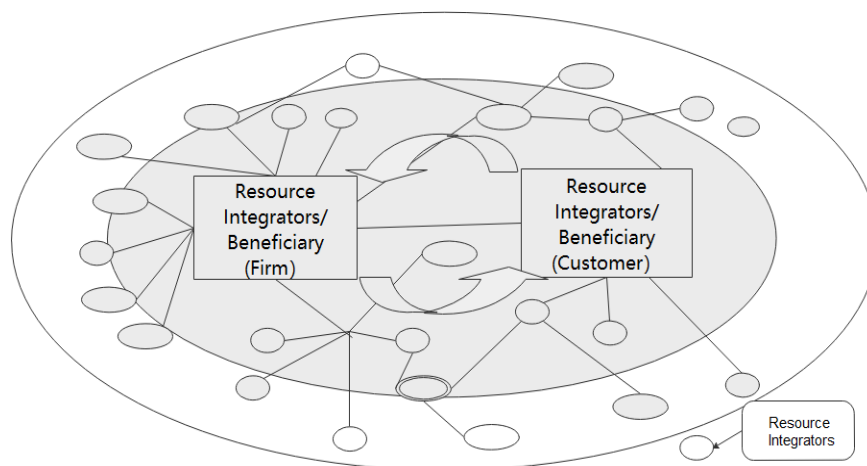
Alternative Views	G-D Logic	S-D Logic
Basis of Exchange	Goods	Service
Role of Goods	End Products	Appliances (means)
Customer	Operand Resource	Operand Resource
Value	Embedded in Offering (good)	Beneficiary Determined
Firm-Customer Interaction	Transactional	Relational
Economic Growth	Surplus Tangible Resources	Application of Specialized Skills & Knowledge

S-D theory believes that operand resources are fundamental factors for value co-creation. However, the distribution of operand resources is uneven, and the status is different too; so, it needs to be integrated and optimized. Resource integration requires a support system. (Vargo & Lusch, 2004). Enterprises play three roles in creating value

systems, which are value claims (an enterprise cannot create value by itself), interaction with consumers, and providing value co-creation support systems, (Prahalad & Ramaswamy, 2004). Co-creation of value exists in the process of interaction between consumers and enterprises. Enterprises and consumers determine service goals, solve related problems, improve service quality and create value together through interactions. Since the creation of value is an interactive process, we need to rely on the creation of a value service system to support it.

A service system is a resource, which includes people, technology, information, etc. connected to other systems through value claims (Spohrer, 2008). In service exchange systems, value is determined by dynamic (and sometimes static) resources using resources integration during the application process (Lusch & Vargo, 2006). Under S-D theory, the resources interorganizational integration framework has become an important prerequisite for value co-creation. Because resources integration and co-creation value involve many kinds of objects, the integrated system will be supported by organizational networks and information networks, thus forming a true co-creation value network, which is called the "service ecosystem" (Vargo & Lusch 2010).

Figure 2.6: Service Ecosystem



Axiom 4: Value is always uniquely and phenomenologically determined by the beneficiary.

The value here refers to the value of use. The value of service itself has no

objective criteria. It is a subjective perceived value dependent on experience and circumstances. It depends entirely on the characteristics of the beneficiary, such as knowledge, skills, and the circumstances of services using process. Therefore, Vargo and Lusch (2008) suggest that using value in context to replace the use value may be more appropriate. The core proposition of S-D theory puts forward a basic understanding of value creation: the value from the service experience which interacts between enterprise and customer; enterprise is not marketing, but is marketing with customers together, the essence of the supplier is to provide the value proposition (value claim) and commitment, only the customer is the value judgment (Vargo & Lusch, 2008). With further research, Lusch and Vargo (2014) describe the process of S-D logic as follows: all actors create value together through resource integration and service exchange and decide the value in specific circumstances.

Finally, it should be noted that service is inherently customer oriented because, in S-D logic, service is defined as the application of knowledge and skills for the benefit of another; that “other” is what we often call a customer. Service orientation is thus always inherently directed at the beneficiary of the service. From the standard of value judgment or axiom 4, we receive hypothesis 8: which is a service centered view is the internal beneficiary orientation and the relationship between them (Lusch & Vargo, 2014).

Axiom 5: Value co-creation is coordinated through actor-generated institutions and institutional arrangements.

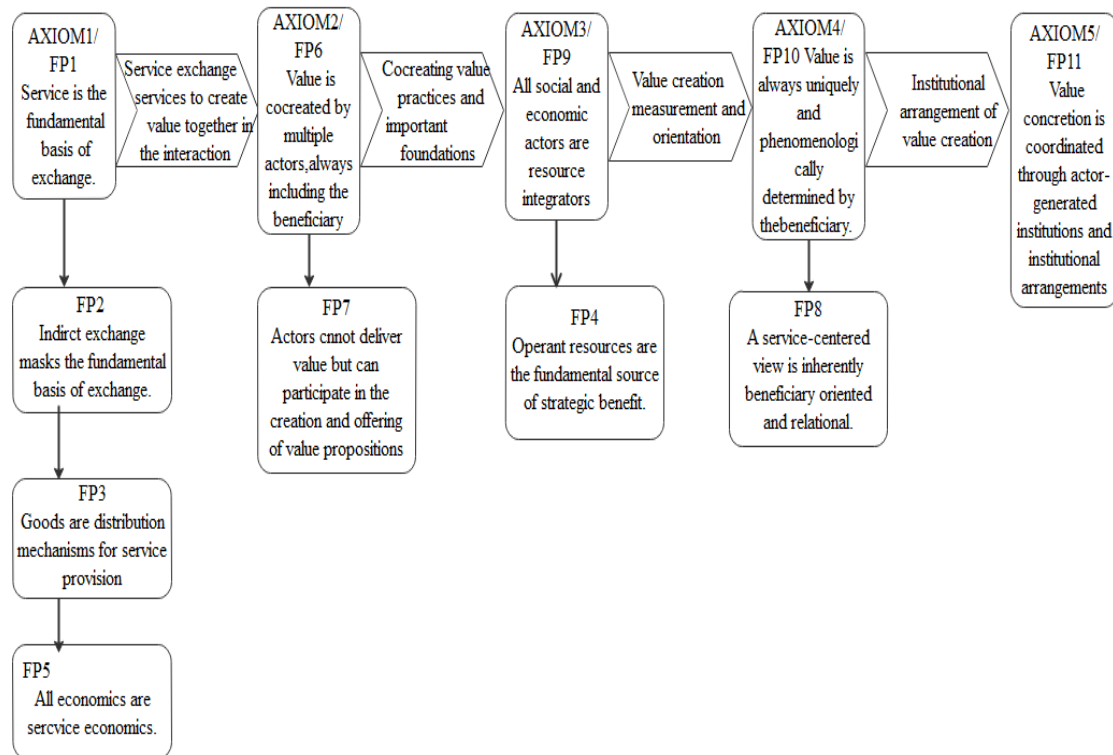
Due to the involvement of many co-creation value actors within resource integration and service exchange, in order to ensure the effectiveness of value co-creation, Vargo and Lusch (2016) emphasized that the institutional and institutional arrangements are significant in value co-creation and service exchange processes (FP11). Vargo and Lusch (2016) add S-D to the axiomatic 5/ hypothesis 11: Value co-creation is coordinated through actor-generated institutions and institutional arrangements. All actors are constrained and coordinated by institutional and institutional arrangements through resource integration and service exchange. The system is a guarantee for value co-creation based on the experience of a nested and

overlapping service ecosystem. This is the inevitable development of S-D logic in order to adapt simple environments to the complex network environments, the enterprise and the customer are two factors moving to interactions of multiple factors of value co-creation.

From the perspective of service dominant logic, it is easy to see that service is a fundamental basis for exchange (FP1), all the economy is the service economy (FP5); that is the service is the basic factor of economic activities. All actors are centered around the goal of economic activity, which is customer oriented (FP8) during the service process. Service process is also the value co-creation process which is customer centric and includes all actors. Moreover, actors are resource integrators (FP9), and the integration resource process is the fundamental source of strategic interests (FP4). During the value co-creation process, all actors will decide how much value they will create, including the beneficiary (FP6). The value here refers to the use value, which is a kind of subjective perception of value, it depends on the beneficiary's experience and external circumstances. This means value is always uniquely and phenomenologically determined by the beneficiary (FP10). The integration of resources and value co-creation constitutes a complex system, so service exchange and interest distribution systems need an effective support system to protect it (FP11).

If all the assumptions of the S-D logic are arranged according to the following graph, we find that using "actor participation" and "value co-creation" clearly expresses the progressive relationship between the hypotheses mentioned above. It can be noted that "actor participation" and "value co-creation" are the key components of S-D logic.

Figure 2.7: The Service Dominant Logic Relation Diagram



Source: Stephen L. Vargo and Robert F. Lusch (2015)

Therefore, service dominant logic offers a new pathway towards understanding market, customers, value and other issues for enterprises. An enterprise can plan its business activities from the service dominant logic, to establish customer-oriented value propositions, constructing the corresponding processes to realize customer value proposition in services. This can lead to service introduced customer participants value co-creating processes, and integration resources for all actors, realizing the service and value exchange during interactive processes; then realizing the value co-creation and sharing, and finally the use of institutional arrangements to protect value formation and effectiveness during the service. It shows a broad application for the strategic development of the enterprise with this concept.

Service dominant logic (S-D) has developed into being one of the more important precepts of contemporary service science literature. In recent years, it also has become the main way of thinking about goods and services both in theory and practice (Kaczor

& Kryvinska, 2013). One of the most important contributions in the field of service science is the introduction of S-D logic over the last decade (Moussa & Touzani, 2010). S -D logic is an evolution rather than a revolution. Its foundation is "invisible and dynamic resources, value co-creation, and actors' inputs, relationships, economic and social process" (Gummesson et al., 2010). While the logic has been expanded upon theoretically and empirically in several, this thesis takes the position that further empirical research as conducted for this study are warranted to improve the evidence base for S-D logic.

- Service dominant logic has emerged as a critical representative service paradigm in recent years. Although value co-creation is a proposition hypothesis, there is no specific explanation for the process of value co-creation (Zhong & Tang, 2014). At the highest level of abstraction - both the customer and the service provider are in some capacity part of a value-creating process - the statement 'The customer is always a co-creator of value is correct. However, this is too simplistic to allow for theoretical development or practical decision making in any meaningful way. It is not clear what is meant by value creation which the research conducted in this thesis attempts to clarify (Grönroos, 2011).
- Research on service leading logic and value creation lacks empirical support and evidence. No matter where the researchers stand in terms of perspectives on S-D logic, from current published papers, one thing is clear: the empirical evidence is insufficient (Brown & Patterson, 2010). The research ideas remain at the stage of conceptual research and consumer goods case studies and lack operable key constructive and empirical conclusions for value co-creation (Payne & etc., 2009). Many studies focus on qualitative discussion, with a lack of measurement of customization capability, and almost no empirical analysis on the interaction mechanism of the key factors in the process of co-creation. This concept makes value co-creation between enterprise and customers lack in empirical support (Zhang & Chen, 2009). In the knowledge intensive industry and complex transactions, collaborative value creation is quite important. However, few literatures perform empirical research on this situation (Zhang & He, 2014). In a

word, the results of empirical research based on service dominated logic are still relatively weak (Guan & Pi, 2017).

2.2.3 Customer participation

The International Standardization organization (ISO) defines a customer as an organization or individual person who accepts a product or service. In this study, a customer refers to an individual or an enterprise that accepts or intends to accept PE products or services. Along with the change of economic development, the customer plays a more and more important role in goods production and services, and customers role changes from one of passive acceptance to being active creators in value production (Dong et al., 2008). It is not enough that many enterprises only emphasize an orientation towards the customer, they also arguably require a match between enterprise needs and customers in order to create value together and finally meet customers value claims. (Prahalad & Ramaswamy, 2000). How to best manage customer participation in value co-creation processes is one of the most important sources of enterprise competitiveness (Smets et al., 2013). Research on customer participation has become a popular topic for study as addressed by this thesis.

At present, academic research on customer participation has been ongoing for a long period but it has not yet formed a more unified definition of what it entails for enterprises. Customer participation is defined in different ways by different scholars, which includes: customer participation refers to the customer being involved in the process of product innovation or the development of the enterprise (Fang, 2008); During the process of production or service experience, customer experience in value co-creation will meet their value claims and achieve good psychological expectations in terms of a consistency perspective on customer participation; (Wang, 2006). Moreover, in value co-creation and service delivery processes, customers provide advice, share information, participate in decision making, so customer participation is in effect a form of behavioral construct (Chan et al., 2010); There also has been some research on the degree of customers participation in value co-creation. (Bendapudi &

Leone, 2003).

Academic research has published research results on customer participation from different perspectives, which can be roughly divided into three categories: the motivation for customer participation, the method of customer participation and the results of customer participation.

Motivation of customer participation

It is believed that in many services customers need to participate to a certain degree to ensure the production and consumption of services and customer participation can be described as a form of access to service-related information and a related degree of effort (Kelley, Donnelly & Skinner, 1990). Customer participation is also the result of the maximizing of customer's pursuit of utility. Some studies conclude that customer participation is the result of customers' pursuit of higher psychological needs, which includes emotions, desire for respect, recognition and self-fulfillment (Kellogg, Youngdahl & Bowen, 1997). Along with improvements in these regards through customer participation, customers will also have more information and knowledge about production processes, product quality and so on as a result of their participation (Bitner et al, 1990). Claycomb, Lengnick-Hall and Inks (2001) emphasize that customer participation not only includes the behavior of the customer in the cooperative production, but also reflects a positive role for the customer in the process and encourages responsible behavior on the part of the customer.

The motivation of consumers to participate in new product development activities initiated by enterprises is the result of the interaction between internal and external incentives (Füller, 2006). Internal incentives are interest, involvement, curiosity, satisfaction and positive challenges associated with value co-creation; the task itself may be fun, satisfy curiosity, where participation can also offer a sense of achievement. External incentives include skills improvement and knowledge acquisition, information search, recognition, altruism, making new friends or network connections, personal dissatisfaction, cash reward etc. He also explores the driving factors shaping customer participation in value creation behavior and finds that the

degree of clarity perceived by both enterprises and customers, and the intrinsic motivation of customers' professional knowledge and participation can promote customer participation in value creation behavior. Customer participation can enable customer to satisfy a variety of their needs, such as financial, social needs, technical needs and psychological needs that the customer is concerned about (Hoyer et al., 2010).

Methods of customer participation

Customers provide production resources to organizations in the form of information and effort (Dabholkar, 1990). File, Judd and Prince (1992) identified four main customer participation methods through conducting interviews and suggested four key event methods: (1) providing tangible, specific materials or auxiliary tools; (2) creating opportunities for meeting; (3) cultivating listening skills; (4) meaningful interaction. Other researchers have also used the key event method, through empirical research on education, food, retail, repair, leisure and medical, banking, insurance and other industries, and as a result identify four measurement dimensions for customer participation, which are preparation, establishment of relations, information exchange and interference behavior (Kellogg et al., 1997).

It is believed that customers communicating with employees and participating in production together is a good way to pursue value creation (Meuter & Bitner, 1998). Cermak, File and Prince (1994) believe that customer participation reflects psychological and material behavior related to the product or service, the customer's effort and the degree of involvement can influence greatly the level of customer participation. Customers provide activities and resources for service production and delivery (Meuter & Bitner, 1998). Rodie and Kleine (2000), when describing customer participation in the service industry point out that customer participation is a resource or behavior that the customer provides in the process of service production or delivery. They see customer participation as being divided into two basic dimensions which are providing resources and active behavior. Customer participation also refers to the effort of customers in the process of buying and consuming products and services in the with reference to emotion, cognition, behavior and energy (Liu & Chen, 2009).

The impact of customer participation

Zeithaml (1981) proposed that the service production and consumption are simultaneous processes, which means that consumers participate in the process of service design, service production and service delivery when they buy services or accept a service. Customer's contribution to the service process is twofold and interactive (Silpakit & Fisk, 1985). Customer participation is the latest trend to have emerged in the development of service industry. Customers' contribution to service process will affect their service and service quality (Lloyd, 2003). It is suggested that customer participation is initially the consumer's economic demand, but with an increase in customer participation, customer participation gradually has a social function, which is to satisfy customers value claims. In the process of providing customized products and services, an important way is to use customer's capabilities to create unique competitiveness attributes for enterprises (Zhang & Chen, 2006).

In participating activities, customers provide various resources to service organizations (enterprise), which show two quality characteristics: customer function quality and customer technology quality. Among them, Customer function quality refers to how customers perform and act in participating activities, such as, for example, friendship and respect, and customer's technical qualities refers to what specific information and services the customer provides in the activities of participation (Kelley, Donnelly and Skinner, 1990). Ennew and Binks (1999), argue that based on the perspective of customer and enterprise interaction, there is a measure of customer participation utilizing three dimensions which are trust sharing, responsibility behavior and interpersonal interaction. This measurement emphasizes the interaction between the customer and the enterprise. Derived from previous research, some studies propose measuring customer participation utilizing four dimensions, which are preparation, information exchange, cooperative behavior and interpersonal interaction in the context of Chinese consumers' background (Peng, 2005).

Some studies have conducted an empirical analysis of customer participation in service innovation from the perspective of organizational learning and point out that

customer participation has a promotional effect on the improvement of service innovation performance (Zhang, 2010). These also point out that enterprises and consumers value co-creation will increase the possibility of customer loyalty, perceived quality, customer satisfaction and enable a positive feedback effect (Roser et al, 2009). Customers participation can help promote their sense of identity, ownership and intrinsic enjoyment, while also increasing people's sense of control and weakening risk perception, which will enhance their purchase behavior and increase their loyalty to products (Auh et al., 2007; Franke et al., 2010; Thompson and Sinha, 2008; Troye, 2012;).

Some research suggests that the value co-creation through customer participation in services will also affect the perception of quality of service, enable more positive evaluations of the brand, increase repurchase and generate recommendations for other customers (Ostrom et al., 2010). The enterprise can deliver brand information through the process of interacting with the customer, so as to understand the customer's tastes and preferences and obtain opinions and suggestions from the customer on the product. The customer can also build the brand image through the process of interaction with the enterprise and finally participation can satisfy the customer's individualized demands and as a result improve brand reputation (Zhang, 2010). Enterprises can take advantage of the network platform mechanism to enable customers to participate in the development of product innovation. Customer opinion has a significant impact on product innovation and plays an important role in brand management. Enterprises can absorb customers' opinions on products by interacting with customers and make use of value co-creation in maintaining the competitive advantage of the enterprise (Sawhney, 2005). Supporting customers participation in value creation has become an important source of competitive advantage (Bendapudi & Leone, 2003; Chan, 2010).

The service dominant logic hypothesis 6 states that " Value is co-created by multiple actors, always including the beneficiary. ". Customer participation is not only an important factor of customer satisfaction but is also the core value of co creation (Vargo & Lusch, 2004; Yim, 2012). Accordingly, in light of the above literature, customer participation is defined as the resources or behaviors provided by the

customer - the individual or PE that accepts or intends to accept the PE product or service - in the process of the production or transmission of the product or service in pursuit of its own utility.

2.2.4 Value Co-creation

Value

In the goods-dominant logic, value is a prerequisite for the exchange of products (including services). Market and goods exist because of the existence of exchange value and make today's producers and customers. In order to measure the exchange value, some scholars have published and developed an income-investment model (Zeithaml, Bitner & Gremler, 2006). Moreover, it is also can be used as an objective method to measure exchange value. (Rossi et al., 1989) These studies are based on the theory of exchange value in goods dominant logic

In service marketing and management, value may be the most uncertain and elusive concept (Fernandez et al., 2018). The meaning of value can encompass two types of value, which are value-in-exchange and value-in-use. The ability to buy other products is called exchange value and the utility of certain specific items is called the use value (Vargo & Lusch, 2008). Along with in-depth study of value, the connotation of value was also expanded, and studies have also proposed including value-in-experiences, value-in-context, value-in-social-context and value-in-cultural-context. From the customer experience perspective of value co-creation, it has been determined that customer experience occurs in the process of value co-creation between the enterprise and the customer, thus the focus changes from the exchange value to the customer value-in-experience. Therefore, value is created jointly by customers in the process of the personalized experience of products.

Service dominant logic focuses on value-in-use of a product or service and the use value-in-use is value co-creation, which is created jointly by the customer and the enterprise. S-D logic also emphasizes the feeling of value in the process of customer use, experience and feelings are indispensable for value determination, there isn't value

without use (Vargo & Lusch, 2006). Value is determined by the combination of certain knowledge and skills of the customer during the usage process. Therefore, the value is based on the value-in-use of customers determined and generated (Vargo & Lusch, 2004, 2006, 2008). Exchange value is a functional relation of using value (Grönroos, 2008).

When Vargo expounds on the service dominant logic, a clear definition of the importance of value in his paradigm construction is given and the obvious difference between the value cognition and the goods dominant logic. He believes that value comes from the use transfer from operant resources or operand resources during the process of value creation. Value is not just exchange value (Baron, et al., 2010). As the researcher points out in the analysis of the service dominant logic, as the origin of the exchange value, the value-in-use becomes the focus of attention, and the exchange value as the important theoretical basis of the goods dominant logic becomes a part of the use value, and is achieved through the integration of all of the interests. The efforts of the relevant people are created together (Zhong, et al., 2014). Vargo and Lusch present the difference in goods dominant logic and service dominant logic of value creation in the following table (Vargo & Lusch, 2014).

Table 2.4: Differences in Value Creation between G-D and S-D

IHIP Characteristic	G-D logic	S-D logic
Intangible	Value is embedded into goods during the production and distribution process. Firms can alter natural resources to create new forms, alter the location of goods and the time goods are available, which make them more valuable.	Value is intangible. Value is co-created by actors. Only in the use and integration of resources is value created. Value is experiential or phenomenological which is inherently intangible.
Heterogeneous	Products should be made homogeneous to take advantages of mass production. Homogeneous products are of higher engineered quality.	Each actor is unique, heterogeneity exists, and customized offerings are natural. Efficiency is important but of paramount importance is effectively meeting the actor needs.
Inseparability	Firms and customers should be separated for maximum efficiency.	Actor interaction naturally occurs. Interaction through dialogue and conversation enhances effectiveness of service offerings. It is in the interaction that value is co-created.
Perishable	Goods are less perishable than services and thus they can be inventoried. Since gaps exist between the time and place where customers need goods, inventory can be used to overcome this challenge.	Experiences are perishable but are remembered and shared. When the offering is tangible, it is the use of the good that is important, and this is perishable. Value is perishable.

Source: Vargo, S. L. and Lusch, R. F. (2014).

All in all, value is always determined by the unique phenomenological method of beneficiaries (FP10, Vargo and Lusch, 2016). The enterprise cannot transmit the value, it only provides the value proposition, value is always determined by the beneficiary's unique phenomenological method. The same service is different in different situations. The value evaluation depends entirely the beneficiary's context and the characteristics of the beneficiary itself (Vargo & Lusch, 2008).

Customer Role

The traditional view divides enterprises and customers into two different elements, where enterprises are the value creators and customers are the product receivers. Market

execution value exchange and the function of value extraction is does not capture new methods and insights into how value is created and a more exact expression is enterprise and customer cooperation in the process of value creation (Prahalad & Ramaswamy, 2004). With the change in market competition environments, the role of customers in value creation has changed, the value is no longer created by the enterprise alone, but through the co-creation and interaction between the enterprise and the customer, (Prahalad & Ramaswamy, 2000). In value co-creation, consumers assume an active role and create value together with the firm (Kohler et al. 2011; Prahalad & Ramaswamy, 2004), through direct and indirect collaboration across one or more stages of production and consumption (Hoyer et al. 2010; Payne et al. 2008; Roggeveen et al. 2012; Tynan et al. 2010).

The Role of Enterprise

Enterprises cannot provide value, but they can participate in creating and making value propositions. The enterprise puts forward the value proposition according to the demands of the consumer, and after the consumer accepts the proposition, it forms the common value creation goal with the consumer, and then creates the value through the exchange of resources and the interaction with the consumer. It is the reciprocal commitment around value which then realizes the value by converting the resources provided by other actors into the specific interests of their respective value processes. Co-creating consumer experiences are at the core of customer and enterprise value creation. Enterprises need to invest more energy and actively participate in the activities of "joint value creation" (Prahalad & Roadway, 2004).

In order to ensure the success of value creation, enterprises must also provide value creation support systems, which includes infrastructure and other hardware as well as organizational structure, regulations, culture, atmosphere and other software to help and support consumers to achieve value co-creation (Kelley, 1992). Enterprises play three roles in the value creation system, such as putting forward value propositions, value co-creating through consumer interaction and providing value creation support system. Improving the interactive quality of consumer value and providing unique experience support systems for consumers is an important strategy for promoting

consumer value co-creation (Vargo & Lusch, 2004; Prahalad & Ramaswamy, 2004; Cova & Salle, 2008).

Initiating Method

From the perspective of enterprise strategy and marketing, value creation is the process of making customers (or users) better in some ways or increasing customer benefits (Vargo et al., 2008). Value creation is one of the core issues of corporate strategic concern, it is an important prerequisite for establishing and maintaining customer relationships and is even considered as the core purpose and key process of economic exchange (Vargo et al, 2008). Zwass (2010) thinks that value creation in a virtual environment can be initiated by enterprises or be spontaneously initiated by customers. He divides value creation into sponsored value co-creation and autonomous value co-creation. Value co-creation is a value creation activity initiated by an enterprise or community, while spontaneous value creation refers to an activity that is created voluntarily by customers.

Enterprise and Customer Interaction

Prahalad and Ramaswamy (2004) believe that value co-creation exists in the process of interaction between consumers and enterprises. Enterprises and consumers determine service targets through interaction, solve related problems, improve service quality and create value together. Cooperation between the actors of value creation can contribute to the creation of value, such as the consumer value and enterprise value, for instance value created through consumer community interaction. The interaction between enterprises and customers is the key aspect of value co-creation, and interaction guidance is the concrete implementation and realization process of value co-creation. Value not only comes from the use of products or services, but also depends on the reciprocal interaction process between customers and suppliers (Payne et al., 2008; Cronroos, 2008). Value co-creation refers to the interaction and cooperation between the customer and the enterprise in the process of value creation, product or service design, development, production and consumption (Sheth et al., 2000). Interaction is the pathway for value co-creation. Without interaction there is no value co-creation,

(Payne et al., 2009). Therefore, customer participation in value creation is a highly interactive activity (Auh et al., 2007).

Prahalad and Ramaswamy (2004) offer basic views on value co-creation which can be summarized as having two points. One is that co-creating consumer experience is the core of customer and enterprise value creation, another is that interaction between actors is the basic realization method of value co-creation. During an interaction, the enterprise creates an opportunity to entry for the customer in a value creation stage and help the customer in order to create value together. The enterprise has an opportunity at this point and during this process to influence customer experience and practice when the customer uses the product or service. Meanwhile, the customer can also use the interaction to participate in the production process of the enterprise. Interaction is the primary interface between parties undertaking co-production. It is an opportunity to understand, share, and serve needs, and to simultaneously assess and adapt resource commitments, (Merz et al. 2009; Prahalad & Ramaswamy 2004). Value is realized not only through the usage process of the subject matter of the transaction, but also through the transaction process, so it is affected by the relationship and interaction between the supplier and the customer (Grönroos, 2008).

Resources of Value Co-creation

The resource-based view believes that resources are the source of competitive advantage and that resources can create value (Barney, 1991). Ma (2005) gives the basic hypothesis of the resource dependence theory which is that no organization is fully self-sufficient, and that all organizations need to exchange with the external environment (environmental organization), to ensure survival and development of the enterprise. In the exchange process between enterprises and external environment, the environment provides the key resource to the organization. Without the support of external resources, the enterprise cannot operate normally.

Operant Resources and Operand Resources

In S-D logic, Vargo and Lusch (2004) redefine service as the process of using

professionalization (knowledge and skills) through action, process, and behavior performance for the benefit of itself or other entities. Operant resources consist of two components: knowledge and skills; value is derived from the effective use of operant resources and may also be delivered through operand resources or goods or services. Based on the theory of resource advantage, the operand resources are divided into a hierarchy of three: Basic, operand resources—an entity is a resource to the firm; Composite, operand resources—as a combination of two or more distinct, basic resources, with low levels of interactivity; Interconnected, operand resources—as a combination of two or more distinct, basic resources in which the lower order resources significantly interact. Moreover, going up the hierarchy will significantly increase the possible sustainability of firms' competitive advantages (Madhavaram & Hunt, 2008) .

According to S-D logic, operant resources play a significant role in the process of value co-creation and argues that operant resources are the fundamental sources of strategic interests. Customers are owners of operant resources, they put their knowledge, skills, experience and other resource into the process of value creation, which is an important prerequisite for value co-creation. Customer resource integration denotes a customer's incorporation, assimilation, and application of resources into the processes of other actors in brand-related utility optimization processes (Ehret & Wirtz,2019). The value comes from the operant resource using or the operand resources transfer (Baron, 2010). In this thesis, value co-creation resources refer to resources that customers participate in value co-creation and integration in PE industry's resources.

Dimension

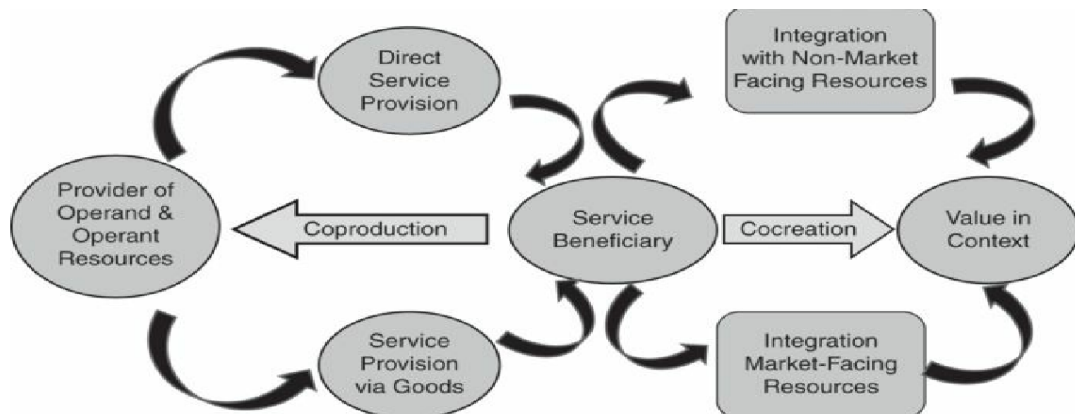
Numerous researchers have studied the principles and processes of value co-creation. Ranjan & Read (2016) identified 149 papers during a search for different academic papers and studies on value co-creation and extracted two main concepts of value co-creation from a review of this literature: the dimension of common production and use of value. Common production is divided into three elements: knowledge sharing, fairness and interaction; use value is divided into three elements as well: experience,

personalization and relationship. Further, value co-creation is a theoretical representation of an extended exchange process of joint production and consumption of value.

Value Co-creation and Coproduction

Co-creation has also become a central part of contemporary business and marketing literature but most of what is thought of as co-creation can be more accurately termed co-production. Two important but related conceptually distinct forms of collaboration are the co-creation of value and co-production. Co-creation of value is the most encompassing, and nested within it is co-production. Furthermore, co-creation of value always occurs and thus is not something that actors can opt out of or outsource; conversely, co-production is optional for the actors involved (Figure 2.8). When social and economic actors increase their specialization, they become more dependent on other actors for service. This service-for-service exchange results in a mutualism that helps create an interacting network of actors that, in turn, becomes society. During this process, actors have access to more resources but consequently need to engage in more resource integration. Actors living in this sea of other actors and resources spend a considerable amount of effort on collaboration for co-production and co-creation of value, which is facilitated through representing, normalizing, and integrative practices (Lusch & Vargo 2014).

Figure 2.8: Value Co-creation and Co-production



Source: Vargo, S. L. and Lusch, R. F. (2008b)

Value co-creation is a significant part of S-D logic. Actors dynamic interaction is

the main component of value co-creation. During this dynamic interaction process, participants use operant resources as the fundamental source of strategic benefits created by value (FP4) dynamically integrate resources (S-D, FP9) dynamically perform service exchange (S-D, FP1) and dynamically create value (S-D, FP6). Therefore, in this thesis, value co-creation refers to the service process based on service dominant logic, and customers participate in PE industry value creation and interaction with operant resources.

The idea of value co-creation not only breaks from the viewpoint of the traditional enterprise creates value alone, but also is a concept developed in tandem with the network economy expansion. Value co-creation changes from the customer and enterprise representing two factors interaction to multiple socioeconomic participants bringing multiple factors into processes, which is a significant development. While much research has been conducted providing theoretical frameworks and insights there has been less empirical research conducted. We know little about the details of the process of value co-creation, such as when it starts, what it includes, when it ends (Caru, 2003; Sanchez-Fernandez & Bonillo, 2007). In the process of value co-creation, there are few studies on the value vehicle, the way of participation and the way of entry into value co-creation. In the interaction process of value co-creation, it is hard to find support systems or service systems for ensuring the effectiveness and dynamism of value co-creation.

2.2.5 Customer Perceived Value

In 1980s, the study of service quality moved from service providers to customers, therefore researchers studied the customer perceived value in different ways from different perspectives.

Perceived value based on customer perspective

Grönroos (1982) puts forward the concept of customer perceived service quality based

on cognitive psychology theory. It argues that service quality is a kind of customer perception, which is determined by the comparison of a customer's service expectation and perceived performance, and the customer is the evaluator of service quality rather than the enterprise. Lewis and Booms (1983) support the view of Grönroos from the perspective of the service provider that the quality of service is the degree to which the service and expected service are consistent, that is, the service provided is consistent with the service expected by the customer.

Parasuraman, Zeithaml and Berry (1985) proposed "service quality perception continuous band" and built a gap analysis model between customer cognitive service and expected service, and the connotation of service quality was illuminated. After empirical research, they conclude that the evaluation function of service quality consists of three variables: customer expectation, service process quality and result quality. Parasuraman, Zeithaml and Berry (1988) further point out that service quality is an overall evaluation from the customer, and it is a dynamic process. The quality of service comes from the comparison between the pre-accepted service expectation and the cognitive process after receiving the service. Therefore, the measurement of service quality includes not only the evaluation of service results, but also the evaluation of service processes.

Some studies further suggested that the customer perceived value is the overall evaluation which is weighed by the product or service between the customer's perceived benefits in the process and the cost of the customer of obtaining a product or service (Zeithaml,1988). Perceptions of value are a trade-off between the buyer perceived performance and the cost of purchase (Porter, 1985). Alderson (1965) define the perceived value as the ratio between perceived benefit and perceived pay and believes that the perceived value of the customer reflects the trade-off and comparison between perceived quality or perceived benefits of the product and perceived cost resulting from payment. Anderson et al. (1992) and others believe that a series of economic, technical, service and social benefits obtained by customer companies in the transaction of payment for the products provided by the suppliers are perceived value as the value measured by the monetary unit. Customer perceived value is a preference and

evaluation of the customer's perception of product or service attributes, as well as the goal or purpose of the customer, resulting from the use process of the customer (Woodruff, 1997).

Kotler defined customer perceived value as the difference between total customer benefit and total customer cost (Kotler, 2000). Laukkanen (2006) argues that sometimes it can reflect its value only when compared with other products. Holbrook (2005) defines customer value as an interactive relative preference and experience. The customer perceived value (economic value, relationship value, technical value) of different types of services is different (Lovelock, Patterson & Walker, 2007). Value comes from the service experience of the interaction between the enterprise and the customer; the enterprise is not marketing to the customer, but with the customer marketing; the essence of the supplier marketing activity is to provide value proposition / commitment, only the customer is the value judge (Vargo and Lusch, 2008). All participants create value through resource integration and service exchange and decide the value in specific situations (Lusch and Vargo, 2014).

The Dimension of Customer Perceived Value

Regarding the dimensions of customer perceived value, many researchers have put forward their own views utilizing an empirical perspective. Customer perceived value is mainly composed of factors such as product quality, service quality and price (Parasuraman et al., 1985). Their research demonstrates that consumers perceive the quality of service from their expectations and actual performance. Sheth, Newman and Gross (1991) argue that products and services provide customers with five kinds of value, such as functional value, emotional value, situational value, cognitive value and social value. Roger (1997) further subdivides customer perceived value into three dimensions: economic interest, perceived interest and emotional interest. The driving factors of customer perceived value includes three aspects: objective product or service factor, customer subjective perception factor and service environment (Robert & Woodruff, 1996). From the perspective of two dimensions of value and resolution, twelve item value scales were developed to measure customer perceived value

(Grewale et al., 1998). Petrick (2002) measures customer perceived value from five dimensions and include 25 items such as service quality, emotional response, monetary price, behavioral price and reputation. Some studies suggest that the empirical study of customer perceived value is becoming more and more important.

It is believed that the perceived value of customers can be defined and studied by dividing different organizations into parts to learn from existing empirical research on customer value, from the three dimensions of products, services, relations and the two fields of interest and cost. The composition of customer perceived value is divided, and the customer perceived value scale has been advanced (LaPierre, 2000). Liu (2006) explores the source of customer value and its relationship with organizational procurement and finds three types of perceived value of the customer: perceived economic value, perceived relationship or support value and perceived technical or core value. The perceived value is divided into five dimensions, which are functional value, emotional value, social value, image value and cognitive value, and use 33 items to measure the customer perceived value of the business school education service, (Leblance & Nguyen, 1999).

Kotler (2000) suggests that the customer perceived value should be analyzed from two aspects being total customer value and total customer cost. The total customer value includes four dimensions which are product value, service value, personnel value and image value, while the customer perceived cost includes money price, time cost, energy cost and physical cost. Some researchers also divide customer perceived value into four dimensions: quality factor, emotional factor, price factor and social factor. And on this basis, Sweeny & Soutar (2001) put forwards a new concept to divide customer perceived value into four dimensions: emotional value, social value, functional value (price) and functional value (quality). Through empirical research, the composition of perceived value is illuminated. The perceived value of a customer is different from customer satisfaction but has a more complex structure. Through exploratory analysis, studies have concluded that it comprises of the following four dimensions: emotional value and social value (improvement of self- social perception), functional value (relative to the processing / value of money) and functional value (performance /

quality). Feng (2010) constructs a three-force model of customer perceived drive in service industry from the perspective of perceived quality of service industry, perceived cost of service industry, and three drives of perceived risk of service industry in the study of customer perceived value of service industry.

The view of customer perceived value is a function of customer perceived quality and perceived price has also been widely recognized (Ravald & Grönroos; 1996). Fan and Li (2006) demonstrated that the service experience paradigm not only distinguishes both functional and emotional effects, but also identifies a third kind of utility, namely social utility. They argue that consumers are not only economic people, but also social people, who are closely related and integral to society. The service experience of the consumer, family and friends not only generates emotional and functional satisfaction, but also improves the relationship between individuals, for example, through building affection and friendship.

The Characteristics of Customer Perceived Value

To conclude, customer perceived value has the following basic characteristics:

- Subjectivity and individuality. The use value of service itself has no objective criteria. It is subjective perceived value. Only customers are the value evaluators (Vargo & Lusch, 2008).
- Difference. The subjective perceived value of customers leads to differences in customer perceived value. The overall evaluation of the product or service will be evaluated by the customer based on the trade-off between obtaining benefits perceived in the process of the product or service and its associated costs (Zeithaml, 1988). In S-D logic, the difference of customer perceived value refers to the difference in perceived value of use.
- Dynamic and context. Customer perceived value is subjective and dynamic, and it is always uniquely and phenomenologically determined by the beneficiary (S-D, FP10). As a result, the perceived value of customers depends on dynamic experience contexts or specific situations.
- Relations. Perceived value is an emotional connection established by a product

provider after a consumer is using a product, service, and creates a sense of added value (Butz & Goodstein, 1996).

- Multidimensional. The multidimensional nature of customer perceived value is generated synchronously with their service acceptance or in the process of exchanging service contexts with other participants.

So far, there is no consensus on the definition of customer perceived value. However, there is a consensus in academia on the characteristics of customer perceived value: (1) The value of the customer's perceived value is provided by the enterprise to the customer; (2) The value of the customer is the value perceived by the customer; (3) The customer's perceived value is determined by the customer, not the enterprise, but the enterprise has a significant influence on the perceived value of the customer; (4) The medium of customer perceived value is the product or service that the enterprise provides to the customer; (5) The customer's perceived value is the result of the customer's balance, and the trade-off between the perceived value gain and the loss during this process.

2.2.6 Continuous Relationship

A continuous relationship means that one party to the cooperation wants to keep the relationship with the other side stable and have it developed long term and into the future (Anderson & Weitz, 1989; Kim and Oh, 2002). Berry (1983) defines relationships as "multiple service combinations provided by enterprises to attract, maintain and enhance customer relationships". Research shows that customer retention rates increase by 5% every year, which can enable 60% growth in fifth years profit (Reichheld, 1993). In many service industries, customer turnover rate can be reduced by 5%, and enterprises will increase profits by 25% to 100%. Business to business marketing studies have identified that enterprises should cooperate with customers and establish partnerships (Bucklin, 1970; McCammon, 1970). The long-term survival and development of an enterprise depends on attracting, absorbing and maintaining

customers and developing continuous relationships with them.

Profit originates from the customer relationship and is the source of the vitality of all enterprises (Alan, Leonard, 1995). Robust continuous customer relationships are a prerequisite for enterprises in obtaining benefits from relationships (Weitz & Jap, 1995). The more satisfied the customer is, the more likely it is that the relationship will continue (Anderson & Narus, 1990). The interaction between the two parties or multiple parties is made up of a series of economic or non-economic exchanges.

Researchers have put forward a service centric view, which is a consumer-oriented view which is concerned with the importance of relationships with customers. Maintaining long term and strong relationship and developing continuous relationships with customers is clearly beneficial to enterprises. The difference between G-D and S-D relationships is compared in the table 2.5 (Vargo & Lusch, 2009). Grönroos (2000) also suggests that the relationship paradigm is dominant and uses the relationship marketing theory to explain service. The view here is that the service process is the process of building a relationship between the customer and the service provider and establishes a partnership through interactions between the two parties. The relationship leading paradigm evolves from the previous paradigm to discuss the relationship between the product and the service and tries to use a universal way to understand service.

Table 2.5: The difference between relational definition and meaning of G-D and S-D Logic

	G-D Logic	S-D Logic
Meaning(s) of relationship	Dyadic bonds represented by trust and commitment Long-term patronage – repetitive transactions	Reciprocal, service-for-service nature of exchange Co-creation of value Complex, networked structure of the market Temporal emergent nature of value creation Contextual nature of value determination
Normative implications	Manage customers (through communications, satisfaction, etc.) to maximize CLV	Collaborate with customers to develop mutually beneficial value propositions Co-create value propositions through service-for-service exchange

Source: Vargo & Lusch. (2009)

There are three dimensions in identifying customer relationships; Firstly, the relationship between the customer and the enterprise (activity links) - the relationship is based on a series of activities, which are closely or loosely linked together to exchange the internal activities of the two parties; Secondly, the customer and the enterprise resource link (resources ties) - the relationship connects various resources, enterprises and customers will use these resources to keep this relationship, and resource that can be used and developed for both enterprise and customer; Thirdly, actors bonds - as the relationship emerges and develops, it forms a participant bond and affects all participants perceptions, evaluations, and how to handle the relationship with each other. Nowadays, with the rapid development of the Internet, the pace of integration of resources in the manufacturing industry to the service industry is very rapid.

Many industries have been characterized by specialization, knowledge intensive and complex technology, which makes the service providers and customers more dependent on each other's knowledge and resources. This kind of mutual dependence has become more and more important in many industries. Finally, this kind of dependence promotes cooperation. Mutual co-operation ensures the continuous

deepening of cooperation through contract, and contract further promotes the interaction and deepening of the relationship. Service providers and customers transform from transaction type to relationship type in the exchange process, and customers' trust can guarantee the sustainable value creation of cooperation. This is an important prerequisite for building and maintaining customer relationships. It is even regarded as the core purpose and key process of economic exchange (Vargo et al., 2008).

With the emergence and proliferation of information technology, it is worth studying carefully the following issue, which is how to use advanced interconnection and intercommunication means to effectively organize customer participation in enterprise value creation, and how to interact with other participants in the interaction of value creation, produce activities connections and resource connections, exchange services with each other in interaction, form participant bond and continuous cooperative relationships.

Combined with the above literature and research, based on the S-D logic value perspective, the customer and the enterprise interact in the process of value co-creation, and thus establish a cooperative relationship. Therefore, continuous relationships can be defined as the persistence of the relationship with the deepening of the enterprise cooperation relationship in the process of participation and the interaction of value co-creation processes.

2.3 Research Hypothesis

The process of empirical research may not only start from theory but can also start from observations or interviews. Empirical research which originates from theory is the study of deductive hypothesis, and the empirical research which commences from observation or interview is called the theoretical study of induction (Wallace, 1971). In practical application, many researchers combine theoretical deduction and qualitative induction to study. That is, they first discuss related theories, and then use qualitative interview survey methods to understand the object of the study, make inductions and summaries, build models and put forward hypothetical research, and then do empirical

verification of their hypotheses. This thesis also follows this method and its application is discussed below.

2.3.1 The Impact of Customer Participation in Value co-creation on Customer Perceived Value and Its Hypothesis

Value is created by multiple participants such as customers and enterprises, and always includes beneficiaries (S-D, FP6). Following the hypothesis of the reciprocal service, it can be defined as the ability for the benefit of the other party, which is the basic economic exchange (Gummesson, 2010). Participants interact with each other on a service basis, and jointly create value (Vargo, 2009). In S-D logic this becomes the process of using resources for the benefit of another party expressed as the singular "service," rather than the traditional conceptualization of an intangible unit of output, usually referred to in the plural services (Vargo & Lusch, 2008). The importance of service dominant strategy is to improve the effectiveness of resource integration and value co-creation in complex dynamic systems through the exchange of services. The object of resources integration and value co-creation is the customer who has operant resources. Customer participation is the resources or behaviors that customers provide in the process of service generation or transmission (Rodie & Kleine, 2000).

Resources are the source of competitive advantage, and resources create value (Barney, 1991). Customers who have operant resource join value co-creation process with enterprise. Operant resources are resources that act on operand resources and are resources that produce results (Virgo & Lush, 2004). The application of professional skills and knowledge is such that operant resources are the basic units of exchange and "Application of skills and knowledge" (operant resources) for the benefit of the other, it is "service". From the perspective of S-D logic in service exchange service and resource integration, both enterprises and customers provide service to each other with their own resources in the interaction of value co-creation and participate in creating value processes. Therefore, the process of creating value is the process whereby participants participate in the integration of resources and the use of resources to serve

the benefit opportunities for the participants to serve exchange services. It is also a process of reciprocal service.

After customers, enterprises or customers and enterprises put forward value propositions together, it is necessary to fully integrate the resources of participants and partners. Moreover, actors are resource integrators (S-D, axiom 3 / hypothesis 9). This states that customer participation is an important source of competitive advantage (Bendapudi & Leone, 2003; Chan et al., 2010). Customer participation is not only an important factor in customer satisfaction, but also the core value of co-creation (Vargo & Lusch, 2004, 2012). In the process of customer participation PE value co-creation, PE acts as the vehicle of service exchange, on the one hand, PE invests the resources needed for service; on the other hand, it provides services for the integration of resources brought by customer participation and its own resources; Thirdly, operant resources provide value support in the process of operand resources transferred (Baron et al., 2010), that is, the effectiveness of value co-creation needs to be guaranteed, so as to gain benefits for participants in service exchange services. Therefore, it is very necessary and important for PE to provide services based on its operant resources for customers to participate effectively in the value co-creation process.

H1: PE service (based on PE's operant resources) has a significant positive impact on customer participation (based on customer's operant resources) in the value co-creation.

2.3.2 The Impact and Hypothesis of Customer Participation Value co-creation on Customer Perceived Value

The value of service logic is always determined by the beneficiary in a unique phenomenological way (FP10). Value comes from the service experience of the interaction between the enterprise and the customer; the enterprise is not marketing to the customer, but marketing with the customer; the essence of the supplier marketing activity is to provide the value proposition or commitment, only the customer is the

value judge (Vargo & Lusch, 2008). All participants jointly create value through resource integration and service exchange, co-creation values and determine the value in specific situations (Lusch & Vargo, 2014). Value comes from the use of operand resources or the transfer of operand resources. In the process of value creation, customers get use value and not just exchange value (Baron et al., 2010). S-D Hypothesis 7 holds that participants cannot transfer value but can participate in value co-creating and value propositions. That is, "reciprocal commitment to value", and then realize value by converting resources provided by other actors into specific interests in their respective value processes (Lusch et al., 2008).

The customer's contribution in the service process will affect the service and service quality. Liu (2006) found three kinds of perceived value through research, which are perceived economic value, perceived service support value and perceived core service value. Different types of services bring different customer perceived values economic value, relationship value, and technical value (Lovelock, Patterson & walker, 2007); there is a positive relationship between customer participation and customer perceived value (Liu, 2008). Perceived economic value, perceived relationship or support value and perceived technology or core value have a continuous impact on the relationship between customers and enterprises (Liu, 2014). Participation in value co-creation may not only be a function of altruism, but also a function that participants can reasonably benefit from, expecting to gain and perceive value in the process of participation (Fernandes & Remelhe, 2016). For enterprises, customer retention can generate considerable profits (Reichheld, 1993).

The economic benefits perceived by customers is an important factor in determining customer participation (Lloyd, 2003). Value co-creation increases customer's revenues (Vargo et al., 2008). Value is ultimately determined by the customer's knowledge and skills in the use process (Vargo & Lusch, 2004). Moreover, it believes that service-based competition can enable producers to obtain better profits and sustain longer-term partnerships. Customer perceived value as a function of perceived quality and perceived price has also been widely recognized (Ravald & Grönroos, 1996). Perceived economic value focuses on quality, price and other factors,

while cost performance is usually one of the important factors for customers in purchasing and re-purchasing (Gale, 1994). Sweeny and Soutar (2001) through empirical research highlight that functional price value and functionality are dimensions of customer perceived value. Customers who actively participate in value co-creation process can lead to positive emotions and contribute to enjoyment and pleasant experiences.

Customer relationships are an important dimension of customer perceived value (Grönroos, 2000; Berry, 2000). Of importance is customer perceived value from the perspective of relationship marketing (Grönroos, 1997). Perceived value is an emotional bond with product providers when consumers use products, services and feel they have an added value. Gassenheimer et al. (1998) pointed out that whether to continue (cooperation) usually depends on whether the customer is satisfied with the perceived value. If they are not satisfied, they will look for other service providers (Kumar, Hibbard & Stern, 1994). Relationship value is the result of the cooperative relationship to improve the competitiveness of both sides, and value creation is the process of developing trust and finding mutually beneficial results. Any relationship creates some value for both parties. Customer satisfaction is an indicator of the development of a continuous relationship (Anderson & Narus, 1995). Bolton (1998) also noted that service satisfaction has a positive effect on developing and sustaining continuous relationships.

A continuous relationship means that the relationship between one party of cooperation and the other party will continue to be stable and develop over the long term and ensure the existence of the relationship in the future (Anderson & Weitz, 1989). Vargo and Lusch (2004) also point out that in the service-dominant market, intangible resources are exchanged, and enterprises keep close contact with each other. Customer perceived relationship / support value is identified and created value by the buyer and the seller through investment of time, energy and resources. Butz (1996) defined customer perceived value as an emotional bond between the customer and the manufacturer when the customer uses the products or services produced by the supplier and finds that the product provides an additional value. Customers evaluate products

and enterprises through these feelings and cognition, thus forming satisfaction or loyalty (Hu & Yu, 2004) and the importance of focusing on relationships (FP8). The driving factor of customer loyalty is customer value (Zhang, 2003). Customer value perception and solid relationship perception have a direct causal relationship with the success of establishing continuous relationships and customer value perception has a positive effect on customer being engaged in continuous relationships (Liu, 2003).

Value co-creation makes customers (or users) feel better in some ways. (Grönroos, 2008) The value co-creation of customer participation in service affects the perception of service quality, the evaluation of brands, and the repeated purchase and recommendation behaviors (Ostrom, 2010). In the process of participating in production or service, the experience is consistent with the way in which psychological expectations can be realized positively (Wang & Wang, 2006). Grönroos (1982) thinks that service quality is a kind of customer perception. According to Parasuraman et al. (1985), customer perceived value is mainly composed of product quality, service quality and price. Service value is the dimension of customer perceived value (Kotler, 2000). Lewis and Booms (1983) believed that the service provided should be consistent with the service expected by customers.

To summarize, customer perceived value is not only subjective but also dynamic and is determined by the beneficiary with a unique phenomenological method, customers are the only judges of value. That is to say, the perceived value of customers can only be fully reflected in dynamic experience scenarios or specific contexts. Therefore, this thesis studies the PE value co-creation with its operant resources, the dynamic and situational economic value, perceived relationship / support value, perceived core / technical value under the process of resource integration and service exchange. Economic value is the evaluation of the economic benefits of the services provided by customers relative to PEs; relationship / support value is the evaluation of the working relationship and support effectiveness of the services provided by customers relative to PEs. The value of technology / core services refers to the assessment of technical and professional capabilities relative to the services provided by PEs. Therefore, the hypotheses of this thesis are as follows:

H2: Customer participation in value co-creation has a significant positive impact on customer perceived economic value.

H3: Customer participation in value co-creation has a significant positive impact on customer perceived relationship / support value.

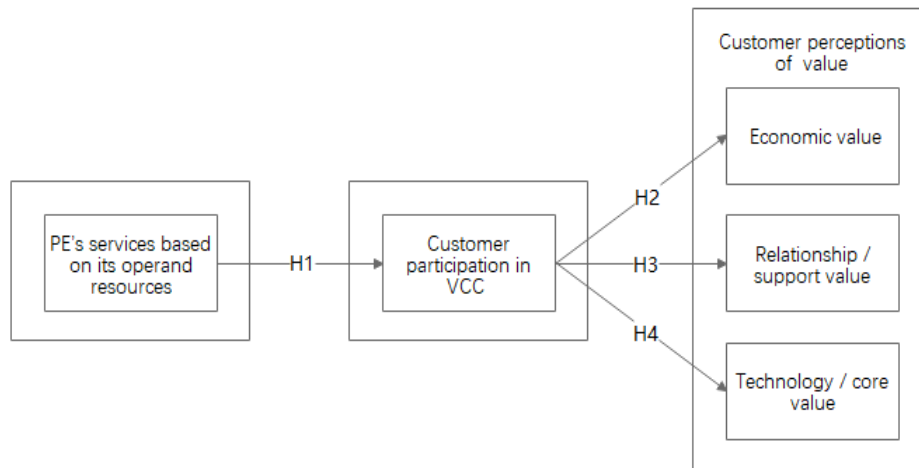
H4: Customer participation in value co-creation has a significant positive impact on customer perceived core / technical value.

2.3.3 Research Model and Hypothesis Summary of Customer Participation

Based on numerous previous studies, especially those conducting empirical research, this thesis studies and clarifies the relevant concepts and logical relations based on the service-dominant logic. Operant resources refer to knowledge and skills, which are often in an active role in production activities; operand resources refer to tangible resources (including goods), natural resources, etc., which are usually in the passive role in production activities; customers participation in PE value co-creation with operant resources; customer perceived value is the value perceived by customers with unique phenomenological methods in the process of value co-creation, in the process of using products or services in the experiential context. Based on these research basis and following the service-dominant logic, the theoretical model logic of customer participation in this thesis is as follows: PE provides basic services for customer participation, and customers participate in the PE value co-creation with operant resources; customers participate in the value co-creation interaction process, carry out resource integration and service exchange with PE, and perceive economic value, support value and technology / core value in the interaction process scenario of value co-creation. As such the path of PE based on operant resources service ---- customer

participation value co-creation ---- customer access perceived value, the relationship model between customer participation constructs is as follows:

Figure2.9: Customer Participation in Value Co-creation (VCC) Research Framework



According to the figure of customer participation in value co-creation process, there are four hypotheses in this whole chapter, which are:

H1: PE's services based on its operand resources have significant positive effects on customers participation in value co-creation

H2: Customer participation in value co-creation has a significant positive effect on customer perceived value of economic value.

H3: Customer participation in value co-creation has a significant positive effect on customer perceived value of perceptions relationship / support value.

H4: Customer participation in value co-creation has a significant positive effect on customer perceived value of technology / core value.

2.4 Methodology

In order to test the proposed hypotheses, the survey method was adopted and used in this empirical study. This was followed by rigorous psychometric analysis as proposed by methodologists Anderson and Gerbing (1988). In psychometric analysis, structural equation modeling is a well-established and dominant quantitative data analysis method which is widely used, which includes education, customer behavior, marketing, information system, organization behavior and many other disciplines (Kline, 1998). It is especially suitable for testing causal relationships amongst psychological perceptions which are not directly observable to researchers; so, compared with conventional statistical methods (such as correlation analysis), it can test the hypothesis of complex relationships among many variables (Xu, 2011). The traditional multiple regression statistics cannot explain the complex reality, but SEM allows us to identify the complex path model through explore and predict the relationship of multiple variables, finally find out the causal model among variables. Therefore, this research will use SEM method to focus on relationships between customer participation value co-creation, customer perceived value and the development of continuous relationships between GP and LP.

In addition, as we know SEM method must requires to know that the variables are correlated before hypothesis test through prior research. In the sense of this point, SEM is a confirmatory analysis method rather than an exploratory analysis method. Consequently, in order to find out more significant variables during PE value co-creation process and improve structure of this research model, SPSS as research tool will be used in the future research to do more exploratory factor analysis.

2.4.1 Research Method

In psychometric analysis, in order to test hypotheses, an instrument is developed to measure people's perceptions of interest, such as using a questionnaire. People's perceptions of an object are called constructs or latent factors and are psychometric

variables. A construct is assumed to be an unobservable direct factor, which manifests in different ways. For example, we cannot directly observe how people make choices amongst so many different available PE funds, but we can ask them different questions regarding the PE fund service quality, PE fund revenue status in order to implicitly determine their reasons. Responses to those questions are the manifestations of the customer (LP) perception value construct. The questions are known as items or scales; and they reflect the different angles of the construct. This is to measure customer's choices and reasons for joining the PE fund value co-creation construct, survey participants might be asked about their education and occupational background, relative experience, industrial knowledge and other relevant professional skills. Multiple questions are better than a single question. With multiple questions the construct underlying all the questions can be extracted using statistical procedures such as factor analysis to produce a more accurate measure of a subject's true perceptions (Nunnally & Bernstein, 1994). With single questions on the same construct, you can only observe a single aspect, and other possible manifestations of why customers join value co-creation are able to be accounted for. Indeed, the concept of construct isn't new to information and statistics scientists. When all constructs are measured with multiple questions in a survey, the relationships among them can be deduced.

It is recommended that a researcher should reuse existing questions designed by others for the same construct in research where their effectiveness has been proven, (Nunnally & Bernstein, 1994). Because there has been no previous study using a psychometric instrument in Private Equity Fund industry, this thesis developed all questions in this study based on the following ways. First one was through focus group discussion, where invited experienced PE fund management staff discussed the construct which was provided. The output of this discussion was used in order to find out suitable measurement items. Secondly, this thesis developed all questions on our literature review and definitions of the three core concepts, which are GP and LP value co-creation, customer perceptions value, and continuous relationships. Moreover, all the questions used the Likert Scale method, which means there are five anchoring points on the scale, with one on value zero, one on value one until one on value five. For

example, a question measuring GP and LP value co-creation was LP or customer have a lot of experiences to respond to the demand from PE. (1-Definitely disagree, 2-Mostly disagree, 3-Uncertainty, 4-Agree, 5-Definitely agree). The complete questionnaire is in Appendix. 1. Thirdly, there are relevant research in different industry. The research measurement items, which are mature to be as reference of our research. Finally, the initial measurement items were pre-investigated. A pre-adjusted questionnaire was sent to some senior members of the PE community, and 20 valid questionnaires were received. After analysis and modification of the pre-survey questionnaire during pilot study, two items were reduced, and the number and content of the items were optimized.

To ensure that items reflected the intended construct, content validity should be checked first. The position here is to assume that all the possible manifestations of a construct collectively inform the population of question, content validity is the degree to which the questions used in a survey for a construct provide representative coverage of the population. The questions used were to a large degree the rephrasing of different aspects of a construct as defined in the literature. This provided the basis for content validity. Finally, the use of the validity check method to double check all measurement items, and the process will combine the focus group discussion method mentioned above. Feedback was utilized in order to make changes and adjust the survey where needed.

2.4.2 Sampling and Data Collection

Target groups

In economics and other social sciences, researchers tend to study the interests of a group, but the number of studies corresponding to this group can be quite large, and the study itself is affected by geographical, financial, human resources and other factors in order to achieve a full range of coverage. Even if it can achieve a large area of coverage of the survey population, due to the limitations of the budget and other reasons the cost on each unit is too low, and the survey data obtained may not necessarily be accurate and reliable. Sample surveys are therefore a necessary means of data collection, and

samples can also represent the population, although the reliability and validity of the samples need to be guaranteed, thus ensuring the quality of the survey and the conclusions reached.

The object of this paper are the private Equity investment funds in China, so the GP, LP and also fund-related practitioners are the target group of our survey, and the extension of the sample may also include the potential customers who have a desire to join PE funds.

Sampling method

After the study group was established, the research needed to establish the range of sampling involved in terms of the target population. For example, we avoided samples coming from the same PE fund management company or from a local area of PE practitioners. The choice of every individual was independent, meaning that the selection of one individual did not affect the probability of the selection of another individual. Given that the author has worked in private equity funds in Beijing, Shanghai and Chengdu, the size of private equity in these three places can fully represent the situation of private equity funds in China. According to statistics issued in 2016 China's private equity management total scale was 10.21 Trillion RMB, of which Shanghai comprised 2.38 Trillion RMB, Beijing 2.39 Trillion RMB and Chengdu 8000 Billion RMB, which accounted for 50% of the total size (Xu, 2016). Therefore, the issuance of this questionnaire was carried out in these places.

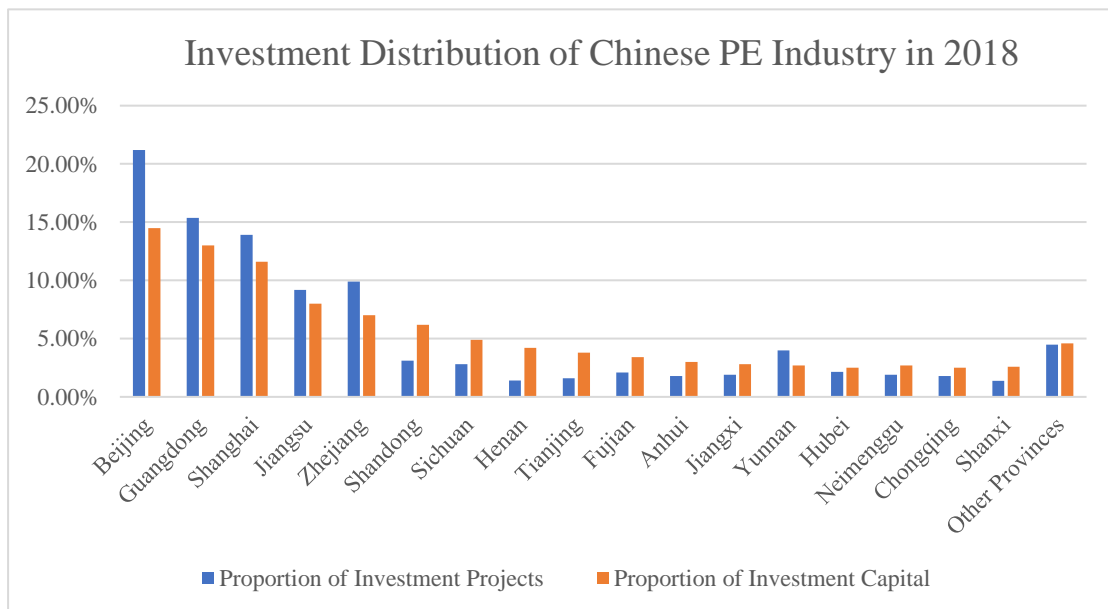
Secondly, to focus on the sample size. In this thesis, SEM structural equation was used to analyze the statistical data. The analysis is based on the covariance matrix, so the parameter estimation of chi-square test and fitness is very sensitive to the sample size. 200 samples can be regarded as a medium-sized sample. In order to generate stable SEM analysis results, the best number of samples is more than 200 (Velicer & Fava, 1998). Muller (1997) believes that the standard sample size of SEM analysis is at least more than 100, and more than 200 is better. Although SEM analysis with large sample numbers are better, new statistical test methods allow research sample lower than 60 (Tabachnick & Fidell, 2007). Hoelter (1983) puts forward the critical sample number (CN), the index value of sample size. The critical number of samples refers to the lowest

sample size to get the degree of fitness of a research model based on statistical test. When the CN value is greater than 200, it means that the research model can properly reflect the characteristic of the actual samples. Therefore, the final sample size of this study is 232, which meets these standards. The sample data is described in section 2.5.1 in detail.

2.4.3. Distribution and Recovery of Research Questionnaires

The main areas investigated in this questionnaire were Beijing, Guangdong, Shanghai, Jiangsu, Zhejiang, Shandong and Sichuan, where PE is developed and has the largest market in China. The main respondents were GP, LP and PE management staff, as well as customers (individuals and enterprises) who wanted to participate in PE. The questionnaire was an online type, which was easily received and answered by smartphones and computers.

Figure 2.10: Investment Distribution of Chinese PE Industry in 2018



Source: Association of Chinese Security and PE Investment Fund (2019)

With the help of Tencent's social survey website and WeChat (Chinese WhatsApp) community, Tencent is the China's largest Internet integrated services and services company with the largest number of users. Online questionnaire distribution ensure

access was achieved to representative individuals comprising a sample of the target group. Tencent Questionnaire Professional Website and WeChat Community have more than 300 million real name registered users. On this basis, Tencent Questionnaire Professional Website has established various professional registration questionnaires answering groups, which are willing to share attitudes through registration and have been filtered through big data for a long time. Their professional level and ability have become an important application tool for social surveys with numerous research institutions, universities and enterprises. For instance, it helps Fudan University, Shanghai Jiao Tong University for academic cooperation for many years. It is one of the most popular research tools among graduate students in China. Moreover, it helps Mercedes-Benz, Porsche and Ford for customer satisfaction survey as well.

This research utilized the WeChat community to distribute online questionnaires to GP, LP and PE management staff and colleagues who have long-term working relationships in PE in China. In order to achieve the precise delivery of the questionnaire, each person was granted permissions to answer only one online questionnaire. Tencent Questionnaire Professional Website provides a dedicated information channel to receive the information collected from questionnaires in a unified way. The survey tools provided surpass the traditional ones in terms of questionnaire design, convenience and completeness of questionnaire answers, time of questionnaire recovery, pertinence of the objects to be distributed.

Finally, SEM (structural equation modeling) was used as an analysis theory for this research. Structural equation Modeling is a kind of mathematical model presenting objective states, which is mainly used to test the hypothesis relationship between observation variables and latent variables. It combines two techniques of factor analysis and path analysis (Bollen & Long, 1993). SEM adopts the confirmatory factor analysis method, which is more accurate and detailed than the traditional exploratory factor analysis method (Kelloway, 1998). In addition, SEM has been used to find out determine the fitness between the hypothesis model and the sample data. This statistical analysis study evaluates whether the hypothesis model structure proposed by the researcher can be applied to the real sample data, it is the adaptability test as well (Byrne,

2001).

2.4.4 Data Analysis Method

Regression analysis is typically used to find a relationship between a dependent variable (y) and an independent variable (x) or a set of independent variables (x_n). The relationship is fitted into a curve that represents dependent variables (y) and independent variables (x)(Relationship) which corresponds to the law of change, that is: $Y=A+BX$. Typically, there are multiple independent variables x_n , only one dependent variable y, and the data is a quantization value that can be tested directly utilizing regression analysis.

In social research and the study of certain social problems, we usually cannot obtain quantitative independent variables to study the social problems involved. Many times, we can detect a result and infer that the result is related to some reason (factor-see later definition). For example, we may intend to analyze the reasons why certain people like running (results-because of variables), we know roughly that people like to run because due to their hobbies, have to run because of physical needs, have to run during the run to socialize, or run as an opportunity to participate in community activities and so on. There may be several reasons for liking running, but what exactly is the (main) cause (factor) associated with it and what is the degree of relevance of the various factors?

We often perform social surveys to analyze these questions for example to determine what the reason is that people like running with answers based on the data obtained. When doing a survey, we tend to find causality by assuming that certain behaviors are related to certain causes, that is, hypothetical, and through investigation and analysis, determine whether our assumptions are valid. Social statistics correspond to psychological variables-also known as theoretical components. We can reverse analysis the dependent variable y (result, or like the act of running) and the independent variable X (factor), this whole process is called factor analysis. However, because it is a psychological variable, often not an exact amount, different people may have different

interpretations of the results and come to divergent conclusions.

Psychological variables (Factor) are not a single concept, but a corresponding set of concepts. By refining these concepts, these concepts form the so-called conceptual space of the psychological concept. Obviously, the concept of conceptual space refinement is bound to be different in the way it should be expressed. Different expressions are designed to be investigated by questionnaire for different factors, and to measure those expressions can be reflected that we need to know, but we can't measure it directly. These questions to test expression factors are called Measurement items. Questionnaires designed with multiple measurements can better and more comprehensively reflect the actual psychological perception of a survey subject. For example, in this research topic, it is based on previous research to develop the following measurement items to find out the relationship (or prove the hypothesis) among each factor in quantitative way, in section 2.5.4.

At present, LISREL and AMOS are the most suitable application software for structural equation modeling analyzing. Although the output report of LISREL provides very rich index parameters, it is difficult for normal users to use, because they need to write computer commands and matrix parameters. AMOS is the abbreviation of analysis of motion structure, which is mainly used for the analysis of SEM, analysis of covariance structures or casual modeling. The interface of AMOS is graph based, which means users only needs to understand the drawing of causality diagram of theoretical model and the setting of basic parameters. More and more researchers use AMOS as a research tool for structural equation modeling analysis (Wu, 2010). Therefore, this thesis is uses software AMOS for data analysis after the questionnaire collection.

2.4.5 Measurement Items

The following tables illustrate research variables and relevant measurement item of this research. The abbreviations (identifier) of variables and items are also shows in this table, and section 2.5 and 2.6 apply abbreviations to make the data analysis.

Table 2.6: Research Variables and Measurement Items

Variables	Identifier	Measurement Item	Scale sources
Customer participation in value co-creation (Based on customer's Operant Resource)	COR		(Constantin and Lusch, 1994); Hunt (2004)
	CO1	Customers or LP have a lot of relevant experience to respond to the needs of PE	
	CO2	Customer participation in PE value co-creation will use a lot of knowledge	
	CO3	Customer or LP have enough industry knowledge.	
	CO4	Customer or LP have professional skills to respond to the needs of PE.	
	CO5	Customer or LP use his knowledge to provide service for PE.	
PE provide service (Based on PE's on operant resources)	POR		
	PO1	PE can configure the appropriate conditions according to the needs of the customer.	
	PO2	A lot of knowledge is used in the services provided by PE.	
	PO3	PE has a lot of relevant experience to respond to customer needs.	
	PO4	PE have enough industry knowledge	
	PO5	PE has professional skills to respond to the needs of Customer.	
Customer Perceived Economic Value	CVE	Compared with other PE s , this PE's (Private equity funds you participate in or intend to join) .	Liu, Annie (2006) ; Liu (2014)
	VE1	provides the best value.	
	VE2	provides better value for the money.	
	VE3	provides high cost performance ratio products.	
	VE4	charges a reasonable price for the services provided.	
Customer Perceived Relationship/Support Value	CVS	Compared with other PEs, this PE's (Private equity funds you participate in or intend to join)	
	VS1	has a better working relationship with customers.	
	VS2	responds to our service needs more promptly.	
	VS3	Collect feedback from customers when necessary.	
	VS4	keeps customers better informed of new developments in PE industry.	
Customer Perceived Technology/Core Value	CVC	Compared with other PEs, this PE's (Private equity funds you participate in or intend to join) .	
	VC1	are more competent.	
	VC2	are more professional.	
	VC3	have better overall job performance.	
	VC4	have better attitudes on the job.	

2.5 Empirical Analysis

Under the structural equation model (SEM) theory, SPSS statistics and IBM SPSS AMOS (V.24) software were used to analyze and verify the collected data and test research hypothesis.

This research studies PE customer participation value co-creation of equity investment funds, and the objects of the research are individuals or enterprises who accept or intend to accept PE products or services. The items of the questionnaire in this study were mainly used to verify the theoretical model, which was mentioned in the previous chapter. They are supported by many theoretical and academic studies. The measurement items are relatively mature, and they were selected and established after consultation and discussion with industry experts. The questionnaire was mainly based on an online questionnaire, which made full use of the characteristics of professional social survey online questionnaires, quickly and accurately placed into the smart phones or computer terminals of the respondents, effectively delivered and recycled, and processed the data with the application of professional software.

2.5.1 Data description and Statistics

The results of statistical analysis of individual characteristics are as follows:

Table 2.7: Data Description

Category	Classification	Quantity	Percentage
Personnel Structure	General Partner	53	22.84%
	Limited Partner	16	6.90%
	Management Staff of PE	50	21.55%
	Customers willing to join PE	113	48.71%
Working Time in PE Industry	Not yet	107	46.12%
	Less than 1 years	41	17.67%
	2-3 Years	39	16.81%
	3-5 Years	26	11.21%
	More than 5 years	19	8.19%
Education Background	High school / The Secondary school / Technical School	12	5.17%
	Professional training College	34	14.66%
	Undergraduate	134	57.76%
	Postgraduate	45	19.39%
	Doctoral Degree or above	7	3.02%

- Personnel Structure of Investigation
- The total number of survey samples was 232, including 119 general partner GP, LP and management staff who have already worked in PE fund, accounting for 51.29%, which is equivalent to 113 customers who are willing to join PE; 53 general partners, accounting for 22.84%, which is the research object of this thesis, the rest of LP accounting for 29.74% in total. The representativeness of the sample structure was suitable for this research.
- Working Time in PE Industry of Instigator
53.88% of the respondents had work experience in PE, 36.21% of them had more than 2 years of work experience. Their participation is undoubtedly very beneficial to the quality assurance of the questionnaire in this thesis.

- **Education Background**

80.17% of the respondents had bachelor's degree or above, 22.41% had master's degree or above, including 7 doctors. The participation of highly educated people in the questionnaire provides a favorable guarantee for the data obtained in this research.

2.5.2 Data Normal Distribution Test

In empirical research, maximum likelihood estimation (MLE) is a statistic method of estimating the parameters of a probability distribution by maximizing a likelihood function, so that it is using to test a research model and whether observed data is most probable or not. In this chapter, AMOS (V24.0.0) and SPSS (V22.0.0.0) is used as the analysis tool using the MLE method to test fitness of research model. This method requires that the sample size is large enough and the data should obey multivariate normal distribution (Wu, 2009) In this research, the number of survey samples was 232, and the data of normal test of each observation variable was as follows:

Table 2.8: Assessment of Normality

Variable	min	max	mean	skew	kurtosis
PO1	1	5	3.67	-1.17	1.35
PO2	1	5	3.97	-1.17	1.86
PO3	1	5	3.89	-1.16	2.22
PO4	1	5	3.89	-1.10	1.93
PO5	1	5	3.91	-0.66	0.46
CO1	1	5	3.72	-0.88	0.82
CO2	1	5	3.86	-0.88	1.37
CO3	1	5	3.69	-0.83	0.60
CO4	1	5	3.54	-0.53	-0.14
CO5	1	5	3.78	-0.82	0.77
VE1	1	5	3.54	-0.65	0.49
VE2	1	5	3.63	-0.43	0.04
VE3	1	5	3.63	-0.61	0.42
VE4	1	5	3.61	-0.60	0.42
VS1	1	5	3.72	-0.81	0.84
VS2	1	5	3.72	-0.83	0.78
VS3	1	5	3.70	-0.67	0.29
VS4	1	5	3.79	-0.86	1.05
VC1	1	5	3.77	-0.47	-0.07
VC2	1	5	3.81	-0.65	0.52
VC3	2	5	3.81	-0.38	-0.26
VC4	1	5	3.79	-0.71	0.70
Multivariate					205.151

As we know the standard normal distribution has a skew which equals 0 and kurtosis which equals 3.0 respectively. However, these standard skew and kurtosis may not be very useful in large samples because even slight differences from normal distribution may also be statistically significant for the research (Kline, 1998). There are numerous previous studies which give us a different normal distribution criterion, though these are based on computer simulation studies of estimation methods used by SEM computer programs. According to the research results of Kline (1998), variables with absolute values of skew index less than 3.0 and where kurtosis is less than 8.0, it can be determined that the sample data basically obey the normal distribution. The absolute value of skew is more than 3.0 and kurtosis index greater than 10.0 may suggest a problem, and values greater than 20.0 may indicate a more serious one.

As shown in the table, the absolute values of skewness and kurtosis of the survey sample data in this research meet the requirements of normal distribution for further testing.

Moreover, there is an alternative test for normality. Mardia coefficient (Mardia & Foster, 1983) is the value in the multivariate kurtosis line of assessment of normality in Amos software. If $Mardia < P(P+2)$, it means the sample data basically obey the multivariate normal distribution (Bollen, 1989). According to table 2.8, it is easy to get that $Mardia = 205.151$, P means sum of total variables ($P=22$), so $P(P + 2) = 528$, $Mardia < P(P+2)$, the research sample data obey normal distribution.

2.5.3 Model Testing

This section focusses on model testing, which mean discussing the fit issue dealing with the research model. The goodness of fit index refers to the degree of consistency between the research model and the actual data.

There are many different suggestions on the evaluation of model fit, but the arguments of scholars Bagozzi and Yi (1988) are the most comprehensive. They suggest that if the hypothetical model and the actual data have good fit index, the following three aspects should be considered at the same time: preliminary fit criteria, the overall model fit and the fit of internal structural model. Bagozzi and Yi (1998) subdivided the overall model fit into absolute fit indexes, relative fit indexes and parsimonious fit indexes. In addition, Hair (1998) also divided the overall model fit evaluation into three categories: absolute fit measurement, incremental fit measurement and parsimonious fit measurement. When evaluating the fitness of the model, it is better to consider the above three indicators at the same time, to produce a consensus result on the acceptability or rejection of the model.

SEM method analysis can evaluate whether the hypothesis model proposed by researchers is compatible with the actual data. Model-fit evaluation indexes and standards are as follows:

Table 2.9: SEM overall model goodness of fit evaluation indexes and standards

Statistic inspection value	Fit standard or critical values	Reference
Absolute Fit Indexes		
χ^2	Significant probability value $p>0.05$	Wu ,2009 Rigdon,1995
GFI (goodness-of-fit index)	>0.9	Yu, 2006
AGFI (adjusted goodness-of-fit index)	>0.9	Hu & Bentler,1999 Bollen & Long,1993
RMR (root mean square residual)	<0.05	Cudeck & Henly,1991 Stevens, 1996
RMSEA (Root mean square error of approximation)	< 0.05 (good fit) < 0.08 (reasonable fit)	Hu & Bentler,1999 Mc Donald & Ho,2002
Relative Fit Indexes		
NFI (normed fit index)	>0.90	Bentler,1995
RFI (relative fit index)	>0.90	Bentler,1995
IFI (incremental fit index)	>0.90	Bentler,1995
TLI (NNFI) (Tacker-lewis index=non-normed fit index)	>0.90	Qiu,2005
CFI (comparative fit index)	>0.90	Hu & Bentler,1999 Bollen & Long,1993
Parsimonious Fit Indices		
PGFI (parsimony goodness-of-fit index)	>0.50	Huang,2005
PNFI (parsimony-adjust NFI)	>0.50	Yu, 2006
CN (Critical number of sample)	>200	Hoelster,1983
NC ((χ^2 /Freedom, Normed chi-square)	<2	Wheaton,1987, Huang, F. M., 2005

In the table, χ^2 refers chi-square value of research model, when $\chi^2=0$ means it is perfect fit for research model and data. However, there is a problem along with sample increase, the chi-square will increase too, especially in a large sample. Therefore, $P > 0.05$ is a key point, which means the possibility of discrepancy between research model and actual data is very low.

According to the previous research on criteria of goodness fit index, it is easy to test fitness of our research model. The fit indexes show in follow table:

Table 2.10: Test Data and the Fit Judgment of the Research Model of Customer Participation in Value Co-creation

Statistic Inspection value	Fit Standard or Critical Values	Test Results Data	Model Fit Judgment
Absolute Fit Indexes			
χ^2	Significant probability value $p > 0.05$	145.915 (P=0.579)	Yes
GFI	>0.90	0.945	Yes
AGFI	>0.90	0.908	Yes
RMR	<0.05	0.035	Yes
RMSEA	<0.05(good fit) <0.08(reasonable fit)	0.000	Yes
NCP	The smaller the better, the 90% confidence interval contains ZERO	0.000	Yes
Relative Fit Indexes			
NFI	>0.90	0.952	Yes
RFI	>0.90	0.925	Yes
IFI	>0.90	1.001	Yes
TLI (NNFI)	>0.90	1.002	Yes
CFI	>0.90	1.000	Yes
Parsimonious Fit Indexes			
PGFI	>0.50	0.561	Yes
PNFI	>0.50	0.618	Yes
CN	>200	232	Yes
NC	<2	0.973	Yes

The results illustrate that the model has a high goodness of fit with actual data. Therefore, it can get the hypothesis test result through this research model.

2.5.4 Reliability and Validity Analysis

The goodness of fit index can be said that is the analysis the external quality of the research model. The degree of the fitness of the internal structure of the model represents the reliability and validity of each measurement Items. It is the test of the internal quality of the model.

Bollen (1989) proposed component fit measures to explain the fit of internal

structural index of the model. He thought that research model and actual data has good fit index, but the individual measurement item may be meaningless. Therefore, it is better to test each item to ensure the fit of the model. The evaluation of internal structural fit includes the following two aspects: one is the evaluation of measurement model; the other is the evaluation of structure model. The former focuses on whether the measurement variables are enough to reflect the corresponding latent variables, and its goal is to understand the validity and reliability of the latent construction; the latter is to evaluate whether the causal relationship defined in research model.

In the measurement of fitness of the model, researchers have focused on the relationship between latent variables and their indicator variables (such as explicit variables). Validity reflects the actual measurement degree of the index variable. Reliability refers to the consistency of measurement. Only when we believe that the measurement is accurate, then we can further explore the relationship between latent variables.

Reliability

Reliability usually focus on consistency, stability and reliability of measurement results. It indicates the possibility of using the same observation method to obtain the same observation data (results) for the same object (Li, 2004). Cronbach's alpha coefficient and composite reliability are usually used for reliability tests. The best composite reliability is above 0.7 for Cronbach's α reliability coefficient (Hair et al., 1998).

Composite reliability can be used as a reliability index of structural equation to test potential constructs, which is also known as construct reliability. It is the value calculated by standardizing the index factor load and error variation of the estimated value. The composite reliability mainly evaluates the consistency of a set of latent construct indicators. This reliability index belongs to internal consistency index. The higher the composite reliability is, the higher the internal correlation exists between the measurement indexes. Generally, the composite reliability coefficient values are all above 0.60, indicating that the internal quality of the model is good (Bogozzi & Yi,

1988).

Although there is not a criterion for composite reliability to judge whether the research model has good internal structure, most of studies adopt the following classification points as the basis for discrimination. According to Kline (1998), he proposed that where the value of composite reliability coefficient above 0.90 means composite reliability is excellent; near 0.80 is very good; near 0.70 is moderate; above 0.50 is the minimum acceptable range; if the reliability is lower than 0.50, it means more than half of the observed variation is from random error, and the reliability is slightly insufficient at this time, so it is better not to accept. Generally, the composite reliability coefficient values are all above 0.60, indicating that the internal quality of the model is good (Bagozzi & Yi, 1988).

Validity

Validity indicates the degree of authenticity and accuracy of a study. There are many methods to test validity. The content validity and construct (also known latent construct) validity are commonly used validity testing tools.

Content Validity

Content validity refers to the extent to which the measured content reflects or represents the construct that the researcher wants to measure. It is usually judged by experts that is to say; relevant experts make a judgment on the conformity between the test questions and the original content range; or use quantitative statistical analysis to evaluate the content validity of measurement items. The measurement content of this thesis mostly comes from the previous mature research results and published papers by many researchers investigating this area. Base on these previous researches, this thesis applies PE industry expert and focus group discussion method to improve measurement items.

Construct-related Validity

Construct-related validity refers to the consistency between the definition and

measurement of construct, which is composed of convergence validity and discriminant validity (Chen et al., 2008).

- **Convergent validity**

Convergent validity refers to the degree to which a test can measure a theoretical construct or its characteristic, that is, whether the test results can confirm or explain the hypothesis, term or construct of a theory (Wu, 2009). In the application software of AMOS, the factor load of all indicators in each measurement item is highly significant (Table 2.11), and the average variance extracted value AVE (average variance extracted) is greater than 0.5, it means that the data has a high convergence validity.

Table 2.11: Criteria of Factor Load

Factor Loading	(Factor Loading) ²	Status
0.71	0.50	Excellent
0.63	0.40	Very good
0.55	0.30	Good
0.45	0.20	Normal
0.32	0.10	Poor
Lower than 0.32	-----	Fail

Source: Qiu & Lin, (2009). *Principle and application of structural equation model*

In the fitness evaluation of SEM, the evaluation of the model measurement part should be prior to the evaluation of the model structure part, so the validity test of the index variables should be carried out first. The validity analysis is the significance of the path between the latent variable and its indicator variable, and the path coefficient here is the factor load (Wu, 2009).

- **Discriminant Validity**

Discriminant validity refers to the existence of significant differences or low degree correlation between indicators in different constructs. There are many methods to evaluate the discriminant validity. In AMOS software, the AVE (average variation extracted) method and SEM method proposed by can be applied conveniently (Ping 2005).

Average variation extracted method was proposed to check whether the AVE in

each construct is greater than the determinant coefficient (square of correlation coefficient) among them, to test the discriminant validity (Fornell & Larcker, 1981). That is to say, if the AVE of an individual construct is greater than the determinant coefficient (the square of normalized correlation coefficient) of this construct and all other constructs, there is a difference between them.

In SEM, in order to find the discriminant validity between two construct, we use a single group to generate two models, which are unconstrained model A (the covariance between constructs is unrestricted, which is a free estimation parameter) and constrained model B (the covariance between constructs is limited to 1). The null hypothesis and the opposite hypothesis tested are as follows:

Null hypothesis: Model A = Model B

Alternative hypothesis: Model A \neq Model B

After AMOS's calculation, if the significance P value of chi-square difference between the two models is less than 0.05, the null hypothesis of no difference between the two models is rejected. If the significance P value of chi-square difference between the two models is greater than 0.05, then we cannot reject the null hypothesis of the two differences; If the increase of NFI, IFI, RFI and TLI is less than 0.05, the null hypothesis that there is no difference between the two models was supported (Little, 1997; Wu, 2009).

AMOS is applied to verify the factor analysis of this research model. It gets composite reliability, Cronbachs' α coefficient and AVE coefficient through the calculation about factor load of variables and test items (See Table 2.12). And comparison between variable's AVE and square of construct's standardized correlation coefficient is shown in Table 2.13.

Table 2.12: Reliability and Validity Test

Variables	Measurement Item	Factor load and P	(Factor load) ²	Cronbachs' α	Composite Reliability	AVE
Customer Perceived Relationship/Support value (CVS)	VS1	0.796***	0.634	0.835	0.825	0.540
	VS2	0.741***	0.549			
	VS3	0.618***	0.382			
	VS4	0.771***	0.594			
Customer Participation in Value Co-creation (COR)	CO1	0.766***	0.587	0.865	0.844	0.520
	CO2	0.729***	0.531			
	CO3	0.737***	0.543			
	CO4	0.715***	0.511			
	CO5	0.652***	0.425			
PE Provide Service Based on its Operant Resources (POR)	PO1	0.683***	0.466	0.844	0.856	0.550
	PO2	0.677***	0.458			
	PO3	0.832***	0.692			
	PO4	0.728***	0.530			
	PO5	0.760***	0.578			
Customer Perceived Economic Value (CVE)	VE1	0.658***	0.433	0.838	0.809	0.524
	VE2	0.824***	0.679			
	VE3	0.849***	0.721			
	VE4	0.511***	0.261			
Customer Perceived Technology/Core Value (CVC)	VC1	0.775***	0.601	0.815	0.853	0.593
	VC2	0.809***	0.654			
	VC3	0.723***	0.523			
	VC4	0.770***	0.593			

Note: *** means $p \leq 0.001$

It can be seen from table 2.12 that, according to the judgment criteria, this research 22 factor loads and factor load squares of construct measurement items are good and above except that 1 item is “normal” of the criteria, and the average variance extracted value AVE is all greater than 0.50, indicating that the data has a high convergence validity. Moreover, according to the analysis of table 2.12, it is easy to see that in the reliability and validity test the Cronbachs' α are all above 0.70 and composite reliability coefficient are all above 0.80. The AVE values are all above 0.5. That means the research model has good internal quality and good convergent validity.

Table 2.13: Comparison Between Variable's AVE and Square of Construct's standardized Correlation Coefficient

Variables	CVE	CVS	CVC	POR	COR
Customer Perceived Economic Value (CVE)	0.524 (AVE)				
Customer Perceived Relationship/Support value (CVS)	0.599	0.540 (AVE)			
Customer Perceived Technology/Core Value (CVC)	0.496	0.778	0.593 (AVE)		
PE Provide Service Based on its Operant Resources (POR)	0.317	0.473	0.446	0.550 (AVE)	
Customer Participation in Value Co-creation (COR)	0.407	0.371	0.251	0.504	0.520 (AVE)

Fornell and Larcker (1981) proposed that if the AVE of an individual construct is greater than the square of the standardized correlation coefficient between this construct and all other constructs, there is a difference between constructs. The comparison results in table 2.13 show that the AVE of most constructs is greater than the square of standardized correlation coefficient with other constructs, and the difference validity is significant. However, the square of correlation coefficient between CVE and CVS is 0.599, which is larger than its AVE 0.524. The same situation between CVS and CVC is 0.778, which is larger than its AVE 0.540. In order to further determine their discriminant validity, SEM method is adopted as follows.

Firstly, it focusses on analysis between customer perceived economic value (CVE) and customer perceived relationship and support value (CVS). The comparison of nested models is as follows:

Table 2.14: Nested Model Comparisons (CVE&CVS)

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
The Constrained Model	1	57.004	0.000	0.064	0.065	0.083	0.086

The degree of freedom difference between the two constructs of customer perceived economic value and customer perceived relationship and support value is 1, and the difference of chi-square value is equal to 57.004 ($P = 0.000 < 0.05$); the increase

of NFI, RFI, IFI and TLI values is not less than 0.050, rejecting the null hypothesis that the two constructs have no difference. There is a difference with discriminant validity between the two constructs.

Secondly, it focusses on analysis between customer perceived technology and core value (CVC) and customer perceived relationship and support value (CVS). The comparison of nested models is as follows:

Table 2.15: Nested Model Comparisons (CVC&CVS)

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
The Constrained Model	1	43.885	0.000	0.048	0.049	0.062	0.064

The degree of freedom difference between the two constructs of customer perceived economic value and customer perceived relationship and support value is 1, and the difference of chi-square value is equal to 43.885 ($P = 0.000 < 0.05$); the increase of NFI and IFI near the 0.05, RFI and TLI values is more than 0.05, rejecting the null hypothesis that the two constructs have no difference. The discriminant validity between the two constructs is obviously.

Therefore, through a comprehensive analysis and test of reliability and validity, the measurement items of customer participation value co-creation mostly come from mature research results and published papers by many researcher, based on these previous researches, this thesis apply PE industry expert and focus group discussion method to improve measurement items, it provides a solid base for this research. The composite reliability and Cronbach's α coefficient of the five related dimensions are all greater than 0.7, and the AVE value is also greater than 0.5, indicating that the research model of customer participation in PE value co-creation has better internal and external quality. Moreover, the factor loads and the square of factor loads indicates that the data has good convergence validity. In the last part, discriminant validity test also provides a reasonable result in this section. It is believed that the following hypothesis test result will show a comprehensive content to us through this research methodology.

2.5.5 Hypothesis Test Results

Applying the results of the structural equations model (SEM) by AMOS, the standardized path coefficient estimates between the conceptual models are shown in the table:

Table 2.16: The standardized path coefficient estimates between the conceptual models

Path Relationship	Path coefficient β	T	P	Hypothesis Test
Customers participation in value co-creation <--- PE's services based on its operant resources	0.792	7.010	***	H1 was Supported
customer perceived technology / core value <--- Customers participation in value co-creation	0.659	7.180	***	H2 was Supported
customer perceived economic value <--- Customers participation in value co-creation	0.746	6.721	***	H3 was Supported
customer perceived relationship / support value <--- Customers participation in value co-creation	0.819	7.588	***	H4 was Supported

Note: *** means $P \leq 0.001$

According to the test data in the table above, the hypothesized are supported

2.6 Data Discussion and Results

2.6.1 PE Service and Customer Value Co-creation Based on Operant Resources

Service dominant logic focuses on the use value of products or services, and the use value is jointly created by customers and enterprises, which is value co-creation. The key to value creation is to mobilize customers to cooperate in production (Normann & Ramirez, 1993). In the process of PE value co-creation, PE as the vehicle of service exchange platform, on the one hand, invests needed resources for service; on the other hand, it provides services for the integration of resources brought by customer participation and its own resources; thirdly, operand resources are transformed by operand resources to form value (Baron, et al., 2010) and to provide guarantees for value

co-creation efficiency. Participants gain benefits from the exchange of services processes. Based on the empirical results, this thesis supports the theoretical research of service dominant logic, which is that PE services based on its operant resources has a significant positive impact on customer value co-creation with operant resources. ($\beta = 0.792, t = 7.010, P < 0.001$)

2.6.2 Analysis the Impact Factors of GP and Customers on the Customer Participation Value Co-Creation Process

According to the methodology discussed in this thesis, Spss22.0.0.0 was used to analyze the influence of GPs and customers on the factors important to customer participation in value co-creation. The results of the analysis (Table 2.17) show that there is no significant difference in the mean value of GPs and customers' influence on value co-creation factors for customers' participation with operant resources. That is to say, the opinions of GP and customers on customers' participation in value co-creation with operant resources are similar; the mean value and distribution data of each test item are also similar, and the majority of "agree" items were selected (see table 2.18), which further shows that GPs and customers' recognition of customers' participation in value co-creation is beneficial for both sides.

Table 2.17: Average value T test of GP and Customer in Customer Participation Value

Co-creation

Measurement Item		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Customers or LP have a lot of relevant experience to respond to the needs of PE	Equal variances assumed	-.284	163	.776	-.046	.160
	Equal variances not assumed	-.255	81.266	.799	-.046	.178
Customer participation in PE value co-creation will use a lot of knowledge	Equal variances assumed	-.864	163	.389	-.124	.143
	Equal variances not assumed	-.752	76.086	.454	-.124	.164
Customer or LP have enough industry knowledge.	Equal variances assumed	1.548	163	.124	.257	.166
	Equal variances not assumed	1.494	96.037	.139	.257	.172
Customer or LP have professional skills to respond to the needs of PE.	Equal variances assumed	-.531	163	.596	-.087	.164
	Equal variances not assumed	-.494	87.899	.622	-.087	.176
Customer or LP use his knowledge to provide service for PE.	Equal variances assumed	-.228	163	.820	-.035	.151
	Equal variances not assumed	-.203	79.293	.840	-.035	.170

Table 2.18: Measurement Items distribution comparison of GP and customer in
Customer participation value co-creation

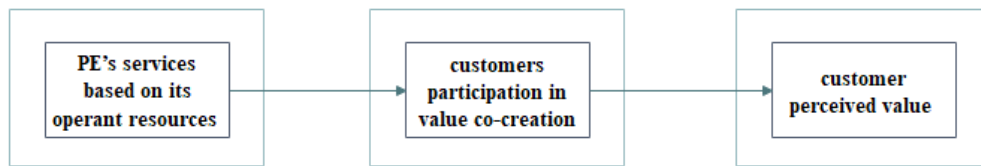
		Mean	Definitely disagree %	Mostly disagree %	Uncertainty %	Agree %	Definitely agree %
Customers or LP have a lot of relevant experience to respond to the needs of PE	GP	3.62	9.43	5.66	18.87	45.28	20.75
	Customer	3.92	0.00	3.76	19.55	57.14	19.55
Customer participation in PE value co-creation will use a lot of knowledge	GP	3.74	5.66	7.55	18.87	43.40	24.53
	Customer	3.69	3.01	7.52	24.06	48.12	17.29
Customer or LP have enough industry knowledge.	GP	3.83	5.66	3.77	20.75	41.51	28.30
	Customer	3.59	0.75	12.03	27.82	45.86	13.53
Customer or LP have professional skills to respond to the needs of PE.	GP	3.42	7.55	11.32	28.30	37.74	15.09
	Customer	3.82	0.00	4.51	27.82	48.87	18.80
Customer or LP use his knowledge to provide service for PE.	GP	3.70	5.66	11.32	13.21	47.17	22.64
	Customer	3.76	1.50	6.02	23.31	53.38	15.79

2.6.3 Customer participation plays a Mediation Effect Between PE's Operant Resource-based Services and Customer Perceived Value

According to the service dominant logic, PE provides basic services for customer participation in value co-creation. Customers participate in PE value co-creation with their operant resources, PEs and customers jointly carry out resource integration and service exchange in value co-creation interactions. Meanwhile, customers perceive economic value, relationship/support value and technology/core values in the context of the interactive process of value co-creation. The test results for the theoretical model are as follows, which is the PE services based on its operant resources have a significant positive impact on customer participation in value co-creation; moreover, it is easy to note that customer participation in value co-creation has a significant positive effect on customer perceived value of economic value. Customer participation in value co-creation has a significant positive effect on customer perceived value of perceptions of positive relationships / support values. Finally, customer participation in value co-

creation has a significant positive effect on customer perceived value of technology / core values. For the convenience of analysis, we call the three perception values of customers as customer perceived value, which is illustrated as follows:

Figure 2.11: Schematic diagram of the role of customer participation in value co-creation



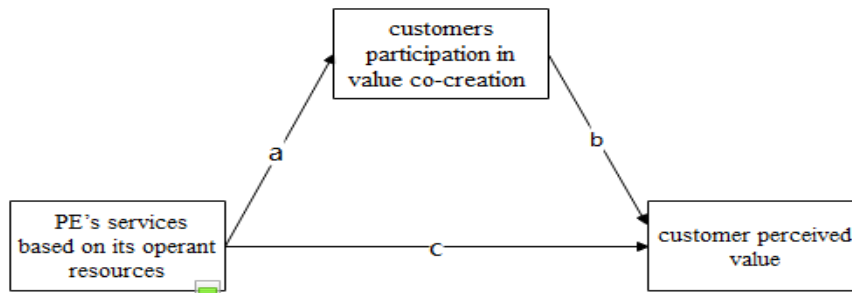
From figure 2.10, we can see that customer participation in value co-creation plays a mediation effect in the impact of PE operant resource-based services on customer perceived value. If the mediation effect is indeed significant as evidenced through the sample data, then it can further prove that customer participation in value co-creation has a positive impact on customer perceived value and this pathway is shown in the figure above.

According to the four steps proposed to verify mediation affects by Baron and Kenny (1986), the first step is to use **PE's services based on its operant resources** as an independent variable to perform a regression analysis of **customers participation in value co-creation** (as an mediation variable) and show that there is significant relationship between them. Secondly, we use **PE's services based on its operant resources** as an independent variable to perform a regression analysis of **customer perceived value** , and show that they are significantly correlated; thirdly, we use **customers participation in value co-creation** as an mediation variable to conduct a regression analysis of **customer perceived value**, and show that they are significantly correlated; Fourthly, **PE's services based on its operant resources** (independent variable) and **customers participation in value co-creation** (mediation variable) are also subjected to a regression analysis (figure 2.11) on **customer perceived value** (dependent variable), and show that the direct effect of **PE's services based on its**

operant resources (independent variable) on **customer perceived value** (dependent variable) is significantly reduced.

Therefore A and B paths in figure 2.11, the mediation variable **customer participation in value co-creation** significantly "diverts" the amount of information of C, so there is a partial mediation effect played in customer participation in value co-creation; If the direct effect of PE's operant resource-based services on customer perceived value is zero (regression coefficient $C = 0$ or not significantly related), then customer participation in value co-creation is the complete mediation variable of **PE's Services Based on Its Operant Resource** (independent variable) on **customer perceived value** (dependent variable) (Xu, 2011).

Figure 2.12: The Mediation Effect of Customer Participation in Value Co-creation

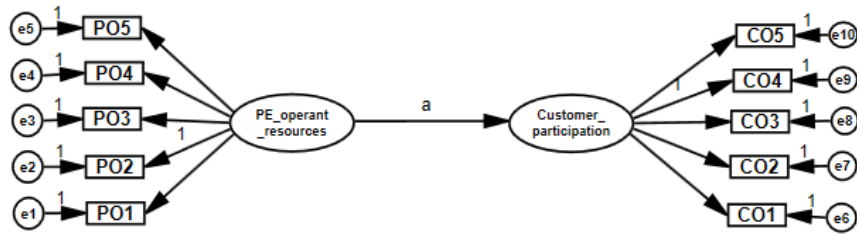


(1) Regression Analysis of PE's Services Based on Its Operant Resource on Customers Participation in Value Co-creation

- Regression Analysis Modeling

The model of the theory that PE's services based on its operant resources have significant positive effects on customers participation in value co-creation is as follows:

Figure 2.13: The Regression Analysis Model of PE’s Services Based on its Operant Resources to Customers Participation in Value Co-creation



Hypothesis A: PE’s services based on its operant resources have significant positive effects on customers participation in value co-creation

- Fit Judgment of Model

The fit judgment of model and data applied AMOS, where maximum likelihood estimation was selected, which incorporated the sample data (232) into the theoretical model, analyzed the structure of the customer engagement and enterprise-initiated value co-creation, and calculated the results of the fit indexes as follows:

Table 2.19: Test Data and the fit judgment of the regression analysis model of PE’s services based on its operant resources to customers participation in value co-creation

Statistical Inspection Value	Fit standard or critical values	Test results data	Model fit judgment
DF		17	
χ^2	$p > 0.05$	19.291 ($p = 0.31 > 0.05$)	Yes
NC (χ^2/DF)	< 2	1.135	Yes
GFI	> 0.90	0.983	Yes
AGFI	> 0.90	0.947	Yes
RMR	< 0.05	0.022	Yes
RMSEA	< 0.05	0.024	Yes
NFI	> 0.90	0.982	Yes
RFI	> 0.90	0.953	Yes
IFI	> 0.90	0.998	Yes
TLI (NNFI)	> 0.90	0.994	Yes
CFI	> 0.90	0.998	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 17, the chi-square value of the model is 19.291, and the probability of significance is $p = 0.312 > 0.05$. The null hypothesis is accepted, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 2.20: Standardized Regression Weights

	Estimate	t	P	Label	Hypothesis test
Customer participation <--- PE operant resources	0.676	6.365	***	a	A was Supported

“***” means $P \leq 0.001$

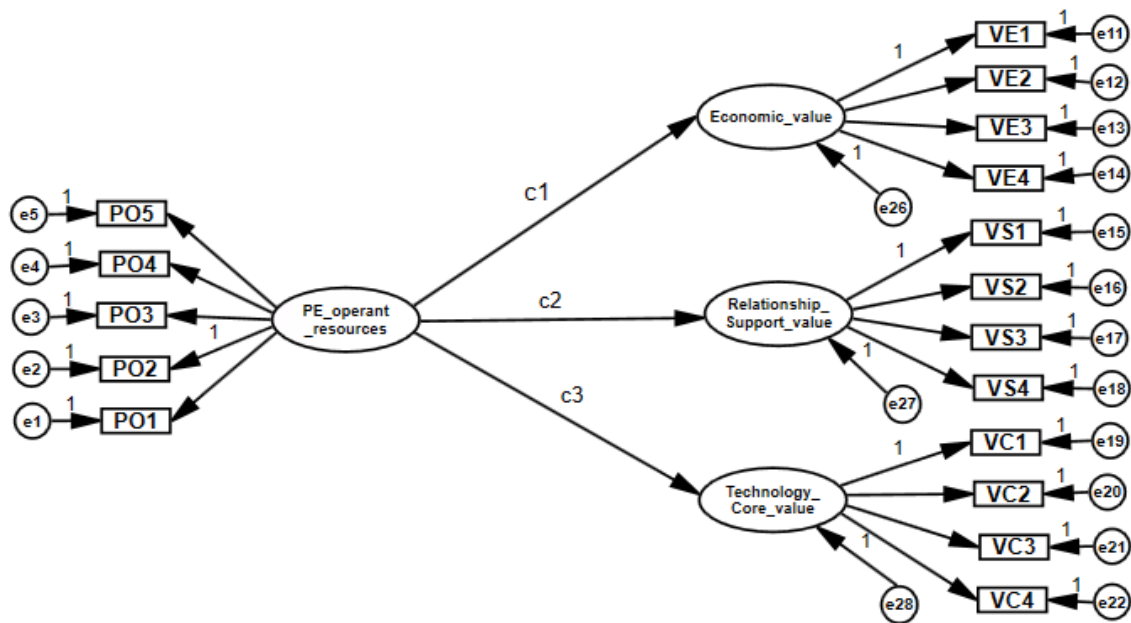
The results show that the regression coefficient between value co-creation initiated by enterprise and customer engagement is 0.676, and significant positive regression relationship was reached.

(2) Regression Analysis of PE’s Services Based on Its Operant Resources on Customer Perceived Value

- Regression Analysis Modeling

The model of the theory that PE’s services based on its operant resources have significant positive effects on Customer perceived value is as follows:

Figure 2.14: The regression analysis model of PE's services based on its operant resources to Customer perceived value



Hypothesis:

C1: PE's services based on its operant resources have **significant positive effect on customer perceived economic value.**

C2: PE's services based on its operant resources have **significant positive effect on customer perceived relationship / support value.**

C3: PE's services based on its operant resources have **significant positive effect on customer perceived technology / core value.**

- **Fit Judgment of Model**

The fit judgment of model and data will apply AMOS software, select maximum likelihood estimation, and incorporate the sample data (232) into the research model, analyze the structure of the customer engagement and PE-initiated value co-creation, and calculate the results of the calculate the results of the fit indexes as follows:

Table 2.21: Test data and the fit judgment of the regression analysis model of PE's services based on its operant resources to customer perceived value

Statistical Inspection Value	Fit standard or critical values	Test results data	Model fit judgment
DF		174	
χ^2	$p > 0.05$	155.263 ($p = 0.843 > 0.05$)	Yes
NC (χ^2/DF)	< 2	0.892	Yes
GFI	> 0.90	0.962	Yes
AGFI	> 0.90	0.933	Yes
RMR	< 0.05	0.037	Yes
RMSEA	< 0.05	0.000	Yes
NFI	> 0.90	0.966	Yes
RFI	> 0.90	0.946	Yes
IFI	> 0.90	1.004	Yes
TLI (NNFI)	> 0.90	1.007	Yes
CFI	> 0.90	1.000	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 174, the chi-square value of the model is 155.263, and the probability of significance is $p = 0.843 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the research model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 2.22: Standardized Regression Weights

	Estimate	t	p	Label	Hypothesis test
Economic value<--- PE operant resources	0.650	6.673	***	c1	C1 was Supported
Relationship Support value<--- PE operant resources	0.789	7.656	***	c2	C2 was Supported
Technology Core value <--- PE operant resources	0.706	8.099	***	c3	C3 was Supported

Note: *** means $P \leq 0.001$

The results show that the regression coefficient of PE based on operant resources to customer perceived economic value is 0.650, the regression coefficient of PE

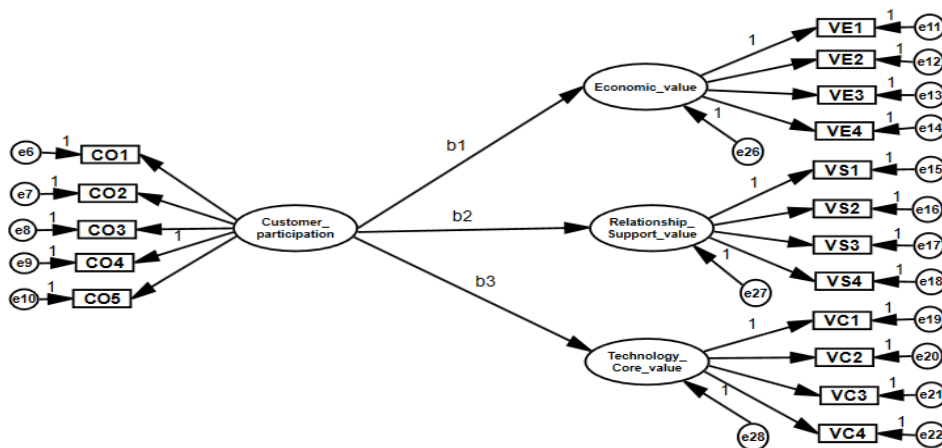
based on operant resources to customer perceived relationship / support value is 0.789, and the regression coefficient of PE based on operant resources to customer perceived technology / core value is 0.706, all of which are significant positive relationship.

(3) Regression analysis of Customers Participation in Value Co-creation on Customer Perceived Value

- Regression Analysis Modeling

The model of the theory that **customers participation in value co-creation** has a significant positive effect on Customer perceived value is as follows:

Figure 2.15: The regression analysis model of Customers Participation in Value Co-creation to Customer perceived value



Hypothesis:

B1: customers participation in value co-creation has a significant positive effect on customer perceived economic value.

B2: customers participation in value co-creation has a significant positive effect on customer perceived relationship / support value.

B3: customers participation in value co-creation has a significant positive effect on customer perceived technology / core value.

- Fit Judgment of Model

As same process as mentioned before fit judgment of model and data will apply AMOS, select maximum likelihood estimation, and incorporate the sample data (232) into the theoretical model, analyze the structure of the customer engagement and PE-initiated value co-creation, and calculated the results of the fit indexes as follows:

Table 2.23: Test data and the fit judgment of the regression analysis model of Customers

Participation in Value Co-creation to customer perceived value

Statistical Inspection Value	Fit standard or critical values	Test results data	Model fit judgment
DF		174	
χ^2	$p > 0.05$	163.155($p = 0.712 > 0.5$)	Yes
NC (χ^2/DF)	< 2	0.938	Yes
GFI	> 0.90	0.961	Yes
AGFI	> 0.90	0.932	Yes
RMR	< 0.05	0.027	Yes
RMSEA	< 0.05	0.000	Yes
NFI	> 0.90	0.963	Yes
RFI	> 0.90	0.942	Yes
IFI	> 0.90	1.003	Yes
TLI (NNFI)	> 0.90	1.004	Yes
CFI	> 0.90	1.000	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 174, the chi-square value of the model is 163.15, and the probability of significance is $p = 0.712 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

The regression index is calculated as follows:

Table 2.24: Standardized Regression Weights

	Estimate	t	p	Label	Hypothesis test
Technology Core value <--- Customer participation	0.702	7.32	***	b1	B1 was Supported
Economic value <--- Customer participation	0.846	7.40	***	b2	B2 was Supported
Relationship Support value <--- Customer participation	0.891	7.80	***	b3	B3 was Supported

“***” means $P \leq 0.001$

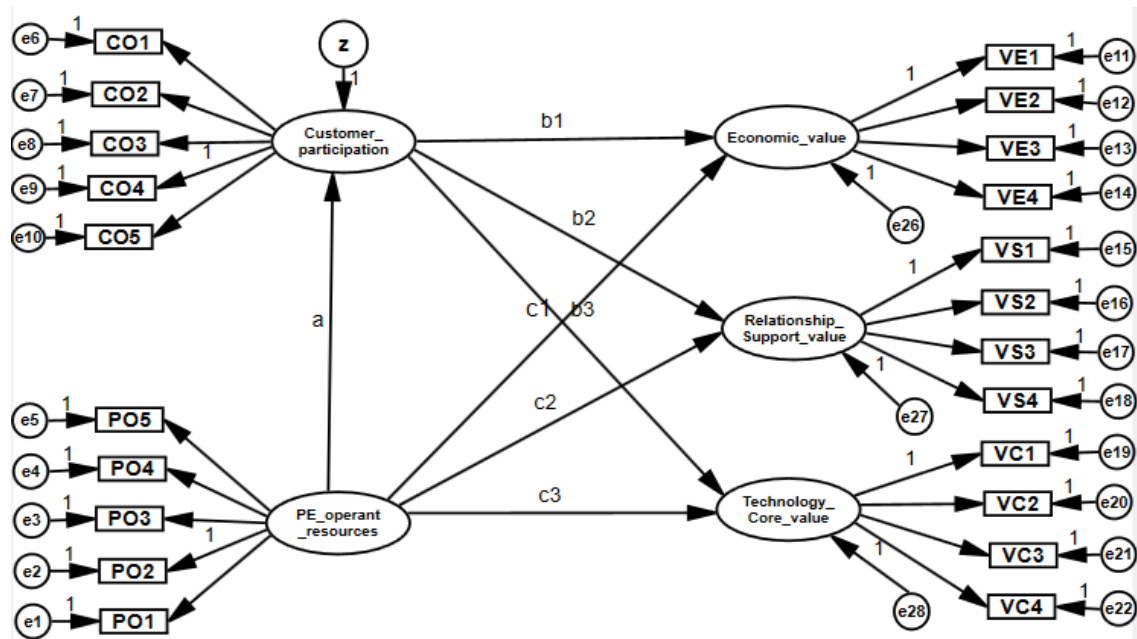
The results show that the regression coefficient of customer participation value co creation to "customer perceived economic value" is 0.702, the regression coefficient of customer participation value co creation to "customer perceived relationship / support value" is 0.846, and the regression coefficient of customer participation value co creation to "customer perceived technology / core value" is 0.891, all of which are significant positive relationship.

(4) Regression analysis on Mediation Effect of Customers Participation in Value Co-creation

- Regression Analysis Modeling

The regression analysis model of the mediation effect of customer participation in value creation is as follows:

Figure 2.16: The regression analysis model of the mediation effect of customer participation in value creation



Hypothesis:

A: PE's services based on its operant resources have significant positive effects on customers participation in value co-creation

B1: customers participation in value co-creation has a significant positive effect on customer perceived economic value.

B2: customers participation in value co-creation has a significant positive effect on customer perceived relationship / support value.

B3: customers participation in value co-creation has a significant positive effect on customer perceived technology / core value.

C1: PE's services based on its operant resources have significant positive effects on customer perceived economic value.

C2: PE's services based on its operant resources have significant positive effect on customer perceived relationship / support value.

C3: PE's services based on its operant resources have significant positive effect on customer perceived technology / core value.

- Fit Judgment of Model

The fit judgment of model and data applied AMOS V24.0.0 again, select maximum likelihood estimation, and incorporate the sample data (232) into the theoretical model, analyze the structure of the customer engagement and PE-initiated value co-creation, and calculate the results of the fit indexes as follows:

Table 2.25: Test data and the fit judgment of the regression analysis model of the mediation effect of customer participation in value creation

Statistical Inspection Value	Fit standard or critical values	Test results data	Model fit judgment
DF		154	
χ^2	$p > 0.05$	163.869 ($p = 0.278 > 0.05$)	Yes
NC (χ^2/DF)	< 2	1.064	Yes
GFI	> 0.90	0.939	Yes
AGFI	> 0.90	0.901	Yes
RMR	< 0.05	0.032	Yes
RMSEA	< 0.05	0.017	Yes
NFI	> 0.90	0.946	Yes
RFI	> 0.90	0.918	Yes
IFI	> 0.90	0.997	Yes
TLI (NNFI)	> 0.90	0.995	Yes
CFI	> 0.90	0.996	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 154, the chi-square value of the model is 163.869, and the probability of significance is $p = 0.278 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 2.26: Standardized Regression Weights

	Estimate	t	p	Label	Hypothesis test
Customer participation<--- PE operant resources	0.771	6.69	***	a	A was supported
Economic value <--- Customer participation	0.866	4.927	***	b1	B1 was supported
Relationship Support value<--- Customer participation	0.888	5.587	***	b2	B2 was supported
Technology Core value <--- Customer participation	0.628	4.466	***	b3	B3 was supported
Economic value <--- PE operant resources	-0.062	-0.044	0.66	c1	C1 was not supported
Relationship Support value<--- PE operant resources	-0.037	-0.296	0.77	c2	C2 was not supported
Technology Core value <--- PE operant resources	0.146	1.196	0.23	c3	C3 was not supported

Note: *** means $P \leq 0.001$

The results show that the regression coefficient of PE's services based on its operant resources to customers participation in value co-creation is 0.771, the regression coefficient of customer participation value co-creation to customer perceived economic value is 0.866, the regression coefficient of customer participation value co-creation to customer perceived relationship / support value is 0.888, and the regression coefficient of customer participation value co-creation to customer perceived technology / core value is 0.628, all of which are significant positive relationship compared with reference values.

However, PE based on operant resources has no significant regression with value co-creation of customer participation, economic value of customer perception, relationship / support value of customer perception, and PE based on operant resources has no significant correlation with technical / core value of customer perception, and the regression coefficient is close to zero. Therefore, these test results show that customer participation in value co-creation meets the criteria of being a "complete mediation". That is to say, the direct effect of an independent variable PE based on its operant resources on dependent variable customer perceived value C1, C2 and C3 are

completely "branched" (see Figure 2.15) due to the intervention of mediation variable customer participation in value co-creation, which has no significant positive effect.

In contrast, the independent variable PE service based on its operant resources has a significant positive effect on the dependent customer perceived value through the mediation variable customer participation value co-creation, which completely "diverts" the influence of independent variable PE service based on its operant resources to the dependent variable customer perceived value.

(5) Value co-creation of Customer Participation and Customer Perceived Value

Service dominant logic states that value is always determined by the beneficiary in a unique phenomenological way (axiom 4 / FP10). Through resource integration and service exchange, all participants jointly create value and determine value in specific circumstances (Lusch & Vargo, 2014). Different types of services generate different customer perceived values (economic value, relationship value, technical value) (Lovelock, Patterson and walker, 2007). In this thesis, empirical results support the claims of the service dominant logic and related theoretical research, which is that value co-creation of customer participation has significant positive effects on customer perceived economic value ($\beta = 0.659$, $t = 7.180$, $P < 0.001$), customer perceived relationship or support value ($\beta = 0.746$, $t = 6.721$, $P < 0.001$), and customer perceived technology or core value ($\beta = 0.819$, $t = 7.588$, $P < 0.001$).

2.7 Concluding Remarks

At present, the operational method of PE is still principally as follows: GP acts as the provider of PE products (investment projects) and the creator of PE value, playing a leading role; while customers are the receiver of products and product value, playing a supporting role. The value of PE is created by the GP alone in the process of financing, investment, post investment management and exit. This follows the law of enterprise value creation under the goods-dominant logic. In the face of an increasingly complex and uncertain competitive environment, no organization can match the development

resources needed in a dynamic, adaptive and fluid manner. For this reason, this thesis examines S-D logic to theoretically study the creation of PE value together with customers, study the factors affecting PE value, and to conduct an empirical analysis to test these theoretical insights. The empirical results show that PE services based on operant resources has a significant positive impact on customer participation in value co-creation with their operant resources, while the customer participation in value co-creation with their operant resources has a significant positive impact on economic value, perceived relationship or support value and customer perceived technology or core values.

Customer participation is not only an important factor of customer satisfaction, but also is the core element of value co-creation (Vargo & Lusch, 2004a; Yim et Al., 2012). Customer participation in value co-creation requires enterprises to provide basic services to ensure that participants create value together and determine value in specific situations through resource integration and service exchange (Lusch & Vargo, 2014). Value comes from the use of operant resources or the transfer of operand resources. Customer participation in value co-creation brings more operant resources from outside the enterprise, and realizes a combination and co-cultivation of resources with the enterprise (Håkansson & Waluszewski, 2002), which jointly produces more value, thus promoting more actors to participate in value co-creation, which is conducive to the efficient and sustainable development of the enterprise.

The empirical results show that GP, LP, PE managers and customers all have positive attitudes towards PE value co-creation with operant resources. Furthermore, the analysis of the empirical results shows that customer participation is the "complete mediation effect" of PE based services on operant resources on customer perceived value. From the perspective of logic and timing, customer participation value co-creation occurs after PE provides service conditions based on operant resources. From the demonstration of the mediation effect, the causal relationship between customer participation and PE services based on operant resources and customer perceived value has been empirically confirmed. Therefore, PE service based on operant resources creates an antecedent of customer participation value, while customer perceived value

is the consequence of customer participation. The antecedents and consequences of customer participation in value co-creation not only show the causal relationship, but also point towards the effective pathways for effective value co-creation. This conclusion is very important for PE in carrying out value co-creation effectively.

Service dominant logic states that value is always determined by the beneficiary in a unique phenomenological way (Vargo & Lusch, 2004; Axiom 4 / FP10). Perceived value is a form of subjective value, which is experiential and situationally dependent. Customers' perceived value can only be fully reflected in dynamic experience scenarios or specific situations. It also points out that whether to continue (cooperation) usually depends on whether the customer is satisfied with the perceived value. Liu (2003) also notes that there is a direct causal relationship between customer value perception and relationship harmony perception and relationship persistence, and customer value perception has a positive effect on customer's continuous relationships with enterprises. GP's original value has a lack of context for customers, so customers lack the adequacy of value perception, which can lead to customers' incomprehension, complaints and even the interruption of cooperation.

From the further analysis of the empirical results, this thesis finds that customer participation is PE's "complete mediation effect" of service based on operant resources on customer perceived value, which confirms the service dominant logic and related theoretical research. This has changed the "old pathway" for customers to directly perceive value through the services provided by PE, and the "new pathway" for customers to directly perceive and create value through customer participation in value co-creation. The results show that customer participation is necessary for value co-creation - PE services based on operant resources has a significant positive impact on customer participation, and customer participation is also sufficient for customer perceived value - customer participation plays a "complete mediation effect" in customer perceived value. In the traditional sense, PE can directly provide value to customers, which can be transformed into providing services for customers to participate in value co-creation, and then customers' perception of value in the process of value co-creation is developed in a more effective way. This provides valuable

decision-making foundations for PE to change the original value of GP and create value together through customer participation.

The illumination here is that PE can use service dominant logic to examine strategy and management practices and procedures. Combined with the empirical results, we can implement improvement measures in the following regards: providing friendly and matching services for building convenient and effective customer participation in value co-creation; establishing effective mechanisms and methods for integrating customer operant resources; perceived value is a subjective value with experiential and situational dependence and can be enhanced as a result. Therefore, it is necessary to establish an effective interactive process of customer participation and a scenario of perceived value in the process of value co-creation which can improve the enthusiasm and impacts of customer participation in value co creation through technological progress, especially the application of and new information and communication technologies.

Based on service dominant logic, this thesis makes an empirical study on the theoretical model of customer participation in PE value co-creation and draws some meaningful conclusions and implications. Although, this thesis provides an innovation idea for strategic and business model trying to instead that the old PE operation structure GP makes profit alone. However, from the perspective of practice, there are still many further researches are waiting for me in this area.

Value co-creation not only breaks the traditional view of value creation of enterprises, but also changes the framework from the dual interaction between enterprises and customers to a dynamic network interaction of multiple social and economic participants with the development of a network economy. This research is significant and far-reaching in terms of the Chinese PE industry. Although, numerous researchers have conducted meaningful research on value co-creation there is little in terms of this economic sector. Also, there has been more macro research and less micro empirical research. We know little about the process of value creation, for example, what it includes, when it starts and when it ends (Caru, 2003; Femandez & Kova, 2007). Without a thorough understanding of the concept of action, it is impossible to determine

the trajectory of value creation and the natural content of value creation. Value co-creation can easily become a concept without substance (Grönroos, 2011). So far, in the process of value co-creation, there are few studies on the vehicle, the way of participation, the way of value exchange and the ability of value co-creation to develop effectively. In the interactive process of value co-creation, it is difficult to find the support system or service system to ensure the effectiveness and dynamic of value co-creation process. Therefore, the potential future research areas are proposed based on the limitations of the research.

- (1) Although it is difficult to find the research of customer participation in PE value co-creation, this thesis has sought to select relatively mature variables and scales with a high citation rate and recognition rate, linked with expert discussion and pre adjustment, as such the empirical results are reliable and effective. However, there are some differences between the industry background of variable classification and selection of test items in references and PE, which may not fully show some details of customer participation in PE value co-creation. In the future research further exploration of the existence of these factors, which may more accurately guide research and practice.
- (2) Based on the institutional limitation of customer's direct participation in PE value co-creation, how can PE's customers who are not yet LPs able to participate in the PE value co-creation process? It is necessary to study the vehicle for these sort of customers in how to participate in PE value co-creation, that is to say we need a VPE, a virtual vehicle, which is established to serve as the vehicle for these kind customers to assist in participating in PE value co-creation processes.
- (3) The key to value creation is to encourage customers to cooperate in value production processes (Normann & Ramirez, 1993). In order to effectively mobilize customers to participate in PE value co-creation, it is necessary to study how customers participate in value co-creation process. We need to study customer engagement problems in value co-creation initiated by customers.

Relationship value is the net value perceived by customers in gaining benefits from the

whole relationship cycle (Hogan, 2001). The realization of monetary value in perceived economic value by customers is the focus of customer participation in value co-creation and the building of continuous relationships. The monetary value generated by value co-creation is mostly reflected in the actual PE, and the customers who want to realize monetary income can only become LP, which means that the customers who are not LP need to buy the equity of PE's LP. This is often too complicated and compounded by issues such as a lack of liquidity. Similarly, customers who are already LPs need to sell PE's equity to realize monetary income. The transaction transfer of PE equity is a measure or means to reflect the currency of customer participation in value co-creation, which needs to be studied in terms of the exit or entry for customer value exchange, so as to facilitate customer participation in PE value co-creation.

-Chapter Three-

Virtual Vehicle of PE Value Co-creation

3.1 Introduction

Previous empirical studies have demonstrated that customer participation is conducive to value co-creation. However, there are rules and regulations which place restrictions on the direct participation of customers in PE partnerships in value co-creation processes, so it is necessary to solve the problem of customer participation in PE value co-creation through finding a participation vehicle method.

There are many authors expounding arguments concerning the definition of a virtual community. Virtual community is a relatively new concept and numerous studies internationally have carried out a lot of research on its meaning and classification. Due to the multidisciplinary nature of the research, there is still a lack of a unified or clear definition of what constitutes a virtual community. Usually, a virtual community is regarded as the counterpart of a real community in the virtual world, which provides virtual places for network users with the same hobbies, experiences or similar professions or business-related to facilitate their exchange and sharing of experience (Klang & Olsson, 1999).

Armstrong and Hagel (1996) argues that a virtual community can be divided into transaction communities, fantasy communities, interest communities and relationship communities according to the needs of community members. Klang and Olsson (1999) classify virtual communities into four categories based on whether it is a profitable enterprise or not. It is a great significance to the classification standard of virtual community and has become the object of reference for many researchers in follow-up investigations.

Moreover, Virtual Customer Environment (VCE) is a very important factors of innovation and product development for enterprises. Virtual customer environments (VCE), which provide services ranging from online discussion forums to virtual design

and prototyping centers, enable firms to involve their customers in product design, product testing, and product support activities (Nambisan,2002). The strategic importance of such initiatives to co-operate customer competencies for value creation is evident (Vargo & Lusch,2004). For example, in the video and computer game industry, this method is very mature, every game enterprise has its own virtual community, you can connect it from computer, mobile phone, ipad and many other forms of electrical equipment. Enterprise and customer put many resources in this virtual platform to make the game better and achieve customer's expectation. In the PE industry, Beaton and Smith (2011) put forward the concept that private equity co-investment is the process of simultaneous investment in portfolio companies by a limited partner alongside funds managed by a general partner (GP). However, co-investment is a direct investment discipline and cannot simply be executed as a normal method to fund investment. It is difficult to be properly structured, carefully planned and well executed. Co-investment method lacks value co-creation platform for GP and LP.

Therefore, based on previous researches, in this chapter designs virtual private equity fund (VPE) which acts as a special vehicle initiated by an actual private equity fund (APE). VPE not only serves as a vehicle of customer value co-creation including LP and potential LP, but also as a vehicle of value co-creation interaction channel with APE, as well as a vehicle of value and identity exchange between APE and VPE. Moreover, it gives customers more choices across a wider range, attracts more customers to participate in value creation, integrates more resources, and establishes stronger and long-term relationships with customers through interactions. During the non-ownership value co-creation process, APE and customers do not have a strict legal relationship in the VPE vehicle, which can be more favorable for a PE in approaching customers. Unlike most non-profit virtual communities, the VPE is a virtual vehicle that aims to create profits and can transform its identity to make profits. VPE+APE is a new operation method of PE's virtual-real interaction constructed by virtue of the characteristics of virtual community, and virtual-real interaction supports resource interaction - "combination and co-cultivation of resources in inter-organizational

interaction" (Håkansson & Waluszewski, 2002), which needs service system to guarantee it's running. VPE + APE + Service system constructs PE value co-creation system.

In the existing virtual community research, most of them involve non-capital trading behavior. However, the limitations of traditional marketing theory based on transaction behavior have begun to appear. With the many studies on value co-creation, the role and influence of customers has become more and more important. Traditional customer satisfaction survey cannot fully reflect the customer response to service performance (Bowden, 2009). Hence, in this chapter the author focuses on another important factor which is customer engagement (CE). Vivek (2009) has a representative definition of customer engagement, it is the intensity of customer involvement in related activities initiated by customers or manufacturers. There is another representative definition of customer engagement from a psychological perspective offered by Brodie et al. (2011), he defines customer engagement as a psychological state, which occurs in the interaction between customer experience and focus objects such as enterprises or brands. A proper customer relationship management and achieving customer engagement (CE) are becoming a strategy for enterprises to increase sales revenue and gain competitive advantage (Kumar et al., 2010). The virtual environment increases the speed and the persistence of customer engagement as interaction happens in real-time, with a high frequency, and without geographic boundaries (Quinton & Harridge-March, 2010).

However, at present, although customer engagement is a popular issue concerned and studied by marketing and academia, there is no consensus on the connotation and dimension of customer engagement at the theoretical level. In terms of the antecedent or outcome variables of customer engagement, although many possible variables have been proposed by scholars, empirical research is still scarce. It is rare to study customer engagement from service-dominant logic, which is only at the initial stage. Customer engagement and customer participation, customer engagement and value co-creation, customer engagement and relationship continuity are all areas worth to study.

Finally, according to literature review of CE, some scholars argue one of the most

important is collaborative innovation, a new paradigm in the field of value creation. collaborative innovation is in virtual communities While co-creation includes several processes (Bugshan, 2015). VPE as a vehicle of value co-creation and a link with APE, has the function of both virtual and real vehicles. It is undoubtedly of research and practical value to apply the characteristics of virtual community and information technology to research and realize customer engagement. It is targeted to carry out value co-creation related with VPE and APE. That means, as a new organizational unit, VPE needs advanced elements to design and use new strategies to initiate value co-creation and serve participants. It is necessary to study the psychological and behavioral engagement of customers in VPE in order to makes value co-creation process regular running.

The remainder of this chapter is structured as follows. Section 3.2 presents a review of relevant literature. Section 3.3 presents the research model and hypothesis. Section 3.4 presents the methodology of research. Section 3.5 describes the data and Section 3.6 discusses the major empirical findings. Finally, Section 3.7 concludes this chapter.

3.2 Literature Review

As discussed in the introductory part, there are there are two core concepts in this research, which are virtual community and customer engagement. These two factors establish the fundamental structure of this thesis and enable the achievement of the research objectives. Therefore, working from the results of previous studies in these two areas will enable this thesis to develop useful items for practical application in the PE industry in China.

3.2.1 Literature Review on Virtual Community

Community as a concept was originally proposed by German sociologists and applied in sociological research as a result (Tönnis,1887). Some researchers argue that communities are formed by the nature and relationships between individual members

(McAlexander et al., 2002). Even in Asia, community has also been an important field of study with researchers believing that community is a group of interpersonal relationships formed by interactions between people (Koh & Kim, 2004). In China, Liu (2013) defined it in terms of the perspective of community psychology where a community is a collection of individuals and groups in a certain region, whose members have certain interrelationship and common understandings in life, psychology and culture.

The idea of a Virtual community is a new concept and numerous authors in China and internationally have carried out substantial research on its meaning and classification. Due to the multidisciplinary nature of the research field, there is still a lack of a unified or clear definition of what constitutes a virtual community. Usually, a virtual community is regarded as the counterpart of a real community in the virtual world, which provides virtual places for network users with the same hobbies, experiences or similar professions or business-related to facilitate their exchange and sharing of experiences.

3.2.1.1 Classification of Virtual Community

Klang and Olsson (1999) classify virtual communities into four categories based on whether they operate for companies and the generate profitability for websites. Among those who are the result of company operations with the purpose of profit is called a shop-type virtual community, while the non-profit is called a forum-type virtual community. For those associated with non-company operations, the website for profit is called a market-type virtual community, while the Club-type virtual community is associated with non-profit-oriented virtual communities. These are of great significance to the classification standards for virtual communities and have become the object of reference for many researchers in follow-up studies (Klang & Olsson, 1999). Armstrong and Hagel (1996) divide virtual communities into transaction communities, fantasy communities, interest communities and relationship communities which form

according to the needs of community members. Among them, the transaction community mainly refers to the network platform which promotes the exchange of information about products and services as well as the exchange of transactions; the fantasy community provides the role-playing network platform for community members; the interest community refers to the community formed by people with the same interests gathering together to exchange and interact information on specific topics; and the relationship community has members with a certain life experience, members of the to provide a platform for deep contacts on often what are specialist or situationally dependent experiences.

Schubert and Ginsburg (2000) divide virtual communities based on two perspectives. Firstly, the formation of virtual communities' stems from common interests of people. According to the different interests of people, the content and types of virtual communities will be different. From this point of view the purpose of virtual communities can be divided into entertainment communities, enterprise communities and research communities. Entertainment communities includes hobby communities, relationship communities and fantasy communities, while enterprise communities include business communities and electronic store transaction communities. Secondly, virtual communities are a kind of network community, which can rely on various forms of media as a communication and interactive platform, and the use of Internet community is an important form of network community. Van Doorn et al. (2004) divide the virtual community into network-based communities and small group-based communities.

The network-based community refers to a specialized community based on structured interests with a relatively loose and dynamic relationship network, in which participants have a common focus of attention and are geographically dispersed. The network community based on small groups is composed of closely related individuals, each of whom forms an online communication group in order to achieve a series of common goals and maintain existing relationships. Before they become members of the community, they are familiar with or have close informal private contacts. Compared with the network community, the relationship structure of the small group-based

community is closer. But in the network community, with the establishment and communication of the relationship between members of the same group, the network community can gradually evolve into being a group community.

In addition, researchers have divided the virtual community into synchronous communities and asynchronous communities according to its timeliness. Among them, synchronous communities include online chat and online games, while non-synchronous communities involve forums, newsgroups and bulletin boards (Papadakis, 2003). As for the research on the influence of virtual community on enterprise innovation, most studies believe that the role of a virtual community is to effectively promote knowledge sharing and transfer among people, organizations and organizations by virtue of the convenient virtual community environment brought about by information technology, thus forming an important channel or platform for mutual acquisition and exchange of knowledge, thus impacting the innovation process of enterprises (Xu & Wang, 2007; Hu & Lu, 2010; Cheng, 2013).

3.2.1.2 Virtual Community with Special Purpose

An explorative case study shows that consumer innovation can be structured, motivated, and partly organized by a commercial firm that organizes the infrastructure for consumers' interactive learning in a public online domain (Jeppesen & Molin, 2003). Furthermore, an increasing number of firms are hosting virtual customer environments (VCEs) to involve their customers in product development and product support activities. Virtual customer environments (VCE), which provide services ranging from online discussion forums to virtual design and prototyping centers, enable firms to involve their customers in product design, product testing, and product support activities (Nambisan, 2002). The strategic importance of such initiatives to co-opt customer competencies for value creation is evident from the research (Vargo & Lusch, 2004).

In contrast to internal corporate ventures (Burgelman, 1983), innovation and product development in the computer games industry depends upon external online

consumer communities. This turns the idea of core competencies (Prahalad & Hamel, 1990) and non-imitability (Dierickx & Cool, 1989) on its head since a major part of the competencies in effect is public and resides outside the firm. Liu (2011) believes that the interaction between community members and brand virtual community refers to the information communication and networking between community members and community networks and information exchange and interpersonal communications between members. At the same time, he also noted that in the brand virtual community, the interaction between members and the community at large includes not only an instrumental interaction of using the virtual community to search for information, but also an emotional interaction of obtaining friendship and support. Therefore, the interactions between members and brand virtual community can be divided into information interactions and interpersonal interactions.

Likewise, Nambisan and Baron (2009) study drew on use and satisfaction theory to develop and test a conceptual model that incorporated the four benefits that customers can gain from participating in VCE interactions. It suggested that customers can obtain four benefits from participating in VCE interactions which are: learning, social integration, personal integration and hedonic. The purpose of this study is to help enterprises clearly understand the key factors that influence what the perceived benefits of VCES are, and to design targeted virtual communities which improve the potential benefits for customers in terms of their own needs. That is, how to use VCEs to build virtual communities as an effective research result of utility to enterprises. The empirical analysis of study conducted in "Research on Trust Generation Mechanism in Virtual R&D Organizations", draws the conclusion that cooperation experiences and normative systems have a significant impact on trust in virtual R&D organizations, and that trust has a significant impact on cooperation within virtual R&D organizations (Dai, 2013). In the empirical analysis of "Customer Participation in Virtual Brand Community Value Co-creation", another researcher drew the conclusion that customer participation in virtual brand community value co-creation has a significant impact on brand equity, and pointed out that virtual brand community could become a significant platform for brand value co-creation (Li, 2014).

In summary, this thesis intends studies virtual communities as a special purpose virtual PE (VPE) vehicle initiated by a physical PE. VPE is used as a vehicle to effectively integrate customer operant resources, as well as an interactive vehicle for value co-creation with a physical PE. It also as acts a transitional or conversion vehicle for customers to become physical limited partners (not yet as a LP) of a PE.

3.2.2 Literature Review on Customer Engagement

It should be said that up to now, the definition of customer engagement has not reached a consensus in the theoretical discourse. Therefore, we examine here previous basic definitions on customer engagement from a variety of sources.

3.2.2.1 Definition of Customer Engagement

Initially, the definition of customer engagement was based on relationship marketing and service-dominant logic. It was considered that customer engagement was a long-term, value-driven relationship between customers and enterprises (Thunderhead, 2014). This relationship could promote interaction between customers and enterprises and enhance customers' emotional or behavioral input into enterprises (Shevlin, 2007). Amongst them, emotional input manifests itself in terms of customer retention and loyalty, as well as the willingness of customers to establish and strengthen business relationships with enterprises (NIST, 2009), and behavioral inputs in purchases and a range of non-transactional behaviors such as word-of-mouth communication, recommendations, etc. (MSI, 2010). Arguably the business community generally defines customer engagement from the perspective of management operations, emphasizes the operability of the definition, and pays attention to customer input and contributions to the enterprise.

Some researchers have proposed five basic hypotheses for customer engagement based on previous studies, and then further propose a general definition of customer engagement. They believe that customer engagement is a kind of psychological state

produced in the process of interaction and creating customer experiences between customers and other stakeholders in specific service relationships. The degree of customer engagement is different and often depends on real circumstances. Customer engagement is a dynamic and cyclical process in the service relationship of value co-creation. Customer engagement plays an important role in the service relationship network. Other relationship variables are the pre-or post-variables of the cyclical customer engagement process (Brodie et al., 2011). Customer engagement includes three dimensions: cognition, emotion and behavior. In different situations, the specific performance of customer engagement with different stakeholders is altered. Customer engagement (CE) is an important concept within online brand community. CE sub-processes include sharing, common development, learning, advocating and socializing. CE can lead to satisfaction, authorization, connection, bonding, trust and commitment, and customers loyalty towards enterprises and brands (See Table 3.1).

The concept of engagement originates from psychology. From the table below, we can see that the definition of customer engagement focuses more on psychology and less on behavior. Van Doorn et al. (2010) and Shevlin (2007) focus on customer engagement definitions in customer behavior. Vivek (2009) has a representative definition of customer engagement, whereby it is the intensity of customer involvement in related activities initiated by customers or manufacturers. A representative definition of customer engagement from a psychological perspective is given by Brodie (2011), where he defines customer engagement as a psychological state, which occurs in the interaction between customer experience and focus objects such as enterprises or brands. Under different backgrounds and conditions, the level of customer engagement is different. Some researchers in China have divided customer engagement into attitudinal engagement (psychology) and behavioral engagement (behavior). Empirical results show that customer engagement can be divided into customer engagement and customer behavior engagement. Customer engagement directly affects customer behavior. Moreover, Customer engagement behavior and customer purchase behavior are two different variables, both can directly influence or promote customers purchasing behavior (Han et al., 2018).

Table 3.1: List of Customer Conformity Definitions

Author	Concept	Definition	Dimension	Type
<i>Van Doom J, Lemon K N, Mittal V, et al. 2010</i>	Customer Engagement Behavior	Customers pay attention to the non-transactional behavior of a brand or enterprise for some motive	Single Dimension	particular emphasis on behavior
<i>Shevlin (2007)</i>	Customer Engagement	Customer engagement is to enhance the repeatability and satisfactory interaction between consumers and brands (or products, enterprises).	Single Dimension	particular emphasis on psychology
<i>Beckers S F M, Risselada H and Verhoef P C., 2014</i>	Customer Engagement	A hidden psychological state of customers can be transformed into customer engagement behavior.	Single Dimension	particular emphasis on psychology
<i>Vivck et al. (2012) (2014)</i>	Customer Engagement	Intensity of Customer Attention to Organizing Products/Services and Participation in Activities Initiated by Customers or Enterprises	Single Dimension	particular emphasis on behavior
<i>Bowden (2009)</i>	Customer Engagement process	Customer engagement is a psychological process, describing the formation mechanism of new customers' loyalty to service brand after repeated purchase.	Single Dimension	particular emphasis on psychology
<i>Cambra-Fierro J J, Melero-P010 I and Vazquer Carrasco R. (2013)</i>	Customer Engagement	A series of transactional and non-transactional behaviors of customers can ensure future sales, produce positive publicity and enhance brand reputation.	Single Dimension	particular emphasis on behavior
<i>Higgins and Scholer (2009)</i>	Engagement	The state of being involved, occupied, fully assimilated or absorbed by the target, resulting in some attraction or exclusion. Highly aligned individuals' approach or reject the target, thus increasing or reducing the value of the target.	Single Dimension	particular emphasis on psychology
<i>Wirtz et al (2013)</i>	Online community Engagement	Online brand community engagement refers to the positive influence of consumers' identification with online brand community.	Single Dimension	particular emphasis on psychology
<i>Mittler et al. (2013)</i>	Customer Engagement	Customer engagement behavior, Individual's Ability and Motivation to Execute these Behaviors	Single Dimension	particular emphasis on behavior
<i>Wagener and Majchrzak (2007)</i>	Customer Engagement	Customer participation in the enterprise, other customers, exchange knowledge, the intensity of participation in the process.	Single Dimension	particular emphasis on behavior
<i>Kumar et al. (2010)</i>	Customer Engagement	Positive interactions between customers and enterprise, which leads these	Single	particular

		interactions can be transactional or non-transactional.	Dimension	emphasis on behavior
<i>Patterson et al (2006)</i>	Customer Engagement	Customer's cognitive and emotional attribution to brand and its relations.	Multidimensional	particular emphasis on behavior
<i>Mollen and Wilson (2010)</i>	Online brand Engagement	The degree of performance of a customer in a relationship with a service provider, including behavioral performance, cognitive performance, and emotional performance.	Multidimensional	particular emphasis on psychology
<i>Scott and Craig-Lees (2010)</i>	Audience Engagement	It consists of pleasure, motivation and cognitive effort.	Multidimensional	particular emphasis on psychology
<i>Hollebeek (2011)</i>	Customer Brand Engagement	Customer's motivation and brand-related situation-dependent mental state are characterized by a certain degree of cognitive, emotional and behavioral activities in the interaction with the brand.	Multidimensional	particular emphasis on psychology
<i>Peterson (2007)</i>	Customer Engagement online	Consumer online engagement is used to evaluate the degree and depth of interaction between website visitors and website. It is measured by some basic measurement indicators, including frequency, access time, purchase, lifetime value and so on.	Multidimensional	particular emphasis on behavior
<i>Brodie et al , (2011)</i>	Customer Engagement	Customer engagement reflects a psychological state, which is generated by interaction with the organization or object in the service relationship and creating experience together. Customer engagement occurs in specific situations, showing different levels of fit. Customer engagement is a dynamic and repetitive process. It plays a central role in the network of rules that affect service relationships. Moreover, it is a multi-dimensional concept, which includes three dimensions: cognition, emotion and behavior.	Multidimensional	particular emphasis on psychology

3.2.2.2 Previous Research on Customer Engagement

Customer engagement is a relatively new concept put forward by marketing academia, which integrates a variety of behaviors which may affect enterprise performance other than customer transaction behavior. Brodie (2011) published a series of special articles and commentary articles on customer engagement in 2010 and 2011 respectively. The American Marketing Science Institute (MSI) has identified priority research topics for 2010-2012, as being customer engagement with the subtitle "Understanding Customer Experience and Behavior". In view of this, customer engagement has become a very relevant and current research area in the field of marketing and customer management (Verhoef et al., 2010). In today's highly dynamic and interactive business environment, the role of customer engagement (CE) in co-creating customer experiences and value has attracted more and more attention from business practitioners and researchers (Brodie et al., 2011).

Customer engagement originated from psychological research. Kahn (1990) first applied the concept of "Engagement" to work, describing the psychological state and behavior of employees. Moreover, there are many sorts of engagement, for example, Civil engagement in sociology refers to participating in voluntary organizations or performing voluntary work to promote the development of social networks (Jennings & Stoker, 2004). State engagement in politics refers to the repeated process that influences the political behavior of the target government (Resnick, 2001). Social engagement in psychology refers to a high degree of initiative, participation and appropriate responses to social stimuli, such as participation in social activities and interactions with others. Student engagement in educational psychology refers to students' academic input, motivation and commitment to the school, and their perception of psychological connections and sense of belonging to the school (Downey & Shauna, 2007).

From reviewing these multiple definitions from different disciplines of social sciences, we can deduce that engagement has some general characteristics: first, the

object of engagement is very wide, the object of engagement in different disciplines is different, and the object of engagement in the same discipline can also be different. The object of engagement can be either individual or collective. Secondly, although the definition of engagement differs greatly from one discipline to the next, most disciplines regard it as a positive concept, such as some researchers who regard engagement as embodying the opposite of burnout (Maslach et al., 2001). Thirdly, there is interaction between the subject and the object of engagement, and it is a repetitive process. Fourthly, most studies believe that engagement is a multi-dimensional concept which includes three aspects being cognition, emotion and behavior or one or two of them in some combination. In the single-dimensional case, the most widely adopted one is the behavioral dimension. Finally, engagement may be long-term or a short-term process. These characteristics provide a good reference point for exploring the concepts involved in customer engagement research.

In marketing and management studies, the study of customer engagement draws on the results of psychological research. Some researchers define customer engagement from the perspective of psychological processes, such as Bowden (2009) whereby the customer fits is a psychological process that covers cognitive and emotional aspects. There are also researchers who focus on a behavioral perspective, such as Van Doorn et al. (2010), Verhoef (2010), Pham and Avnet, (2009). They suggest that customer engagement behavior is "customer behavior over buying brands or enterprises, such as reputation, recommendation, writing blog, writing comments. The concept emphasizes "non-transactional behavior", and MSI (2010) also adopts this definition.

However, it has been argued that behavior should be considered as an engagement, rather than an operationalized definition. Engagement only includes behavioral factors, which cannot provide reasons for customers' repeat purchasing behavior. In addition to external behavior, engagement must also have a continuous psychological connection with the enterprise or brand (Malthouse & Calder, 2011). There are also researchers who define the concept of customer engagement by integrating psychological and behavioral factors. Vivek (2009) believes that consumer engagement is the intensity of consumers' participation and connection with

organizational offerings or activities.

Engagement was first used as a concept in marketing practice dating back to 2001, it proposed that customer engagement consists of rational loyalty and emotional attachment (Appelbaum, 2001). The Advertising Research Foundation (2008) defines customer engagement as a positive customer attitude derived from a given brand, product, or service category, which can be translated into actions, such as communication and buying behaviors that affects the minds of consumers. Engagement performance can increase sales, profits, market value and cash flows of enterprise. The Economist Intelligence Unit argues that customer engagement is a close, long-term relationship with a customer. Moreover, engagement is the creation of experiences that enable businesses to engage in deeper, more meaningful, and more lasting interactions with enterprise, customers, and external participants.

It is proposed that customer engagement is not a fixed point that can be reached, but a process of expansion and evolution which happens over time. Forrester Consulting (2008) defines customer engagement as in-depth contact with customers to drive purchasing decisions, interactions, and engagement. This measures customer engagement by indicators such as sales volume, customer satisfaction and frequency of visits to the site. Thus, practitioners define customer engagement from an organizational point of view, pointing out that customer engagement helps customers to enhance their self-emotional, psychological or material input to the brand. Some researchers believed that customer engagement refers to the intensity of the customer's participation in related activities initiated by the customer or manufacturer. Customer engagement also exists as a dynamic, repetitive process in the service relationship of value co-creation (Vivek etc., 2009). Jaakkola and Alexander (2014) studied the drivers of customer engagement behavior and demonstrated the type of customer engagement behavior in the service system and the role of customer engagement behavior exhibited by different stakeholders.

According to the above research, scholars have also studied customer engagement from different perspectives based on service-dominant logic and relationship marketing. Service dominant logic is also an important theoretical basis for

customer fit. Some researchers found that more than 50 academic studies using the terms "engagement" and "engagement" emphasized service-dominant logic in their approach.

For example, customers are usually co-creators of value (hypothesis 6), indicating that customers and other agents create value together in interaction processes. Its participation and interaction are customer's behavior, which is related to establishing in-depth contacts with customers in order to drive purchase decision-making, interaction and participation (Brodie et al., 2011). Secondly, the service-dominant logic view is essentially based on customer-oriented and relational theory (hypothesis 8)", which indicates that services should not be transactional, but relational, and value co-creation occurs in specific service relationships. Some studies also emphasize that "non-transactional" is the driving force of transactional processes.

Thirdly, the enterprise cannot transfer value, but can only provide value propositions (hypothesis 7), this hypothesis emphasizes that enterprises can only provide their resources after their value proposition is accepted by customers through interaction to pursue value co-creation. Enterprises cannot create and transfer value alone. Customer engagement emphasizes the intensity of the customer's participation in the relevant activities initiated by the customer or manufacturer, that is, the level of customer participation. Service-dominant logic emphasizes customer participation, focusing on behavior, and the focus of customer engagement research is not only on customer behavior but is the performance and intensity of engagement, but also psychologically; it is an extension of core precepts of service-dominant logic.

3.2.3 Conclusion

Through analysis, we can easily note that the definition of preferential behavior is "the intensity of customer involvement in related activities initiated by customers or manufacturers", "related activities" are the focus of customer engagement. Participation in relevant interactions is the behavior that most reflects customer engagement, and "the intensity of related activities" is the result parameter to consider customer engagement.

The definition of biased psychology is "the interaction between enterprises or brands that customers experience", and "interaction" is the focus of customer engagement. It reflects customer engagement in the interaction, and the "level of interaction" is a parameter to consider the degree of customer engagement. Therefore, the difference between the two is that the former pays attention to the behavior and intensity of customer participation, while the latter pays attention to the level of interaction and interactions derived from customer psychological participation.

In fact, customer involvement based on behavior is also motivated by customer psychology. Participation in related activities initiated by customers or manufacturers is both the process of participation and interaction, and the intensity and level of participation are both parameters to consider the degree of customer engagement. Therefore, there is no essential difference in the definition of customer engagement between preferential behavior and preferential psychology. However, the definition of customer engagement is clearer and more comprehensive in a psychological way. With the help of psychological research, enterprises study and pay attention to customers within the framework of customer psychology which achieves a higher level of customer engagement. It should be a principal tenet and focus for theoretical research.

In summary, a combined definition of customer engagement emphasizes both behavior and psychology. This thesis defines customer engagement as a psychological state, which occurs through customer participation in the related interactions initiated by customers or manufacturers, i.e. value co-creation activities. It can be translated into actions, such as communication behavior and purchase behavior. Under different backgrounds and conditions, the level of customer engagement is different; customer engagement also exists as a dynamic and repetitive process in the service relationship of value co-creation.

At present, although customer engagement is an important issue of concern and one which is being widely studied by the marketing industry and academia, there is no consensus as to the connotations and dimensions of customer engagement at the theoretical level. In terms of the antecedent or outcome variables of customer engagement, although many possible variables have been proposed by researchers,

empirical research is still scarce and hence an empirical evidence base is scarce. It is rare to see studies on customer engagement from the perspective of the service-dominant logic, with many that have been conducted being only at the initial stage. Customer engagement and customer participation, customer engagement and value co-creation, customer engagement and relationship continuity are all areas worthy of study drawing on S-D theoretical and practical insights.

3.3 Research Model and Hypothesis

3.3.1 The Impact and Hypothesis of Customer Engagement on Value Co-creation Behavior

Customer engagement refers to the degree of customer's involvement in the relationship with the service provider, which includes behavior, cognitive performance and emotional performance (Patterson et al, 2006). Customer engagement also refers to a series of transactional and non-transactional behaviors aimed at the enterprise, which can ensure future sales, produce positive publicity effect and enhance brand reputation (Cambra-Fierro, 2013). Some authors point out that customer engagement means the ability and motivation of synergistic behavior and individuals to perform these behaviors (Mittler et al., 2013). In the positive interaction between customers and enterprises, potential customers and other customers, these can be transactional or non-transactional (Kumar et al., 2010).

It was also mentioned above that customer engagement is the intensity of customer's attention to organizational products or services, and the intensity of participation in activities initiated by customers or enterprises (Vivek et al., 2012). The intensity of customer involvement in enterprises, the exchange of knowledge and processes among other customers (Wagener & Majchrzak, 2007). When customer engagement reaches a certain intensity, customers are willing to participate in value co-creation process. It also believes that the goal of customer engagement is to establish an in-depth contact with customers in order to drive purchase decision-making,

interaction and participation.

Malthouse and Calder (2011) argue that behavior should be considered a manifestation of engagement. Satisfying customer participation and considering the intensity of customer participation needs to be reflected in certain behaviors; customer engagement is the interaction between customers and other customers, enterprises or brands. Therefore, customer participation in value co-creation can be regarded as the process of customer-to-enterprise and other customers interactions, as well as the process of creating value for enterprises, themselves and for other stakeholders. Customer engagement is a dynamic and cyclical process in the service relationship of value co-creation (Han, 2016). Customer engagement exists in the service system of value co-creation and plays an important role in service relationship networks. Other relationship variables are the pre-or post-variables of the cyclical customer engagement process (Brodie et al., 2011). Value co-creation exists in the process of Customer-Enterprise interaction (Prahalad & Ramaswamy, 2004). The interaction of value creation is carried out in the activity of value creation.

Value co-creation in virtual environments can be initiated by enterprises or customers (Zwass, 2010). Therefore, customer participation in VPE value creation is the interaction between customers' motivation and PE and other participants. The psychological state and a series of behaviors formed in the process of creating value by using knowledge and skills are derived from the backward extension of customer engagement behavior. Customer participation in customer or enterprise-initiated value creation process is customer engagement behavior and postpositional relational variables. According to Service-dominant Logic (FP2), customer engagement exists in the service relationship of value co-creation, which is the value exchange behavior of "service to service" in the process of value creation interactions. Research on customer engagement is important for enterprises to invest in their customers' interests. It can provide consistent behaviors and improve the effectiveness of customer participation in value creation by focusing on customer psychology, behavior and emotions, utilizing targeted and dynamic interactions. Based on this point, it can be considered that customer engagement is a necessary condition for generating better effects on customer

participation in value co-creation, and the entry point for in-depth study of service-dominant logic in value co-creation processes.

Based on the above, this thesis has H1 and H2 hypothesis below:

H1: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by PE.

H2: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by customers.

3.3.2 The Impact and Hypothesis of influence between Customer-initiated Value Co-creation and PE-initiated Value Co-creation

The traditional viewpoint of goods-dominant logic, which is separating enterprises from customers, regards enterprises as value creators, customers as product receivers, and market functions of value exchange and value extraction. This view is arguably outdated, the more accurate expression should be that enterprises and customers cooperate in the process of value creation (Prahalad & Ramaswamy, 2004). With the change in market environments, the role of customers in value creation processes has changed. Value is no longer created by enterprises alone but created by enterprises and customers together (Prahalad & Ramaswamy, 2000). In value co-creation processes, customers play an active role in creating value with companies (Kohler et al., 2011; through direct and indirect production and consumption cooperation in one or more stages (Hoyer et al., 2010; Payne et al., 2008; Roggeveen et al., 2012; Tynan et al., 2010).

Zwass (2010) believes that value creation in virtual environments can be initiated by enterprises or begin spontaneously when initiated by customers. He divides value co-creation into sponsored value co-creation and autonomous value co-creation. The sponsored value co-creation refers to the value co-creation activities initiated by

enterprises or communities, while the autonomous value co-creation refers to the voluntary participation of customers in the value creation activities. According to the service-dominant logic, enterprises cannot provide value, but can participate in creating and claim value proposition. Enterprises put forward value propositions according to customers' demands. After customers accept their propositions, they form common value creation goals with customers, and realize value creation with customers through resource exchange and interaction. That is to say, "reciprocity commitment about value", and then realize value by converting the resources provided by other actors into specific interests in their respective value process. Co-creation of consumption experience is the core of co-creation of customer and enterprise value. Enterprises need to invest more energy and actively participate in the activities of "Joint Value Creation" (Prahalad & Ramaswamy, 2004). They also believe that value creation exists with the process of interaction between customers and enterprises.

Through interaction, enterprises and customers determine service objectives, solve related problems, improve service quality and create value together. Collaboration among value creators may contribute to value creation, such as customer value and enterprise value creation through interaction between consumer communities. Interaction between enterprises and customers is the key to creating value together (Grönroos, 2006). Interaction orientation is the concrete implementation and realization process of value co-creation. Value comes not only from the use of products or services, but also from the reciprocal interaction between customers and suppliers (Payne et al., 2008; Cronroos, 2008). Since cooperative production is a built-in element of transactions, initiated by the company and usually limited to the duration of service contact, it is not voluntary, but is an extra role with behavior with broader interactive characteristics like customer engagement behavior (Jaakkola & Alexander, 2014).

In order to ensure the smooth progress of value co-creation, enterprises must also provide value co-creation support systems, including hardware such as infrastructure and software which includes organizational structure, regulations, culture and atmosphere to help and support consumers to achieve value co-creation (Kelley, 1992). Enterprises play three roles in value creation systems: proposing value propositions,

creating value through interactions with consumers and providing value co-creation support systems. Improving the quality of interaction with consumer value creation and providing unique experience support systems for consumers are important strategies to promote (Vargo & Lusch, 2004; Prahalad & Ramaswamy, 2004).

That is, customer-initiated value creation needs to be realized in the vehicle, which is the vehicle set by the enterprise or virtual vehicle which set by the enterprise. Customer-initiated value creation needs to be supported and guaranteed by the enterprise, and it needs to be transformed into the behavior of the enterprise in order to carry out and realize it effectively. Based on the above, according to the customer's needs - customer initiated value creation propositions, enterprises and customers form a common goal of value creation, and through the exchange of resources and interaction with customers can achieve value co-creation.

Therefore, this thesis has a hypothesis below:

H3: Customer-initiated value creation has a significant positive impact on PE-initiated value creation

3.3.3 The Impact and Hypothesis of Customer Participation in Value Co-creation Activities on the Value of Coproduction

Many studies have shown that co-production and Value-in-Use are the two main dimensions of value co-creation, and value co-creation is the process of extended exchange between co-production and customer value (Ranjan & Read, 2016). They also suggest that customers can interact with enterprises in a variety of ways and create value together. Value co-creation includes value for enterprises and value for customers (Gupta & Lehmann, 2006). Customer engagement stems from a positive customer attitude that communicates with established brands, products, or service categories and can be translated into actions such as communication and buying behaviors. These influencing behaviors refer to customer contributions of resources such as knowledge.

experience, and time, to affect other actors' perceptions, preferences, or knowledge regarding the firm (Jaakkola & Alexander. 2014).

This promotes customer participation in value creation, in the process of customer and enterprise value creation interactions, affects customer purchases, recommendations, influence and feedback behavior and generates value, in order to create the co-creation value behavior. Customer Engagement promotes customer creativity and can improve enterprise performance or customer value (Auh et al., 2007; Chan et al.,2010). In the process of customer behavior, the exchange of value and service of mutual use between enterprises and customers is realized, and the result is that the cooperation between the customer and the enterprise occurs, which is not only what the enterprise expects, but also what the customer expects. It embodies the concept that customer participation is essential for value co-creation (FP6), service is the fundamental basis of exchange (FP1) and the attribution of co-creation value in the service-dominant logic. Therefore, the following assumptions are put forward:

H4: Customer participation in value co-creation initiated by PE has a significant positive impact on the value generated by customer purchasing behavior.

H5: Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer recommendation behavior.

H6: Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer influence behavior.

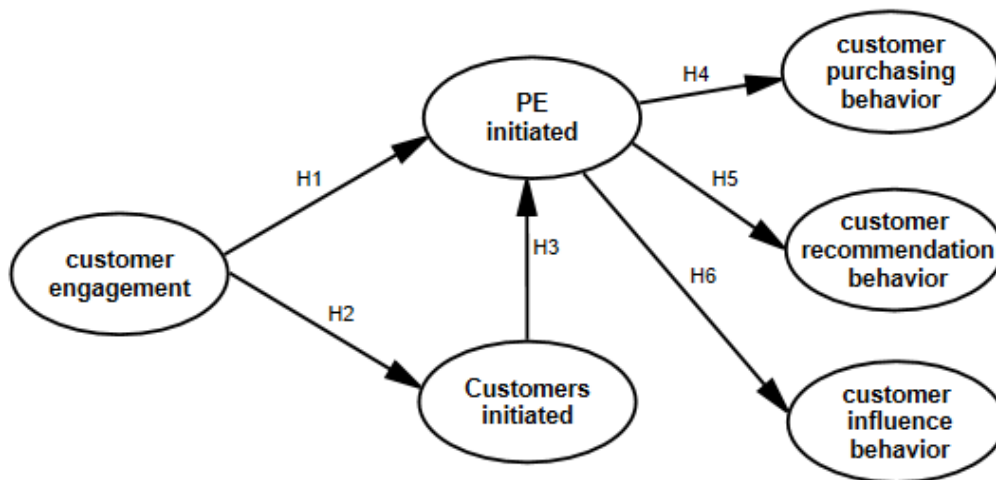
3.3.4 Summary of Customer Engagement Research Model and Hypothesis

It can be seen from the definitions expounded in studies that although the single-

dimension definition of customer engagement focuses on different aspects, it usually implies two factors, which are psychological and behavioral. The three-dimensional definition of cognition, emotion and behavior is also being recognized more and more, because customers' psychology and behavior cannot be completely separated. Customers' behavior is dominated by their implicit psychological activities. At the same time, behavior will affect psychology (Jing & Li, 2015). A one-dimensional definition of customer engagement is a kind of customer's psychology or behavior, which is deficient in reflecting the scope of the concept of customer engagement (Brodie et al., 2011); while a multi-dimensional definition covers both psychological and behavioral aspects, which can better explain customer engagement, enable people to understand customer engagement more thoroughly, and has been well used in empirical studies (Han et al., 2016). However, because customer engagement involves psychology, and there are more psychological variables involved in different application scenarios and different perspectives.

Many researchers have also given more complex research models (Sashi, 2012; Lin, 2013; Van Doorn, 2010; Brodie, et al., 2013). Because customer engagement is dynamic (Brodie, 2011), this means this process is changing every minute. We cannot exhaust or determine the psychological variables involved in the static environment in advance, and it is not necessary, so it is important to recognize the importance of customer engagement and how to control the dynamics of its main elements in the process. Therefore, combined with previous research, customer engagement (CE) is a psychological state that occurs when customers participate in the related interaction initiated by customers or PE, i.e. value creation activities, which can be translated into actions, such as communication behavior and purchase behavior. Under different backgrounds and conditions, the level of customer engagement is different; customer engagement also exists as a dynamic and repetitive process in the service relationship of creating value together. The research model of customer engagement in this thesis is as follows:

Figure 3.1: Customer Engagement and co creation value research model in VPE community



The hypotheses are summarized in the following table in this whole section:

H1: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by PE.

H2: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by customers.

H3: Value creation initiated by customers has a significant positive impact on value creation initiated by PE.

H4: Customer participation in value co-creation initiated by PE has a significant positive impact on the value generated by customer purchasing behavior.

H5: Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer recommendation behavior.

H6: Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer influence behavior.

3.4 Questionnaire design and Investigation

3.4.1 Research Variables and Measurement Items

Definition and Scale of Variables

All variables in the study model were based on the existing measurement scales in the literature. In this thesis, customer engagement refers to the measurement scale of customer engagement developed by Vivek (2012) and Han (2016), which measures customer's psychological and behavioral performance from three dimensions: enthusiasm, conscious participation and interaction (Vivek, et al, 2009); customer participation value co-creation refers to relevant measurement items developed by Zwass (2010), Koh and Kim (2004) and Li (2014); Customer cooperative behavior includes customer purchase behavior, customer recommendation behavior and customer influence behavior. (Kumar et al., 2008) On the basis of references, the tables used in this study were established after consultation with industry experts and group discussions. See the table below that indicate that Likert's five-quarter scale was used to measure all concepts.

The preliminary scale was also deployed in the pilot study, and then it was formally used for testing after pre-judgment and revision based on initial results. In order to ensure the content validity of the questionnaire, this thesis translated the Chinese version of the questionnaire from English. The measurement items referring to the relative translations of the top domestic journals and monographs. Then, professionals were invited to translate the Chinese version into English and revise it several times, to make the Chinese and English versions more correct and accurately reflect one another. There is no significant difference between the two versions in meaning. It can be concluded that the Chinese version of the scale expresses the content of the corresponding source English scale accurately.

In addition, before issuing the scale, some members and experts in the industry were communicated with and subsequently helped revised the test content, the rhetoric and expression of the test content were clear and accurate, covering the content to be

measured. Further, the initial measurement items were pre-investigated. A pre-adjusted questionnaire was sent to some senior members of the PE community, and 20 valid questionnaires were received. After analysis and modification of the pre-survey questionnaire during pilot study, two items were reduced, and the number and content of the items were optimized. Finally, the formal test questionnaire was decided.

Table 3.2: Measurement Item

Variable	Identifier	Measurement Item	Scale sources
Customer Engagement (CE)	CE1	I spend a lot of my discretionary time in the PE community.	Vivek (2012)
	CE2	I am passionate about the PE Community activities	
	CE3	Compared with other activities, I prefer to spend a lot of time online or offline activities initiated by PE community.	
	CE4	Participating in or paying attention to PE community activities is an important part of my spare times.	
	CE5	I pay a lot of attention to anything about the PE Community investment activities	
	CE6	Join the PE community is more fun when other people around me do it too.	
Customer participation in value co-creation process, which initiated by PE (CPC-PE)	CC1	I will often participate new financial product discussion and creative solicitation activities, which sponsored by PE community.	Koh, Kim (2004) Zwass (2010) Li (2014)
	CC2	I will often participate new financial product evaluation activities in PE community.	
	CC3	I will often participate new investment projects or financial product promotional roadshow activities, which sponsored by PE community.	
Customer participation in value co-creation process, which initiated by customers. (CPC-C)	CP1	I will often share my ideas about new products with members in PE community forum.	
	CP2	I will often launch discussions about the PE brand or product related topics in PE community.	
	CP3	I will always respond the demands positively from other members of the PE community.	
	CP4	I will often help other members in PE community to solve problems related to investment and financing. .	
Purchasing Behavior (PB)	CB1	Compared with other PE products, I would prefer this PE products.	Kumar et al., (2010) Han et al., (2016)
	CB2	Compared with another PE fund, I would prefer to become this PE's customer.	

Recommendation Behavior (RB)	CR1	I will take the initiative to recommend this PE to my family and relatives.
	CR2	I will actively recommend this PE to other people in normal chat.
Influence Behavior (IB)	CA1	If a member wants to quit the PE, I will persuade him to stay.
	CA2	I will introduce PE good projects which I believe to other members in the community.
	CA3	I'll introduce other members of the community to how to choose a PE to join.
	CA4	I will take the initiative to introduce to other members of the community PE advanced hardware and software and use experience;
	CA5	I will take the initiative to introduce the service features of PE to other members of PE community.

3.4.2. Distribution and Recovery of Research Questionnaires

The main geographical areas investigated in the questionnaire were Beijing, Shanghai, Jiangsu, Zhejiang and Chengdu, where PE is the most developed and are the largest markets in China. The main respondents were GP, LP and PE management staff, as well as customers (individuals and PE) who wanted to participate in PE. The questionnaire was an online type, which was easily received and answered by smartphones and computers. With the help of Tencent's social survey website and WeChat community, Tencent, China's largest Internet integrated services and services company with the largest number of users. It is the insurance for the validity and reliability of this research that online questionnaires distribution was utilized. Tencent Questionnaire Professional Website and WeChat Community has more than 300 million real name registered users.

In this regards, Tencent Questionnaire Professional Website has established various professional registration questionnaires answering groups, who are willing to share attitudes through registration and have been filtered through to ensure relevant expertise for a considerable duration. Their professional level and ability have become an important application tool for social surveys for numerous research institutions, universities and PE. This research used the WeChat community to distribute online questionnaires to GP, LP and PE management staff and colleagues who have established

their long-term working relationships in PE. In order to achieve the precise delivery of the questionnaire, each person has only the right to answer one of the online questionnaires. Tencent Questionnaire Professional Website provides a dedicated information channel to receive the information collected from questionnaires in a unified way. The survey tools provided surpass the traditional ones in terms of the logic of questionnaire design, convenience and completeness of questionnaire answers, time of questionnaire recovery, pertinence of the objects to be distributed. Finally, as mentioned in for the previous empirical analysis, SEM (structural equation model) was used as an analysis tool for this research. Therefore, extraction and routine statistical analysis of survey data, export and analysis will use SPSS and AMOS software were used for this research.

3.5 Data Analysis

Under the structural equation model (SEM) theory, SPSS (V22.0.0.0) and AMOS (V24.0.0) software were used to analyze and verify the collected data and theoretical model.

This research belongs to the category of PE customer participation value co-creation of equity investment funds, and the objects of the research are individuals or PE who accept or intend to accept PE products or services. The items of the questionnaire in this study were mainly used to verify the theoretical model, which has been mentioned in previous chapters. They are supported by many theoretical and academic studies. The measurement items are relatively mature, and they were also selected and established after consultation and discussion with industry experts. The questionnaire was mainly based on an online questionnaire, which made full use of the characteristics of professional social survey online questionnaire, quickly and accurately put into the smart phones or computer terminals of the respondents, effectively delivered and recycled, and the data was analyzed with the application of professional software.

3.5.1 Data description and Statistics

The results of statistical analysis of individual characteristics are as follows:

Table 3.3: Data Description

Category	Classification	Quantity	Percentage
Personnel Structure	General Partner	53	22.84%
	Limited Partner	16	6.90%
	Management Staff of PE	50	21.55%
	Customers willing to join PE	113	48.71%
Working Time in PE Industry	Not yet	107	46.12%
	Less than 1 years	41	17.67%
	2-3 Years	39	16.81%
	3-5 Years	26	11.21%
	More than 5 years	19	8.19%
Education Background	High school / The Secondary school / Technical School	12	5.17%
	Professional training College	34	14.66%
	Undergraduate	134	57.76%
	Postgraduate	45	19.39%
	Doctoral Degree or above	7	3.02%

- Personnel Structure of Investigation

The total number of survey samples was 232, including 119 general partner GP, LP and management staff who have already worked in PE fund, accounting for 51.29%, which is equivalent to 113 customers who were willing to join PE; 53 general partners, accounting for 22.84%, which is the research target of this thesis, the rest were LP accounting for 26.87% in total. The representativeness of the sample structure is suitable for this research

- Working Time in PE Industry of Instigator

53.88% of the respondents who had work experience in PE, 36.21% of them had more than 2 years of work experience. Their participation is undoubtedly very beneficial to the quality assurance of the questionnaire in this thesis.

- Education Background

80.17% of the respondents had a bachelor's degree or above, 22.41% had a master's degree or above, including 7 doctors. The participation of highly educated people

in the questionnaire provides a favorable guarantee for the validity and reliability of data obtained in this research.

3.5.2 Data Normal Distribution Test

In this thesis, the maximum likelihood estimation (ML) of structural equation model is applied. This method requires that the sample size to be large enough and that the data should obey the normal distribution. In this thesis, the number of survey samples was 232, and the data of normal test of each observation variable was as follows:

Table3.4: Assessment of Normality (Customer Engagement Test)

Variable	Min	Max	Mean	Skew	Kurtosis
CJ1	1	5	3.70	-0.68	0.54
CJ2	1	5	3.81	-0.89	1.27
CJ3	1	5	3.75	-0.54	0.46
CE1	1	5	3.42	-0.42	-0.62
CE2	1	5	3.62	-0.43	-0.38
CE3	1	5	3.48	-0.62	0.08
CE4	1	5	3.59	-0.86	0.41
CE5	1	5	3.88	-1.21	2.25
CE6	1	5	3.76	-1.05	1.49
CC1	1	5	3.82	-0.92	1.17
CC2	1	5	3.88	-0.72	0.67
CC3	1	5	3.59	-0.48	-0.26
CP1	1	5	3.65	-0.66	0.14
CP2	1	5	3.60	-0.43	-0.07
CP3	1	5	3.59	-0.54	-0.03
CP4	1	5	3.70	-0.61	0.31
CB1	1	5	3.67	-0.42	0.39
CB2	1	5	3.92	-0.74	1.25
CR1	1	5	3.61	-0.65	0.49
CR2	1	5	3.68	-0.66	0.53
CA1	1	5	3.45	-0.44	-0.22
CA2	1	5	3.82	-0.65	0.46
CA3	1	5	3.73	-0.69	0.44
CA4	1	5	3.59	-0.45	-0.40
CA5	1	5	3.72	-0.80	0.69
CF1	1	5	3.76	-0.74	0.81
CF2	1	5	3.89	-0.83	0.98

As we know the standard normal distribution has a skew which equals 0 and kurtosis which equals 3.0 respectively. However, these standard skew and kurtosis may not be very useful in large samples because even slight difference from normal distribution may be statistically significant for the research. There are numerous of study which give us a different normal distribution criterion, though that are based on computer simulation studies of estimation methods used by SEM computer programs. According to the research results of Kline (1998), variables with absolute values of skew index less than 3.0 and kurtosis less than 8.0, it can be determined that the sample data basically obey the normal distribution. The absolute value of skew is more than 3.0 and kurtosis index greater than 10.0 may suggest a problem, and values greater than 20.0 may indicate a more serious one.

As shown in the table, the absolute values of skewness and kurtosis of the survey sample data in this research meet the requirements of normal distribution for further test.

3.5.3 Model Testing

There are many different suggestions on the evaluation of model fit, but the arguments of Bagozzi and Yi (1988) are the most comprehensive. They suggest that if the hypothetical model and the actual data have good fit index, the following three aspects should be considered at the same time: preliminary fit criteria, the overall model fit and the fit of internal structural model. Bagozzi and Yi (1998) subdivided the overall model fit into absolute fit indexes, relative fit indexes and parsimonious fit indexes. In addition, Hair (1998) also divided the overall model fit evaluation into three categories: absolute fit measurement, incremental fit measurement and parsimonious fit measurement. When evaluating the fitness of the model, it is better to consider the above three indicators at the same time, so as to produce a consensus result on the acceptability or rejection of the model.

Through SEM method analysis can evaluate whether the hypothesis model proposed by researchers is compatible with the actual data. Model-fit evaluation

indexes and standards are as follows:

Table 3.5: SEM overall model goodness of fit evaluation indexes and standards

Statistic inspection value	Fit standard or critical values	Reference
Absolute Fit Indexes		
χ^2	Significant probability value $p > 0.05$	Wu, 2009 Rigdon, 1995
GFI (goodness-of-fit index)	> 0.90	Yu, 2006
AGFI (adjusted goodness-of-fit index)	> 0.90	Hu & Bentler, 1999 Bollen & Long, 1993
RMR (root mean square residual)	< 0.05	Cudeck & Henly, 1991 Stevens, 1996
RMSEA (Root mean square error of approximation)	< 0.05 (good fit) < 0.08 (reasonable fit)	Hu & Bentler, 1999 Mc Donald & Ho, 2002
Relative Fit Indexes		
NFI (normed fit index)	> 0.90	Bentler, 1989
RFI (relative fit index)	> 0.90	Bentler, 1989
IFI (incremental fit index)	> 0.90	Bentler, 1989
TLI (NNFI) (Tacker-Lewis index=non-normed fit index)	> 0.90	Qiu, 2005
CFI (comparative fit index)	> 0.90	Hu & Bentler, 1999 Bollen & Long, 1993
Parsimonious Fit Indices		
PGFI (parsimony goodness-of-fit index)	> 0.50	Huang, 2005
PNFI (parsimony-adjust NFI)	> 0.50	Yu, 2006
CN (Critical number of sample)	> 200	Hoelter, 1983
NC ((χ^2 /Freedom, Normed chi-square)	< 2	Wheaton, 1987, Huang, F. M., 2005

In the table, χ^2 refers chi-square value of research model, when $\chi^2=0$ means it is perfect fit for research model and data. However, there is a problem along with sample increase, the chi-square will increase too, especially in a large sample. Therefore, $P > 0.05$ is a key point, which means the possibility of discrepancy between research model and actual data is very low.

The fit test results of customer engagement theoretical model were as follows:

Table 3.6: The Inspection Data and Fit Judgment of the Customer Engagement Theory Model

Statistic inspection value	Fit standard or critical values	Test results data	Model fit judgment
Absolute Fit Indexes			
χ^2	Significant probability value $p > 0.05$	145.444 (P=0.404)	Yes
GFI	>0.90	0.948	Yes
AGFI	>0.90	0.907	Yes
RMR	<0.05	0.029	Yes
RMSEA	<0.05(good fit) <0.08(reasonable fit)	0.010	Yes
NCP	The smaller the better, the 90% confidence interval contains ZERO	0.000	Yes
Relative Fit Indexes			
NFI	>0.90	0.957	Yes
RFI	>0.90	0.930	Yes
IFI	>0.90	0.999	Yes
TLI (NNFI)	>0.90	0.998	Yes
CFI	>0.90	0.999	Yes
Parsimonious Fit Indexes			
PGFI	>0.50	0.532	Yes
PNFI	>0.50	0.588	Yes
CN	>200	232	Yes
NC	<2	1.024	Yes

The results show that the model has a high degree of goodness of fit and is suitable. Therefore, the research model can be said to be effective.

3.5.4 Reliability and Validity analysis

The goodness of fit index can be said that is the analysis the external quality of the research model. The degree of the fitness of the internal structure of the model represents the reliability and validity of each measurement Items. In this section it will do the test for the internal quality of the model.

Some studies have proposed component fit measures to explain the fit of internal structural index of the model. Although, the research model and actual data has good

fit index, the individual measurement item may be meaningless. Therefore, it is better to test each measurement item to ensure the fit of the model (Bollen, 1989). The evaluation of internal structural fit includes the following two aspects: one is the evaluation of measurement model; the other is the evaluation of structure model. The former focuses on whether the measurement variables are enough to reflect the corresponding latent variables, and its goal is to understand the validity and reliability of the latent construction; the latter is to evaluate whether the causal relationship defined in research model.

In the measurement of fitness of the model, researchers focus on the relationship between latent variables and their indicator variables (such as explicit variables). Validity reflects the actual measurement degree of the index variable. Reliability refers to the consistency of measurement. Only when we believe that the measurement is accurate, then we can further explore the relationship between latent variables.

Reliability usually focus on consistency, stability and reliability of measurement results. It indicates the possibility of using the same observation method to obtain the same observation data (results) for the same object (Li, 2004). Cronbach's alpha coefficient and composite reliability are usually used for reliability tests. The best composite reliability is above 0.7 for Cronbach's α reliability coefficient (Hair et al., 1998).

The composite reliability mainly evaluates the consistency of a set of latent construct indicators. This reliability index belongs to internal consistency index. The higher the composite reliability is, the higher the internal correlation exists between the measurement indexes. Generally, the composite reliability coefficient values are all above 0.60, indicating that the internal quality of the model is good (Bogozzi & Yi, 1988).

Validity indicates the degree of authenticity and accuracy of a study. There are many methods to test validity. The content validity and construct (also known latent construct) validity are commonly used validity testing tools.

Content validity refers to the extent to which the measured content reflects or represents the construct that the researcher wants to measure. It is usually judged by

experts that is to say; relevant experts make a judgment on the conformity between the test questions and the original content range; or use quantitative statistical analysis to evaluate the content validity of measurement items. The measurement content of this thesis mostly comes from the previous mature research results and published papers by many researchers investigating this area. (see Table 3.2)

Construct-related Validity

Construct-related validity refers to the consistency between the definition and measurement of construct, which is composed of convergence validity and discriminant validity (Chen et al., 2008).

- **Convergent validity**

Convergent validity refers to the degree to which a test can measure a theoretical construct or its characteristic, that is, whether the test results can confirm or explain the hypothesis, term or construct of a theory (Wu, 2009). In the application software of AMOS, if the factor load of all indicators in each measurement item is highly significant, and the factor load of each construct measurement item is greater than 0.7 (at least 0.55, see table 3.7 for the criteria), and the average variance extracted value AVE (average variance extracted) is greater than 0.5, it means that the data has a high convergence validity.

Table 3.7: Criteria of Factor Load

Factor Loading	(Factor Loading) ²%	Status
0.71	50%	Excellent
0.63	40%	Very good
0.55	30%	Good
0.45	20%	Normal
0.32	10%	Poor
Lower than 0.32	-----	Fail

Source: Qiu & Lin, (2009). Principle and application of structural equation model

- **Discriminant Validity**

Discriminant validity refers to the existence of significant differences or low

degree correlation between indicators in different constructs. There are many methods to evaluate the discriminant validity. In AMOS software, the AVE (average variation extracted) method and SEM method proposed by can be applied conveniently (Ping 2005).

Average variation extracted method was proposed to check whether the AVE in each construct is greater than the determinant coefficient (square of correlation coefficient) among them, so as to test the discriminant validity (Fornell & Larcker, 1981). That is to say, if the AVE of an individual construct is greater than the determinant coefficient (the square of standardized correlation coefficient) of this construct and all other constructs, there is a difference between them.

In Amos, in order to find the discriminant validity between two construct, we use a single group to generate two models, which are unconstrained model A (the covariance between constructs is unrestricted, which is a free estimation parameter) and constrained model B (the covariance between constructs is limited to 1). The null hypothesis and the opposite hypothesis tested are as follows:

Null hypothesis: Model A = Model B

Alternative hypothesis: Model A \neq Model B

After AMOS's calculation, if the significance P value of chi-square difference between the two models is less than 0.05, the null hypothesis of no difference between the two models is rejected. If the significance P value of chi-square difference between the two models is greater than 0.05, then we cannot reject the null hypothesis of the two differences; If the increase of NFI, IFI, RFI and TLI is less than 0.05, the null hypothesis that there is no difference between the two models was supported (Little, 1997; Wu, 2009). After do the discriminant validity test, it gets following results showed in table 3.8.

Table 3.8: Reliability and Validity Test of Customer Engagement

Variables	Measurement Item	Factor load and P	(Factor load) ²	Cronbachs' α	Composite Reliability	AVE
Influence Behavior (IB)	CA1	0.680***	0.462	0.876	0.868	0.569
	CA2	0.737***	0.543			
	CA3	0.748***	0.560			
	CA4	0.825***	0.681			
	CA5	0.776***	0.602			
Customer Engagement (CE)	CE1	0.660***	0.436	0.845	0.856	0.501
	CE2	0.769***	0.591			
	CE3	0.817***	0.667			
	CE4	0.756***	0.572			
	CE5	0.601***	0.361			
	CE6	0.617***	0.381			
Customer Participation in Value Co-creation, which Initiaed by Customer (CPC-C)	CP1	0.888***	0.789	0.879	0.922	0.746
	CP2	0.799***	0.638			
	CP3	0.892***	0.796			
	CP4	0.873***	0.762			
Customer Participation in Value Co-creation, which Initiaed by PE (CPC-PE)	CC1	0.799***	0.638	0.770	0.679	0.864
	CC2	0.814***	0.663			
	CC3	0.857***	0.734			
Purchasing Behavior (PB)	CB1	0.848***	0.719	0.728	0.737	0.587
	CB2	0.674***	0.454			
Recommendation Behavior (IB)	CR1	0.828***	0.686	0.816	0.810	0.682
	CR2	0.822***	0.676			

Note: *** means $p \leq 0.001$

It can be seen from table 3.8 that, according to the judgment criteria, this research 22 factor loads and factor load squares of construct measurement items are good and above of the criteria (see Table 3.7), and the average variance extracted value AVE is all greater than 0.5, indicating that the data has a high convergence validity.

Moreover, according to the analysis of table 3.8, it is easy to see that in the reliability and validity test the Cronbachs' α are all above 0.70 and composite reliability coefficient are all above 0.60. The AVE values are all above 0.50. That means the research model has good internal quality and good convergent validity.

Table 3.9: Comparison Between Variable's AVE and Square of Construct's standardized Correlation Coefficient

Variables	CE	CPC-PE	CPC-C	PB	RB	IB
CE	0.501 (AVE)					
CPC-PE	0.542	0.864 (AVE)				
CPC-C	0.445	0.585	0.746 (AVE)			
PB	0.432	0.489	0.487	0.587 (AVE)		
RB	0.281	0.340	0.392	0.679	0.682 (AVE)	
IB	0.471	0.471	0.692	0.490	0.650	0.569 (AVE)

The abbreviation of variables shows in table 3.9, and full description of measurement item can check in Table 3.2.

According to the test date of variables in Table 3.9, it should have more attention on discriminant validity of two groups between variable (CE & CPC-PE) and (PB & RB). The AVE of an individual construct is greater than the square of the standardized correlation coefficient between this construct and all other constructs, so there is a difference between variables (Fornell & Larcker, 1981). However, in the comparison results in table 3.9, there are four groups variable AVE value less than the square of standardized correlation coefficient. The square of correlation coefficient between CE and CPC-PE is 0.542, which is larger than AVE 0.501. The same situation between PB and RB is 0.679, which is larger than AVE 0.587. Moreover, the square of correlation coefficient between CPC-C and IB is 0.692, which is larger than AVE 0.569. The last group is RB and IB, the square of correlation coefficients 0.650, which is larger than AVE 0.569 as well.

In order to further determine their discriminant validity, SEM method is adopted as follows.

Firstly, it focusses on analysis between customer engagement (CE) and customer participation in value co-creation, which initiated by PE (CPC-PE). The comparison of nested models is as follows:

Table 3.10: Nested Model Comparisons (CE & CPC-PE)

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
The Constrained Model	1	52.942	0.000	0.051	0.053	0.066	0.068

The degree of freedom difference between the two constructs of customer engagement (CE) and customer participation in value co-creation (CPC-PE) is 1, and the difference of chi-square value is equal to 52.942 ($P = 0.000 < 0.05$); the increase of NFI, RFI, IFI and TLI values is not less than 0.050, rejecting the null hypothesis that the two constructs have no difference. There is a difference with discriminant validity between these two variables.

Secondly, it focusses on analysis between purchasing behavior (PB) and recommendation behavior (RB). The comparison of nested models is as follows:

Table 3.11: Nested Model Comparisons (PB & RB)

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
The Constrained Model	1	72.997	0.000	0.192	0.192	0.568	0.577

The degree of freedom difference between the two constructs of purchasing behavior (PB) and recommendation behavior (RB) value is 1, and the difference of chi-square value is equal to 72.997 ($P = 0.000 < 0.05$); the increase of NFI, IFI, RFI and TLI values are all more than 0.05, rejecting the null hypothesis that the two constructs have no difference. The discriminant validity between the two constructs is obviously.

Thirdly, it focusses on analysis between the customer participation in value co-creation by customer (CPC-C) and influence behavior (IB). The comparison of nested models is as follows:

Table 3.12: Nested Model Comparisons (CPC-C & IB)

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
The Constrained Model	1	49.438	0.000	0.037	0.038	0.063	0.065

The degree of freedom difference between the two constructs of purchasing behavior (PB) and recommendation behavior (RB) value is 1, and the difference of chi-

square value is equal to 49.438 ($P = 0.000 < 0.05$); the increase of RFI and TLI values are more than 0.05, rejecting the null hypothesis that the two constructs have no difference. The discriminant validity between the two constructs is obviously.

Finally, it focusses on analysis between the recommendation behavior (RB) and influence behavior (IB). The comparison of nested models is as follows:

Table 3.13: Nested Model Comparisons (RB & IB)

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
The Constrained Model	1	53.351	0.000	0.057	0.058	0.079	0.081

The degree of freedom difference between the two constructs of recommendation behavior (RB) and influence behavior (IB) value is 1, and the difference of chi-square value is equal to 53.351 ($P = 0.000 < 0.05$); the increase of NFI, IFI, RFI and TLI values are all more than 0.05, rejecting the null hypothesis that the two constructs have no difference. The discriminant validity between the two constructs is obviously.

Therefore, through a comprehensive analysis and test of reliability and validity, the measurement items of customer participation value co-creation mostly come from mature research results and published papers by many scholars, it provides a solid base for this research. The composite reliability and Cronbach's α coefficient of variables are all greater than 0.7, and the AVE value is also greater than 0.5, indicating that the research model of customer engagement has better internal and external quality. Moreover, the factor loads and the square of factor loads indicates that the data has good convergence validity. In the last part, discriminant validity test also provides a reasonable result in this section. It is believed that the following hypothesis test result will show a comprehensive content to us through this research methodology.

3.5.5 Hypothesis Test Results

Applying the results of the structural equations model (SEM) by AMOS, the

standardized path coefficient estimates between the conceptual models (see Figure 3.1) are shown in the table:

Table 3.14: The Standardized Path Coefficient Estimates Between the Conceptual Models

Path Relationship		Path coefficient β	T	P	Hypothesis Test	
Customer participation in value co-creation initiated by PE	<---	Customer Engagement	0.425	4.592	***	H1 was Supported
Value co-creation initiated by customers	<---	Customer Engagement	0.651	5.938	***	H2 was Supported
Value co-creation initiated by PE	<---	Value co-creation initiated by Customers	0.557	7.188	***	H3 was Supported
Value generated by customers' purchase behavior	<---	Value co-creation initiated by PE	0.718	8.004	***	H4 was Supported
Value generated by customer recommendation	<---	Value co-creation initiated by PE	0.624	6.769	***	H5 was Supported
Value generated by customer influence behavior	<---	Value co-creation initiated by PE	0.707	7.010	***	H6 was Supported

Note: *** means $P \leq 0.001$

According to the test data in the table above, the hypothesis theoretical model are supported as follows:

H1: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by PE ($\beta = 0.425$, $T= 4.592$, $P < 0.001$).

H2: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by customers ($\beta=0.651$, $T=5.938$, $P < 0.001$) .

H3: Customer-initiated value creation has a significant positive impact on enterprise-initiated value creation ($\beta=0.557$, $T=7.188$, $P < 0.001$).

H4: Customer participation in value co-creation initiated by PE has a significant positive impact on the value generated by customer purchasing behavior. ($\beta=0.718$, $T=8.004$, $P<0.001$)

H5: Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer recommendation behavior. ($\beta=0.624$, $T=6.769$, $P<0.001$)

H6: Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer influence behavior. ($\beta=0.707$, $T=7.010$, $P<0.001$)

3.6 Discussion of Data and Results

3.6.1 Value Co-creation Vehicle – VPE (virtual private equity)

Although research shows that customer participation in value co-creation is important, it is also necessary to introduce participants including customers to participate in value co-creation in the service process according to the service-dominant logic. Moreover, there is a need to integrate the operant resources of actors (participants), services exchange and values exchange in the process of service interaction. This thesis has also made empirical confirmations to prove these previous views. However, like many enterprises, PE funds are limited by their own rules and regulations, and customers who have not become shareholders or employees of the enterprise are faced with difficult in directly participating in the value co-creation of a PE fund. Also, the "sense of distance" generated by the closed management mode makes it difficult to attract customers directly to become LP to participate in PE value co-creation. So, where do customers

participate in value co creation? Where is the interactive process of value co creation constructed? Where is resource integration, service exchange and value exchange going on? If these basic elements of value co-creation are not guaranteed, the concept of action of value co-creation cannot be understood thoroughly and determined. Value co-creation can easily become a concept without substance (Grönroos, 2011).

In order to solve the problem of customer participation in the value co-creation process, this thesis designs a special purpose virtual PE (VPE) community initiated by an actual PE (APE), which not only serves as the co-creation vehicle of LP value co-creation, but also serves as the vehicle of interaction and co-creation between VPE and APE. Moreover, it serves as the vehicle of identity transformation and exchange value of APE and VPE for customers. That is to say, the VPE is different from most non-profit virtual communities, and it is a virtual vehicle that aims at creating profits and can change identity to make profits. In the VPE community, APE provides the basic services of value co-creation, provides convenience for customers to participate in value co-creation, provides a guaranteed basis for the integration of value co-creation interactive resources, provides means for service exchange and value exchange, generates value co-creation interactions with APE, and enables customers to obtain more value. In addition to APE, it will have gained more operant resources and creativity from more actors (participants), as well as more value from value co-creation, including continuous relationship with customers. In this way, the core competitiveness of PE will be composed of VPE and APE.

VPE plus APE is a new operation mode of virtual-actual interaction constructed by PE with the characteristics of a virtual community, and virtual reality interaction supports resource interaction - "resource combination and co cultivation in Inter Organizational interaction" (Håkansson & Waluszewski, 2002), thus promoting more actors to participate in value co-creation and enhancing the core competitiveness of PE. This model is not only beneficial to PE, but also useful to other enterprises in non-PE sectors.

3.6.2 Customer Engagement and Value Co-creation

The key to value co-creation is to encourage customers to cooperate in production (Norman & Ramirez, 1993). How to promote customer participation in value co-creation in a virtual community needs to rely on the study of customer engagement psychology and behavior in VPE. Customer engagement (CE) is a kind of psychological state, which occurs during customer participation in the relevant interaction initiated by customers or enterprises, that is value co-creation activities, which can be transformed into actions. Customer engagement refers to the intensity of customers' participation in relevant activities initiated by customers or manufacturers (Vivek et al., 2009). Customer engagement exists in the service system of value co-creation and plays an important role in the service relationship network. Other relationship variables are the pre or post variables of the cyclic in customer engagement process (Brodie et al., 2011).

In this thesis, through empirical research, we find that customer engagement has a significant positive impact on the value co-creation initiated by PE ($\beta = 0.425$, $t = 4.592$, $P < 0.001$) and customer engagement has a significant positive impact on the value co-creation initiated by customer ($\beta = 0.651$, $t = 5.938$, $P < 0.001$), which provides empirical support for some related academic views in the research of customer engagement theory.

3.6.3 The Relationship Between Customer Initiated Value Co-creation and PE Initiated Value Co-creation

According to the service-dominant logic, enterprises cannot create value independently, but can participate in creating and claiming value propositions. Enterprises claim value propositions according to customers' needs. After customers accept the proposition, they form a common goal of value creation with customers and achieve value creation with customers through resource exchange and interaction. In value co-creation, customers play an active role in value co-creation process with enterprises (Kohler et

al., 2011). Zwass (2010) believes that value co-creation in a virtual environment can be initiated by enterprises or by customers. He divides value co-creation into sponsored value co-creation and autonomous value co-creation. Initiated value co-creation refers to value co-creation activities initiated by enterprises or communities, while autonomous value co-creation refers to value creation activities voluntarily created by customers. To ensure the effective development of value co-creation and realize the goal of value co-creation, enterprises need to provide value co-creation support system (service system).

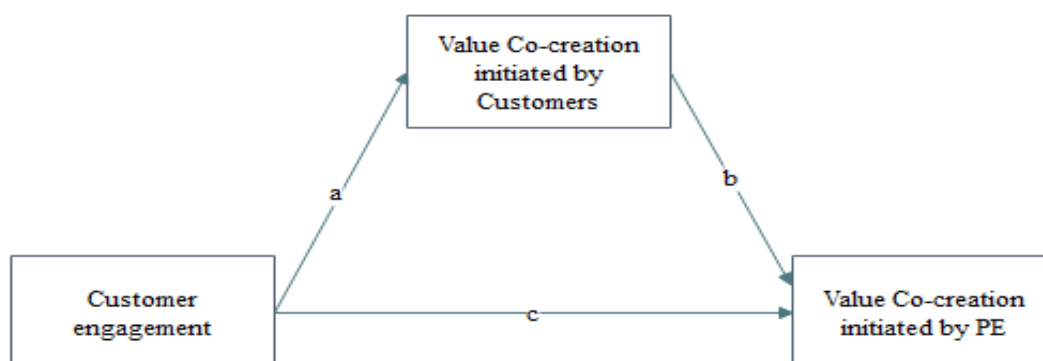
Value co-creation initiated by customers' needs the support of the enterprise, the enterprises need to coordinate the participants to form a "reciprocal commitment on value"; moreover, the organizer and implementer need to make institutional arrangements (FP11) to guarantee the value co-creation process is able to operate. In other words, the value co-creation initiated by customer needs the support of enterprises to be implemented and guaranteed. Otherwise, the value co-creation initiated by customers can only stay in the conceptual stage with a lack of practicality, especially for private equity funds involved in this study. Therefore, the research model of this thesis is that the pathway for customer-initiated value co-creation is through the "serial" initiation of PE (see Figure 3.2), rather than the "parallel" initiation of customer-initiated value co-creation and enterprise-initiated value co-creation (Li, 2014). Through empirical research, this thesis finds that customer-initiated value co-creation has a significant positive impact on enterprise-initiated value co-creation ($\beta = 0.557$, $t = 7.188$, $P < 0.001$), which supports the theoretical hypothesis. In addition, through the analysis and research of the empirical results below, it is demonstrated that customer initiated value co-creation plays a "partial mediation effect" of customer engagement in value co-creation initiated by PE, to prove that customer initiated value co-creation has a significant positive impact on value co-creation initiated by PE.

3.6.4 The Mediation Effect of Value Co-creation Initiated by Customer

According to the four steps proposed to verify mediation affects proposed by Baron and

Kenny (1986), the first step is to use customer engagement as an independent variable to perform a regression analysis of customer-initiated value co-creation (as an mediation variable) and show that there is a significant correlation between them. Secondly, we use customer engagement as an independent variable to perform a regression analysis of value co-creation when initiated by PE, and show that they are significantly correlated; thirdly, we use customer initiated value co-creation as an mediation variable to do perform regression analysis on value co-creation (dependent variable) initiated by PE, and show that they are significantly correlated; Fourthly, customer engagement (independent variable) and customer initiated value co-creation (mediation variable) are subjected to regression analysis (figure 3.2) on enterprise initiated value co-creation (dependent variable), and illustrates that the direct effect of customer engagement (independent variable) on enterprise initiated value co-creation (dependent variable) is significantly reduced. As such for value co-creation initiated by customers the mediation variable significantly "diverts" the information of C through A and B paths as shown in the Figure below. Then, the value co-creation initiated by customers is partially an mediation variable in the influence of customer engagement (independent variable) on the value co-creation initiated by PE (dependent variable) (Rong, 2016; Xu, 2011).

Figure 3.2: The Mediation Effect of Value Co-creation

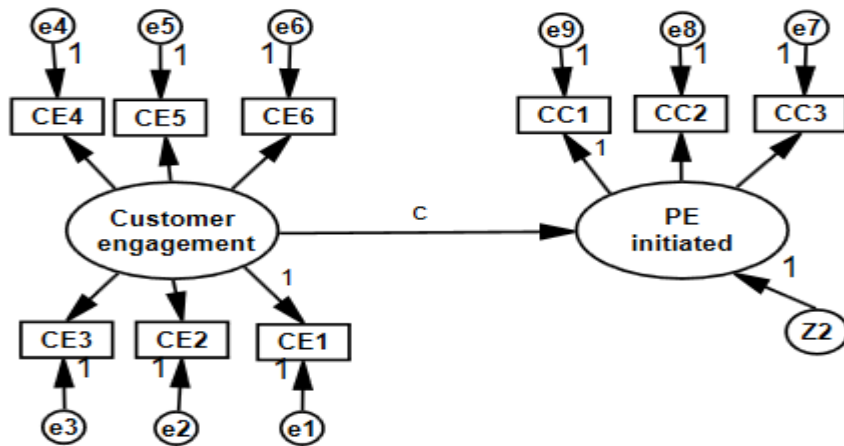


(1) Regression Analysis of Customer Engagement on Value Co-creation Initiated by PE

- Regression Analysis Modeling

The model of the theory that customer engagement has a positive impact on value co-creation initiated by PE is as follows:

Figure 3.3: The regression analysis model of customer engagement to value co-creation initiated by PE



Hypothesis C: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by PE.

- Fit Judgment of Model

The fit judgment of model and data applied AMOS, selected maximum likelihood estimation, and incorporated the sample data (232) into the theoretical model, and analyzed the structure of the customer engagement and PE-initiated value co-creation, and calculated the results of the fit indexes as follows:

Table 3.15: Test data and the fit judgment of the regression analysis model of customer engagement to value co-creation initialed by PE

Statistical Inspection Value	Standard or critical values for suitability	Predictive Test Results Data	Model Adaptation Judgment
DF		13	
χ^2	$p > 0.05$	14.756 ($p = 0.323 > 0.05$)	Yes
NC (χ^2/DF)	< 2	1.135	Yes
GFI	> 0.90	0.986	Yes
AGFI	> 0.90	0.953	Yes
RMR	< 0.05	0.018	Yes
RMSEA	< 0.05 (Well adapted)	0.024	Yes
NFI	> 0.90	0.986	Yes
RFI	> 0.90	0.960	Yes
IFI	> 0.90	0.998	Yes
TLI (NNFI)	> 0.90	0.995	Yes
CFI	> 0.90	0.998	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 13, the chi-square value of the model is 14.756, and the probability of significance is $p = 0.323 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 3.16: Standardized Regression Weights (PE Initialed <--- Customer Engagement)

	Estimate	t	P	Label	Hypothesis test
PE Initialed <--- Customer Engagement	0.873	7.336	***	c	C was Supported

“***” means $P \leq 0.001$

The results show that the standardized regression weights between value co-

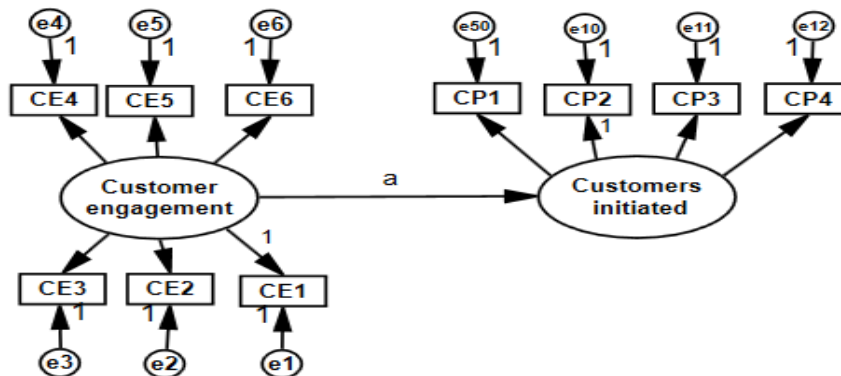
creation initiated by PE and customer engagement is 0.873, and a significant positive correlation is reached.

(2) Regression Analysis of Customer Engagement on Value Co-creation Initiated by Customers

- Regression Analysis Modeling

The model of the theory that customer engagement has a significant positive impact on value co-creation initiated by customer is as follows:

Figure 3.4: The Regression analysis model of customer engagement to value co-creation initiated by customer



Hypothesis A: Customer engagement has a significant positive impact on customer participation in value co-creation process, which initiated by customers.

- Fit Judgment of Model

The fit judgment of model and data applied AMOS24.0.0, selected a large likelihood method, and incorporated the sample data (232) into the theoretical model, and analyzed the structure of the customer engagement and enterprise-initiated value co-creation, and calculated the results of the fit indexes as follows:

Table 3.17: Test data and the fit judgment of the regression analysis model of customer engagement to value co-creation initiated by Customer

Statistical Inspection Value	Fit Standard or Critical Values	Test Results Data	Model Fit Judgment
DF		22	Yes
χ^2	$p > 0.05$	16.444($p = 0.793 > 0.05$)	Yes
NC (χ^2/DF)	< 2	0.747	Yes
GFI	> 0.90	0.986	Yes
AGFI	> 0.90	0.965	Yes
RMR	< 0.05	0.016	Yes
RMSEA	< 0.05	0.000	Yes
NFI	> 0.90	0.987	Yes
RFI	> 0.90	0.973	Yes
IFI	> 0.90	1.005	Yes
TLI (NNFI)	> 0.90	1.010	Yes
CFI	> 0.90	1.000	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 22, the chi-square value of the model is 16.444, and the probability of significance is $p = 0.793 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 3.18: Standardized Regression Weights (Customer Initialed <--- Customer Engagement)

	Estimate	t	P	Label	Hypothesis test
Customer Initialed <--- Customer Engagement	0.723	7.461	***	a	A was Supported

“***” means $P \leq 0.001$

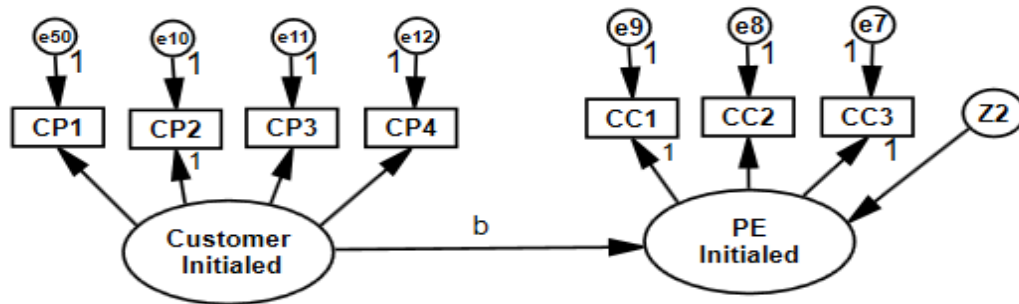
The results show that the correlation coefficient between value co-creation initiated by enterprises and customer engagement is 0.723, and a significant positive correlation is reached.

(3) Regression Analysis of Customer-initiated Value Co-creation has a Significant Positive Impact on PE-initiated Value Co-creation

- Regression Analysis Modeling

The model of the theory that customer-initiated value co-creation has a significant positive impact on PE-initiated value co-creation is as follows:

Figure 3.5: The regression analysis model of customer-initiated value co-creation to PE-initiated value creation



Hypothesis B: Customer-initiated value co-creation has a significant positive impact on enterprise-initiated value co-creation.

- Fit Judgment of Model

The fit judgment of model and data applied AMOS24.0.0, selected a large likelihood method, and incorporated the sample data (232) into the theoretical model, and analyzed the structure of the customer engagement and enterprise-initiated value co-creation, and calculated the results of the fit indexes as follows:

Table 3.19: Test data and the fit judgment of the regression analysis model of Customer-initiated value co-creation has a significant positive impact on PE-initiated value co-creation

Statistical Inspection Value	Fit Standard or Critical Values	Test Results Data	Model Fit Judgment
DF		7	Yes
χ^2	$p > 0.05$	4.473 ($p = 0.724 > 0.5$)	Yes
NC (χ^2/DF)	< 2	0.639	Yes
GFI	> 0.90	0.995	Yes
AGFI	> 0.90	0.978	Yes
RMR	< 0.05	0.009	Yes
RMSEA	< 0.05	0.009	Yes
NFI	> 0.90	0.995	Yes
RFI	> 0.90	0.986	Yes
IFI	> 0.90	1.003	Yes
TLI (NNFI)	> 0.90	1.008	Yes
CFI	> 0.90	1.000	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 7, the chi-square value of the model is 4.473, and the probability of significance is $p = 0.724 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 3.20: Standardized Regression Weight (PE Initialed <--- Customer Initialed)

	Estimate	t	P	Label	Hypothesis Test
PE Initialed <--- Customer Initialed	0.928	10.311	***	b	B was Supported

“***” means $P \leq 0.001$

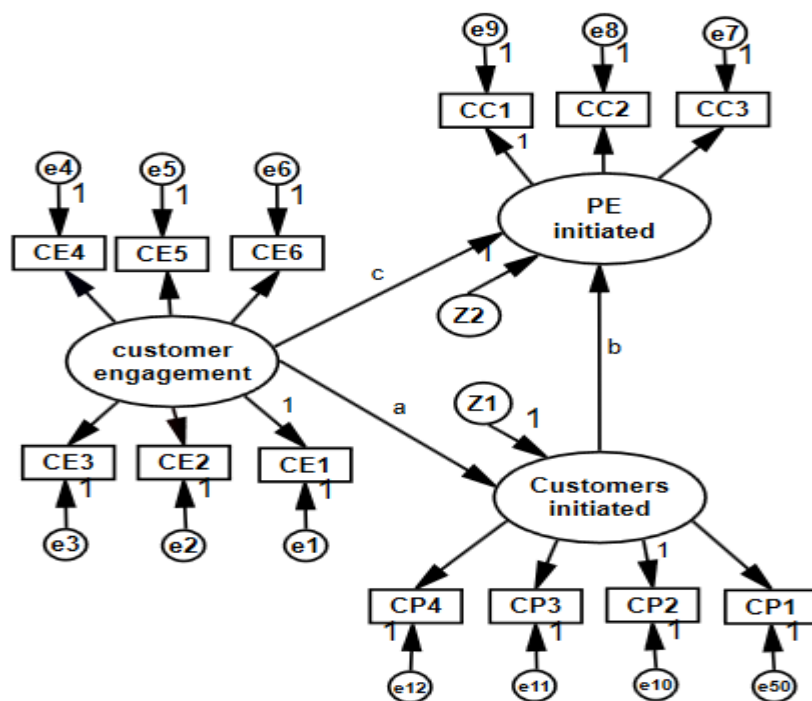
The results show that the correlation coefficient between value co-creation initialed by PE and customer engagement is 0.928, and a significant positive correlation is reached.

(4) Regression Analysis on Mediation Effect of Customer-initiated Value Co-creation

- Regression Analysis Modeling

In this part three factors which are mentioned above are placed within one system to analyze influences between each factor. The model of the theory that mediation effect of customer-initiated value co-creation is as follows:

Figure 3.6: The regression analysis model of the regression analysis of the mediation effect of customer-initiated value co-creation



A: customer engagement has a significant positive impact on value co-creation initiated by customers.

C: customer engagement has a significant positive impact on value co-creation initiated by PE.

B: value co-creation initiated by customers has a significant positive impact on value co-creation initiated by PE.

- Fit Judgment of Model

The fit judgment of model and data applied AMOS24.0.0, selected a large likelihood method, and incorporated the sample data (232) into the theoretical model, and analyzed the influence of these three factors, and calculated the results of the fit indexes as follows:

Table 3.21: Test data and the fit judgment of the regression analysis model of mediation effect of customer-initiated value co-creation

Statistical Inspection Value	Fit Standard or Critical Values	Test Results Data	Model Fit Judgment
DF		42	Yes
χ^2	$p > 0.05$	49.071($p = 0.211 > 0.05$)	Yes
NC (χ^2/DF)	< 2	1.168	Yes
GFI	> 0.90	0.968	Yes
AGFI	> 0.90	0.931	Yes
RMR	< 0.05	0.022	Yes
RMSEA	< 0.05	0.027	Yes
NFI	> 0.90	0.972	Yes
RFI	> 0.90	0.949	Yes
IFI	> 0.90	0.996	Yes
TLI (NNFI)	> 0.90	0.992	Yes
CFI	> 0.90	0.996	Yes
CN	> 200	232	Yes

The test results show that when the degree of freedom is 42, the chi-square value of the model is 49.071, and the probability of significance is $p = 0.211 > 0.05$. The null hypothesis cannot be rejected, that is, the theoretical model and the actual data can fit. Moreover, each fitness index meets the criterion value, and the theoretical model is adaptive.

- Regression Analysis Results

Using AMOS, the regression index is calculated as follows:

Table 3.22: Standardized Regression Weight

	Estimate	t	P	Label	Hypothesis Test
Customer Initialed <--- Customer Engagement	0.726	7.848	***	a	A was Supported
PE Initialed <--- Customer Initialed	0.627	6.971	***	b	B was Supported
PE Initialed <--- Customer Engagement	0.434	4.538	***	c	C was Supported

“***” means $P \leq 0.001$

The results show that the Standardized Regression Weight of value co-creation initiated by customer engagement to customer is 0.726, that of value co-creation initiated by customer engagement to PE is 0.627, and that of value co-creation initiated by customer engagement to PE is 0.434, and significant positive correlations are reached for these three factors. Standardized regression weights are the normalized regression coefficient values (beta values) between variables, and are also the path coefficients in the path model analysis chart (Wu, 2009).

The direct effect of the independent variable customer engagement on value co-creation initiated by PE has been partially "shunted" due to the intervention of value co-creation initiated by customers (mediation variable) (see Figure 3.6). The degree of "shunting" is $a * b = 0.726 * 0.627 = 0.455$. That is to say, the mediation effect of customer-initiated value co-creation is very obvious, and is $a*b(=0.455) > c (=0.434)$, which is greater than the direct effect. In other words, the value co-creation initiated by customers has a positive and beneficial effect on the value co-creation initiated by PE, and its driving force is large and cannot be ignored.

3.6.5 The Impact and Value of PE Initiating Value Co-creation on Customer Behavior

Customer engagement can promote customer's co-creating value behavior and improve enterprise performance and customer value (Auh et al., 2007; Chan, et al, 2010; Prahalad & Ramaswamy, 2004). Moreover, customer engagement promotes customers

participation in value co-creation, and produces value by influencing customer purchases, recommendations, influence and feedback activities in the interaction process between customer and enterprise. Through empirical research, this thesis demonstrates that customer engagement has a significant positive impact on value co-creation initiated by PE and customers, while value co-creation initiated by PE and collaborative customers has a significant positive impact on the value of customer purchase behavior ($\beta = 0.718$, $t = 8.004$, $P < 0.001$), and the value of recommendation behavior has a significant positive impact ($\beta=0.624$, $T=6.769$, $P < 0.001$) . There was a significant positive effect on the value of influencing behavior ($\beta = 0.707$, $t = 7.010$, $P < 0.001$). This provides empirical support for the relevant academic views in the research of customer engagement theory which have been discussed in this thesis.

3.7 Concluding Remarks

The empirical results of this thesis show that customer engagement has a significant positive impact on value co-creation initiated by customers and PE, and the value co-creation initiated by customers also has a significant positive impact on the value co-creation initiated by PE, and that the value co-creation initiated by PE has a significant positive impact on the value generated by customers' purchases, recommendations and behavior. In addition, based on the previous study of customer participation in value co-creation process, this thesis further focuses on the development of value co-creation theory.

Customer participation in value co-creation needs to implement a vehicle that ensures customers can effectively participate in the value co-creation process. The virtual private equity fund (VPE) constructed by PE not only avoids institutional obstacles, but also makes VPE able to recruit the customer who has not yet become a member of an actual private equity fund (APE) and they can become the vehicle of common value creation of APE members. It also becomes the platform of service exchange, value exchange and identity transformation between VPE and APE. It

innovatively constructs the value-co innovation mode between the virtual and real interaction of VPE + APE. In this way, PE can get access to more operant resources from other participants than an APE to participate in value co-creation process, while the value co-creation activity with virtual and real interactions brings operant resources together for participants and organizations – i.e. two or more different basic resource interaction groups are created and sustained.

This is the highest level of resource advantage theory, which greatly increases the sustainability of competitive advantage for enterprises (Madhavaram & Hunt, 2008). Enabling the combination and co-cultivation of resources (Håkansson & Waluszewski, 2002) to promote more participants to join in value co-creation is increasingly a robust management strategy for PE GPs to pursue. From solving customer participation value co-creation vehicle to resource integration, as well as to dealing with market changes and sustainable development, the model of VPE-APE is not only beneficial to PE, but also to non-PE entities that can be used as a reference. That is, VPE as the vehicle for value co-creation, customers can perform value co-creation there.

Secondly, the research conducted here has focused on how to carry out value co-creation effectively in the PE industry. In the empirical study, it is demonstrated that customer engagement has a positive impact on value co-creation initiated by PE and customers. In addition, when demonstrating the relationship between customer-initiated value co-creation and PE initiated value co-creation, this thesis analyzed the empirical data and demonstrated the "partial mediation effect" of customer-initiated value co-creation for customer engagement. Customers can spontaneously claim the idea of value proposition, but customers lack methods and abilities in terms of resource integration, and cannot develop effective value co-creation processes by themselves, especially in real enterprises. Therefore, unlike other studies of "parallel" self-initiated value co-creation, the path of customer-initiated value co-creation in this research is through the "serial" initiative of PE (see figure 3.2) and is confirmed by the empirical research (Li, 2014).

Value co-creation initiated by customers can promote the value co-creation initiated by PE, and it is an "incremental" means to carry out the value co-creation in a

targeted way according to customers' opinions, which supplements current PEs in launching value co-creation activities independently. From the perspective of this pathway, no matter whether value co-creation is initiated from the customer engagement, or from the "mediation" customer, it comes from the customer, not the PE itself. That is, the value proposition of the PE is "customer-oriented". Just as the service-dominant logic points out that enterprises cannot create value alone but provide value propositions and participate in and guarantee value co-creation processes. As such the value of the customer's claim is co-created together with PE.

Value creation carried out by the PE should create value for the customer, and the value of the PE is in the process of creating customer value for the exchange of services. PEs need to coordinate customer engagement and customer's spontaneous initiated value co-creation, the former involves the performance of the customer's potential behavior, the latter involves the behavior that has already occurred. The key issue is that the value co-creation carried out by PEs, whether initiated by PEs in accordance with customers or by PEs in collaboration with customers, is initiated by collaboration rather than independently. Therefore, the collaborative mechanism of value co-creation is important. Firstly, the customer's value proposition can be inconsistent and needs to be coordinated. Secondly, the feasibility and effectiveness of value co-creation needs to be coordinated. Thirdly, the idea of value co-creation of innovation also needs the coordination of innovation systems and institutional arrangements.

Based on previous research on value co-creation of customer participation, this thesis further studied the value co-creation of virtual VPE community based on customer engagement, and the value obtained by the value co-creation enterprise. In addition, the theoretical model is empirically constructed, and some meaningful conclusions and insights have been drawn. However, the research still has the following shortcomings where further research would be beneficial.

- (1) In this thesis, a choice was made between the variables and scales with relatively mature and high citation rate and recognition rate of value co-creation research in virtual community, and through experts and pre adjustment, the empirical results

were determined to be also reliable and effective. Because this research involves the value co-creation of virtual VPE and actual APE. Therefore, there are some differences between the industry background of variable classification and selection of test items in the references and this study, which may not fully show the relevant research details. In future research, we can further explore the existence of these factors, and more accurately guide the research and practice as a result.

- (2) The value co-creation system of VPE + APE needs to study the cooperative mechanism to ensure the effectiveness of mechanisms for value co-creation. As Zhang and He (2014) state, collaborative value creation has become very important in knowledge intensive industrial services characterized by complex transactions. However, there are few empirical studies on this. And it needs further research on synergy mechanisms that involves the organization construction, institutional innovation and institutional arrangement of synergy.
- (3) In order to ensure the effective development of the value co-creation system of VPE + APE, it is necessary to study the matching cross organization and management structures, so as to standardize the interaction activities of value co-creation and which can orderly carry out the value co-creation activities in standardized behavioral circumstances.

-Chapter Four-

Service System of PE Value Co-creation

4.1 Introduction

According to previous research, customer participation and customer engagement are very important for value co-creation. In order to achieve these activities, more interaction between customers and PE fund is required, and secondly, the effectiveness of interaction needs to be guaranteed. The reason for this is that companies can establish value creation process with customers in direct interaction, they will have the opportunity to create value together with them (Grönroos, 2011). Moreover, because the interaction process of customer engagement is dynamic, information interaction, resource integration, value exchange and service exchange services are also dynamic (Brodie, 2011). Therefore, value co-creation is a dynamic process. As such, in order to achieve interaction with customers and ensure their effectiveness, enterprises need to establish a corresponding dynamic support system - service system (Prahalad & Ramaswamy, 2004).

Cova and Salle (2008) argue that there are three elements to consider when they studied customer participation in value co-creation: value proposition, value creation through interaction with consumers and value creation support systems. In the exchange between service systems, value is determined by the use, integration and application of dynamic (sometimes static) resources (Lusch & Vargo, 2006). Combined with previous research results of this thesis, PE provide services based on its operant resources have significant positive effects on customers participation in value co-creation; Customer participation in value co-creation initiated by PE has a significant positive impact on the value generated by customer purchasing behavior; Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer recommendation behavior; and customer participation in value co-creation initiated by

PE has a significant positive impact on the value of customer influence behavior. In this section, a service system of customer participation in PE value co-creation based on virtual community is built and analyzed. The system operates with the help of Internet and information processing tools, to ensure the effective interaction between participants of value co-creation, which means VPE and APE are the most important factors during the value co-creation.

In the service system, this thesis will combine the previous research results to study the following key points:

(1) Customer Preference Discovery and Clustering Modeling.

In view of the previous research, it has been verified that the hypothesis of customer engagement has a significant positive impact on customer participation in value co-creation activities initiated by customers, and that customer engagement has a significant positive impact on customer participation in value co-creation activities initiated by PE. Therefore, research on customer preference discovery and Clustering modeling can help us to accurately grasp customer psychology, which can improve initiative customer participation in value creation.

(2) Collaborative recommendation and decision-making.

Also, in view of the previous research detailed in sections 1 and 2, it has been verified that the hypothesis of the customer participation in value co-creation has a significant positive effect on customer perceptions of relationship/support value; customer participation in value co-creation has a significant positive effect on customer perceptions of economic value; customer participation in value co-creation has a significant positive effect on customer perceptions of technology / core value. The conclusions shown above, can help improve co-creation value and co-creation efficiency through research on collaborative recommendations and decision-making.

(3) Matching and Transaction of Customer PE Equity Assets

Value co-creation is accumulated and embodied in PE rights and interests.

Customers need to obtain co-creation interests in time in order to participate effectively. That is, value co-creation needs to realize monetization exchange or circulation in an orderly fashion to meet customer's needs. Research on PE equity asset matching transaction can realize the real-time exchange of value, and make customers feel the economic value of participation, and help them to participate in value co-creation.

Moreover, in order to solve the tradability of equity rights and interests formed by customers participating in PE, it is necessary to first solve the problem with how to evaluate the PE equity rights and interests value which can be traded with fair value; secondly, it is necessary to solve the problem that the equity rights and interests value can be easily circulated by the trading media. Therefore, this thesis will explore the possibility of applying complex numbers to PE portfolio projects with reference to fair value and block chain technology to PE equity value trading media-tokenization, so as to make equity trading feasible and convenient, and become an important part of the support and service system for customers to participate in PE value co-creation.

Therefore, this thesis studies the matching and transaction of customer PE equity assets, realizes the exchange of value, and enables customers to perceive the economic value in real time as very practical elements of value co-creation processes.

(4) Knowledge Sharing and the Construction of Learning Community

In the process of customer participation in value co-creation, PEs and customers establish a continuous interactive learning relationship, build their knowledge sharing and learning community. It is a significant method to guarantee value co-creation.

Derived from the previous theoretical research in chapter 2 and 3, relying on the VPE and service system, further research on customer participation in value creation activities has practical significance and is conducted here.

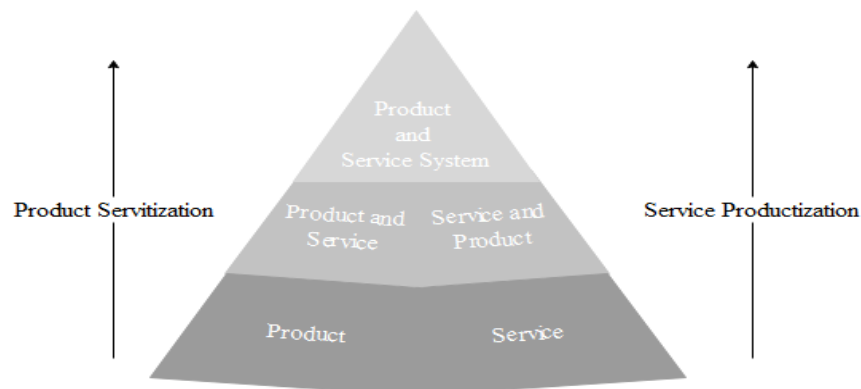
The remainder of this chapter is structured as follows. Section 4.2 presents a review of relevant literature about service system. Section 4.3 presents the framework of service support system and function of each segment. Finally, Section 3.4 concludes this chapter.

4.2 Literature Review

4.2.1 Service System

Under the Goods dominant logic (G-D), people usually consider products and services separately. In addition, research on product service system is carried out under G-D frameworks. Product service systems are defined as a combination of product and service marketization. The portfolio jointly meets the needs of customers, and the proportion of products to services varies according to functional realization or economic value (Goedkoop et al., 1999). Product service systems (PSS) are defined as a solution containing product and service elements to deliver the functions required by customers (Wong, 2004). Product service systems can be seen from the development process: (1) Demand identification and value orientation; (2) stakeholder activity design; (3) function modeling of product service system; (4) function-activity mapping and product service system scheme generation; (5) function modeling of the product service system; (6) original product service system type test (Kim et al., 2011). The starting point here and research focus is on "product + service" to match customer needs, and its value is composed of product value + service value. In recent years, with the change in market conditions and the deepening of research, the product service system has also evolved as illustrated in the figure below (Baines et al, 2007).

Figure 4.1: Evolution Trend of Product Service System



Source: Baines et al, 2007

Service-Dominant logic believes that cross-organizational integration of resources, especially operant resources, is an important prerequisite for value co-creation. Madhavaram and Hunt (2008) based on resource advantage theory, divide operant resources into three levels: firstly, basic operant resources - an entity such as an enterprise is a resource; Secondly, "combined operant resources" - a combination of two or more different basic operant resources; Thirdly, an "interactive operant resources" — Two or more distinct basic resources that interact significantly. Moreover, the higher the level of resource availability and integration will greatly increase the possibility of sustainability of the competitive advantage of enterprises. Service systems are the resources allocation which includes people, technology, information, etc. connected with other systems through value propositions (Spohrer, 2007). Grönroos (2009) argues that "product is the outcome of production process, while service or service behavior is the product of interaction between producers and consumers", and service provides an interactive platform for producers and consumers.

If "consumer products" cause consumers and producers to become two relatively closed systems, then "consumer services", or "products embedded" in the process of services, will promote producers and consumers to become two gradually open and integrated subsystems. In these open systems constructed by services, producers can influence consumers positively through interaction with consumers and guide them to create value together with themselves. The subsystems of mutual integration create the value co-creation system. Contemporary markets are increasingly interconnected, with actors no longer seen as part of linear value chains but existing in networks of service systems where interaction, collaboration and experience sharing take place (Lusch & Vargo, 2014; Chen, Drennan & Andrews, 2012). Value co-creation is an interactive process, which is implemented by value co-creation service systems. In service systems, the purpose and motivation of interaction and exchange is to create value together (Spohrer et al., 2008).

The resources of the service system include private resources, market resources and public resources. By integrating the resources of the existing service system and other service systems, we can realize the interaction of resources within the service

system and create value together. The system can be the survival, adaptation and evolution of individuals or groups through exchanging and applying resources (specific knowledge and skills) with other systems, and then enhancing adaptive survivability by interacting with other service systems to create value for themselves and other members (Vargo, 2008). Some researchers have deeply analyzed the structure and composition of service systems based on previous studies. It is believed that the resources of service system include at least one operant resource which can act on other resources to create value.

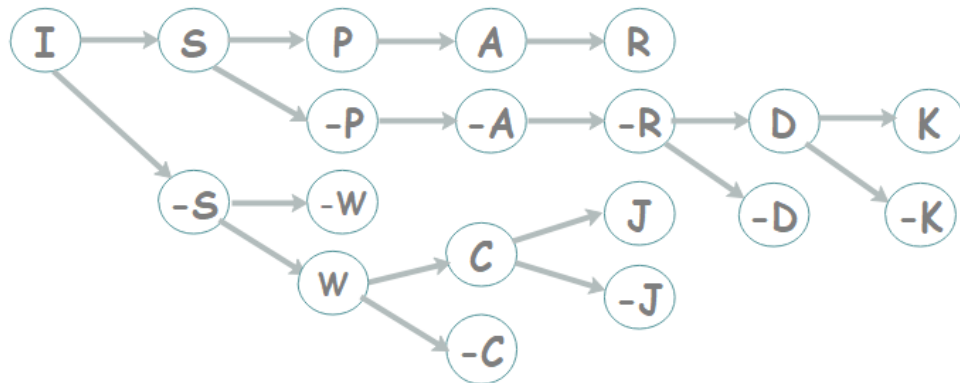
The exchange between service systems is voluntary, and the service system is composed and divided dynamically over time. There is a mechanism of union and adoption in the service system for disassembly and reorganization. They are the evolution, interaction and value co-creation of service systems (Maglio & Spohrer, 2008). The value co-creation interaction between service systems is service interaction. Each service system participates in three main service activities: (1) proposing value co-creating interaction activities with another service system; (2) agreeing to proposals; (3) realizing proposals.

The dynamic nature of the service system is conducive to the improvement of the quality level of the service system and the efficiency of value co-creation. (Vargo et al. 2008) They also believe that (1) service, the application of competences (such as knowledge and skills) by one party for the benefit of another, is the underlying basis of exchange; (2) the proper unit of analysis for service-for-service exchange is the service system, which is a configuration of resources (including people, information, and technology) connected to other systems by value propositions; and (3) service science is the study of service systems and of the co-creation of value within complex configurations of resources.

We argue that value is fundamentally derived and determined in use – the integration and application of resources in a specific context – rather than in exchange – embedded in firm output and captured by price. Service systems interact through mutual service exchange relationships, improving the adaptability and survivability of all service systems engaged in exchange, by allowing for the integration of resources

that are mutually beneficial. Some studies also point out that service systems are a value co-creation network composed of people, technology and organizations, and the interventions taken to change the service status and create value constitute services. They usually interact with other service systems through value propositions to form extended value chains or service networks (Sims, 2007). The interaction fragment ISPAR (Interact - Serve - Propose - Agree - Realize) formed by the interaction between service systems forms the result shown in the figure below.

Figure 4.2: Interaction fragment of service system



I: Interaction; S: Service Interaction; - S Non-Service Interaction; P: Communication Proposals; - P: Non-Communication Proposals;

A: to reach agreement; - A: not to reach agreement; R: to achieve value co-creation; - R to achieve value co-creation;

D: Arguments; - D: No Arguments; K: Accepted Solutions; - K: Unaccepted Solutions;

W: popular non-service interaction; - W: unpopular non-service interaction; C: illegal interaction;

- C: legal interaction; J: facing legal sanctions; - J: unrealized legal sanctions

Result (R): Implementation of proposed and agreed service interactions.

For a service system that has a good reputation in many service systems, this is the ideal result; results (-P) and (-A): A proposal may not be successfully communicated or

understood by other service systems, so the interaction may be terminated. Some suggestions may be communicated, but activities between service systems cannot be agreed upon (-A), so service interactions may be terminated.

Results (-D), (-K) and (K): The co-creation of interactive value of service system failed for uncontrollable reasons. There may be no debate (-D) or co-creation value. When disputes arise, the parties involved in creating value in the service system accept new solutions (K), or do not accept (-K).

Result (W): Many interactions between service systems are not service interactions (e.g. resulting in substantial value co-creation) but may be welcomed (W) interactions among service systems. These non-service interactions may lay a good foundation for future service interactions to create greater value.

Result (-C), (-J) and (J): When the interaction between service systems is not welcomed by one or both service systems, J or-J judgment will be made on the fact of -W due to the unwelcome of non-service interaction (-W).

The ISPAR model can be used to analyze the interaction of group behavior within service systems. Based on this, the method of measuring the interaction quantity, mode, process and result of service systems can be studied. Through the comparison and analysis between the systems, combined with R (result) to judge the effectiveness and stability of the service system, the development trend of value co-creation can be determined.

It is suggested that value is created by participants including customers and service enterprises in the study of service-dominant logic. On this basis, the concept of service ecosystem is put forward. Service ecosystem is regarded as a space-time system composed of social and economic subjects with value propositions. Whether service system or service ecosystem involves a large amount of human resources, processes, capital and so on, it must improve the efficiency of value co-creation. Therefore, it is

necessary to study how to use scientific methods and principles to manage the organizational process and resources of services and improve the effectiveness and efficiency of services (Vargo, 2011).

IBM calls service science not only service science, but also management and engineering (SSME). "Service science is the study of business-technology-industrial innovation, creating value and sharing value through the cooperation of agents and suppliers. The Cambridge SSME special report points out that service science is a study of service systems and value propositions. It also believed that service science is the value co-created by creating and sharing customers and service providers through business-technology-work innovation process. Hidaka (2006) summarized the main purpose of SSME in three aspects: (1) providing scientific analysis methods for services, such as quantitative research methods in mathematical simulation and computer simulation, to maximize service efficiency by engineering service delivery process. At the same time, integrating business, technology and human factors to effectively manage services. (2) Solving some problems arising from the characteristics of service invisibility, heterogeneity and synchronization, especially in making full use of information technology, extracting codable knowledge in the process of service, componentize it and increase the part that can be processed automatically, so as to improve the output rate of service. (3) To provide a systematic development framework for innovation, whereby it mainly studies the background, resources, modes, methods, constraints and environment of service innovation, and provides a systematic method for the realization of service innovation. (Hidaka, 2006)

4.2.2 Previous Research on Customer Preference Discovery and Clustering

In psychological research, preferences refer to an individual's attitude towards a set of objects, typically reflected in an explicit decision-making process (Lichtstein & Slovic, 2006). One could interpret the term "preference" to mean evaluative judgement in the sense of liking or disliking an object, which is the most distinctive definition used in

psychology. Nevertheless, it does not mean that customer preference is inevitably constant all the time. Preference can be notably modified by decision-making processes, such as choices even in an unconscious way (Sharot et al., 2009). Customer preference can be defined as tending to indicate choices among neutral or more valued options with acceptance indicating a willingness to tolerate the status quo or some less desirable option.

Lages and Fernandes (2005) proposed a service cognitive approach with connection chain, which is composed of service personal value, service value, service quality and service type. According to this theory, consumers usually regard the types of services as means to achieve consumption through the benefits generated by types. In order to realize the customers value effectively, we need to use modern information methods to grasp customers' preferences from the type basis of service.

In economics, preference is defined as the preference of "rational man" for goods or services (Grüne-Yanoff & Hansson, 2009). The formation of user behavior preference and decision-making is the result of the common processing of internal cognition and emotion and is the psychological cognitive tendency of the object under the common influence of subject experience and emotion (Liu et al., 2017). Customers' preferences are mapped to their attitudes towards specific consumer goods. The performance of customers' desire for products with specific attributes is based on their preference for product content and results, and the choice of customers for different kinds of services is based on their preference for different things (Shi et al., 2015).

Li et al. (2015) conducted a study on the customer's personal value preference and applied the customer's personal value scale to conduct an empirical study. The research shows that customer personal value preference is reflected in customer service. This thesis suggests that customer personal value forms customer behavior through customer perceived value and customer perceived quality, it also points out that customer personal value needs can be met in a targeted way according to the characteristics of customer personal value preference.

Clustering is used to analyze and compare the data according to its characteristics,

find out internal rules, and gather the items or users with similar characteristics together. The ultimate purpose is to make the data objects in the same group as similar as possible, while the objects in different groups are as different as possible. Clustering method is mainly used in user group-oriented modeling, to build a comprehensive model of user groups. Customers present the characteristics of community Clustering in social network services. Customer relationship network is essentially one of complex networks, and its community Clustering is the community structure characteristics in complex networks (Degenne, 1999). With the development of Internet technology, online reviews have become an important source of product information for customers. Users' online comments are a kind of positive or negative information about products provided by users according to their experience. They more reflect users' satisfaction, so they are regarded as a very useful product information source for customers and enterprise.

Liu and Li (2013) proposed a user clustering algorithm based on the preference of project cluster to solve the problems of traditional collaborative filtering algorithm, such as the lack of service type correlation between projects, the inaccuracy of finding neighbor users and poor real-time performance. The algorithm clusters users based on different preferences of users for project clusters, so that the neighbor users can be found more accurately, and more nearest neighbors can be found in a smaller space, which improves the accuracy of searching neighbor users, and improves the search speed.

4.2.3 The Collaborative Filtering Recommendation and Decision-making

The widely known modern concept of a recommendation system is to use an e-commerce website to provide product information and suggestions to customers, help customers make shopping decision, and help customers complete the purchase process (Resnick & Varian, 1987). In the current period of information overload, in the face of many information resources, how to accurately and efficiently help customers get the

information resources they need has become the primary task of the current network technology development. Recommendation systems have become an effective tool to deal with information overload by collecting customers' behavior information. A potential solution to the problem of information overload is a personalized recommendation system, which recommends information and products of interest to customers according to their information needs and interests (Wang & Liu, 2012). A good recommendation system can not only provide personalized service for customers, but also to establish close relationship with customers, so that customers rely on recommendation.

Content-based recommendation originated from the field of information acquisition (Liu, 2006). This method first extracts the content characteristics of recommended objects and studies the preferences of customers. According to the recommendation strategy, matches the interest points of customers' preferences, recommends the content with high matching degree to customers, guide customers to find and pays attention to their information needs. The project-based collaborative recommendation tries to find the nearest neighbor of the target object (Karypis, 2001). Because the evaluation score of the current customer to the nearest neighbor is similar to the target recommendation object, you can predict the score of the current customer based on the score of the nearest neighbor, and then select several target objects with the highest score as the recommendation results to present to the current customer. There are two main tasks of project-based collaborative recommendation, which is searching the recommendation for nearest neighbor first, and then generating the same recommendation to other customer.

Collaborative recommendation technology is one of the earliest and most successful technologies in recommendation systems. The theoretical basis of collaborative recommendation technology is people always have similar consumer behavior, which emphasizes a kind of cooperation behavior between people. It is based on the assumption that a good way to find out the content that a new customer is really interested in is to find other relevant customer who have similar interests, and then recommend the content to this new customer as the same as other relevant customers.

Based on the user's collaborative recommendation, by measuring the similarity between users, the traditional methods of measuring similarity mainly include modified cosine similarity and the Pearson correlation coefficient method at present (Greg, 2003).

Zhao and Wang (2011) proposed a mixed collaborative recommendation based on factor analysis of users and items. In this algorithm, users and projects are first reduced to several user factors and project factors by factor analysis; then two regression models are constructed with target users and projects to be evaluated as dependent variables and user factors and project factors as independent variables, and then two prediction values of target users on projects to be evaluated are obtained; finally, the final prediction is obtained by weighting the two measurement factors to improve the efficiency and accuracy of recommendation.

Multiple criteria group decision making is a significant segment of collaborative decision-making frameworks. It refers to a group of decision makers who evaluate a scheme or plan based on their own preferences and seek the group's optimal or acceptable goals according to a common rule system. In terms of collaborative decision-making, Xu and Chen (2008) proposed a large group with multiple types decision-making method. Firstly, this thesis expands the method of single scheme large group decision into the multi-attributes and multi-schemes large group decision making and obtains a large group preference matrix. Then, a weight vector of all the attributes is obtained by using the entropy weight method. By combining the weight vector of all the types and the large group preference matrix, an integration evaluation value vector of all the scheme is obtained. From the integration evaluation values in this vector, the ordering result of each scheme is obtained. The method provides a better solution on the problem of multi-attributes and multi-schemes large group decision making.

4.2.4 Literature Review on PE Customer's Equity Assets Matching and Transaction

The transaction of assets is the internal demand of the developed market economy. The transaction of asset securitization is one of the ways of asset transaction, and the core

of transaction is pricing. Equity assets are the basic form of assets, and the principles and methods of pricing are the fundamental problems in the study of Finance and investment. There are two ways to study equity assets, which are intrinsic value and transaction value. The former emphasizes capital cost, pays attention to the capitalization of enterprise cash flow, and focuses on the excavation of intrinsic value of assets; the latter pays attention to the investment income of capital market, emphasizes the relative rationality of transaction price, and highlights the resource allocation function of market (Chen & Song, 2005).

Based on the theory of intrinsic value pricing of equity assets put forward by Graham, which is asset price fluctuates around intrinsic value. Williams (1938) put forward the dividend discount model (DDM), that is, the intrinsic value of equity assets is the sum of the discounted value of future earnings. After that, the free cash flow discount model, Q ratio method, EVA method and other pricing methods are derived from the idea of "intrinsic value". All of these methods are based on the analysis of financial data, combined with the operation of enterprises, to get the static estimation of the intrinsic value of equity assets.

There are many studies on the pricing of equity assets from the perspective of transaction value. Based on Markowitz's portfolio investment theory, William Sharpe et al. (1964) created and developed the capital asset pricing model (CAPM), turning the research on the micro subject of individual investors to the research on the whole market. Ross (1976) proposed a linear multi factor arbitrage pricing model (APT) by assuming that there is no arbitrage opportunity in the market. From the perspective of supply, the concept of "equilibrium" is extended to "no arbitrage", which broadens the research thinking of equity asset pricing. Based on many scholars, Hansen and Richard (1987) emphasized the difference between conditional expectation and unconditional expectation and proposed the stochastic discount factor (SDF) method. The core idea of SDF is that the marginal utility cost of reducing consumption for investment in the current period is equal to the discount value of the marginal utility income of selling the asset at a certain point in the future; the price of the asset reflects the discount value of each risk, and the risk depends on the covariance of the future income of the asset

(payoff) and the change of the marginal utility of consumption. Moreover, based on practical application, Damodaran (2010) suggested that the equity value of an investment enterprise should be the sum of two values, which are initial equity capital invested value and expected excess return value.

The asset securitization process transforms the asset pool into one or more securities called asset-backed securities (Frank & Fabozzi, 2014). Through the asset securitization process, the transaction of assets can be realized. Yang et al. (2017) started from the information security of equity asset transaction, studied the method of blockchain data when conducting equity asset transaction operation, and writing user information into blockchain to realize one-to-one correspondence between basic information of upper user and account information of lower blockchain. Lu and Bao (2018), aiming at the disadvantages of the centralized digital asset trading system, such as being independent and closed, and the transaction is difficult to be carried out across institutions. On the contrary, blockchain has advantages in data distribution and easy to maintain, so that the digital assets can be traded across institutions.

4.2.5 Construction of Knowledge Sharing and Learning Community

In the service dominant logic, knowledge and skills are regarded as operant resources, which is the key for an enterprise to gain competitive advantage. In an organization, knowledge sharing is an important part of sustainable competitiveness. It is not enough for an organization to gain competitive advantage only by relying on its staff recruiting and training system (Brown & Duguid, 1991). The organization needs to consider how to transfer the knowledge and professional skills possessed by experts to new employees who need to possess these knowledge and skills (Hinds et al, 2001). In other words, enterprises need to pay attention how to use more effectively of the existing knowledge resources in the organization (Damodaran & Olphert, 2000). Therefore, the importance of knowledge sharing is obvious.

Nancy (2000) pointed out that the information or knowledge owned by an individual should be transmitted to other people so that the other party also has the same

information or knowledge. Knowing information or knowledge is the process of knowledge sharing. Cross investment is an effective strategy to reduce transaction costs, and mutual influence makes organization members have similar behavior of mutual investment, and establishes an interdependent relationship between each other, which is conducive to reducing the harm between each other and making the interests consistent.

Nelson and Cooper (1996) thinks that mutual influence is the influencing factor of knowledge sharing. When people work together, they all depend on each other, and the result of this dependence will lead to an influence relationship, which is the necessary process to achieve mutual understanding (Anderson & Narus, 1990). It is very important to actively share knowledge and maximize the value of knowledge within the organization, among members, between different departments and teams. Yu and Xu (2019) proposed that knowledge sharing has a significant positive effect on value co-creation.

In the process of knowledge sharing, enterprises can be regarded as a social community of creating, sharing, transferring and knowledge. The learning community is the social arrangement of knowledge production and innovation within and across organizational boundaries; the learning community is a way of learning in which learners and others rely on each other, explore, communicate and cooperate to complete real tasks or problems (Zhong, 2005). It is very important for an organization to establish a competitive advantage to ensure a sustainable knowledge sharing mechanism. Organizational innovation atmosphere plays an important role in knowledge sharing (Ruppel & Harrington, 2001).

In last decade, there are more and more research have focused on virtual organization and virtual community, they both have to face with the phenomenon of information overload. Yang et al. (2006) studied knowledge sharing and personalized knowledge recommendation technology in virtual research communities. It combined with the recommendation strategies of content filtering and collaborative filtering. Moreover, the recommendation process of explicit and implicit knowledge in virtual research community has been designed as well. It also studied the online learning

method based on the theory of online learning community and gave an application case of the model.

4.2.6 Overview

Initially service-dominant logic studied the dualistic interaction between enterprises and customers. Now it has extended to observing the network interactions within and between service systems. It realizes value co-creation through resource integration and service exchange. It attaches importance to the combination of human resources, technology and value proposition in the system, and emphasizes the importance of resource allocation and interactions of the broader system network. Technology is playing a more important role in acquiring co-creation value. The important foundation of value co-creation system is the "service economy". The value proposition is "customer-oriented". The premise is that participants integrate resources through interaction. The guarantee of interaction is "relational", and the service system is the guarantee of the validity of value co-creation. Moreover, in the increasingly complex value co-creation system, service exchange services and value exchange need the support of service systems, which are very important. For this reason, in order to ensure the effectiveness of service and value creation, service system is becoming the focus of service science research.

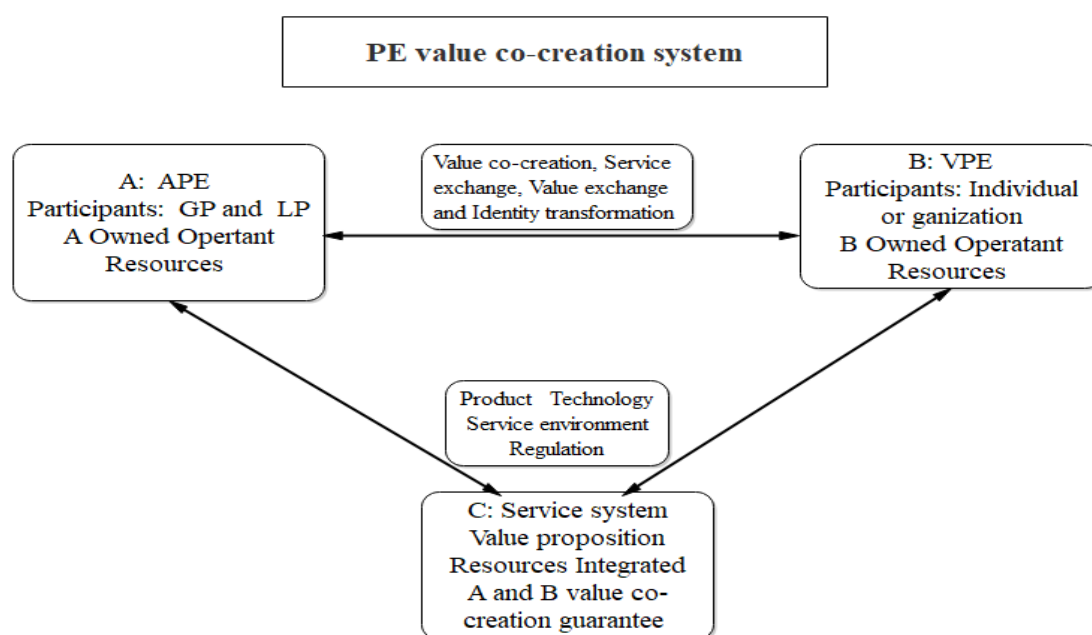
It is true that the empirical study of the causes and consequences of value co-creation is important. However, under the guidance of theory, it is also very important for enterprises to effectively carry out value co-creation activities and build a service system to provide security based on the empirical results. Unfortunately, this aspect of research is rare, and it is more difficult to find in the field of Private Equity Funds. For this reason, this thesis will combine the previous research results, carry out value co-creation activities in PE and the corresponding service system to provide security to perform targeted research, in order to provide help for the managers concerned.

4.3 System Framework and Functional Unit

4.3.1 PE Value Co-creation System and Service System

According to the definition of service-dominant logic, service is the application of capability for the benefit of another participant. The main research object of this thesis are private equity funds, which involves two vehicles: VPE (virtual PE) and APE (actual PE). In this way, service will inevitably involve the interaction and integration of more than two objects and multiple elements. Because service is a continuous process and involves the interaction and integration of multiple elements, it is necessary to use modern technology to construct the basic elements that have an impact on PE value in the continuous process as service elements safeguard components. Moreover, it is embedded in the interactive process of value co-creation, in order to ensure the effectiveness of value creation system, and to protect participants' gains for financial and non-financial service interests (Heskett et al., 1994). In addition, through the system and coordination mechanism created by the participants, the resource integration and service exchange in the process of jointly creating value are guaranteed. This system is the PE value co-creation system as defined in this research.

Figure 4.3: Service System and PE Value Co-creation System with VPE and APE



According to the previous management strategies, PE should be the participant and organizer of service exchange service in the process of value co-creation, which means these factors are the main body of service system construction. According to the previous research: PEs services based on its operant resources have significant positive effects on customers participation in value co-creation; Customer participation in value co-creation initiated by PE has a significant positive impact on the value generated by customer purchasing behavior; Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer recommendation behavior; Customer participation in value co-creation initiated by PE has a significant positive impact on the value of customer influence behavior.

Service is a continuous process, and necessitates the application of modern technology to build the basic elements of PE value in a continuous process into basic service components, which are embedded in the interactive process of value co-creation, in order to ensure the effectiveness of value co-creation, and integrate them into a value co-creation service system.

4.3.2 Customer Preference Discovery and Clustering Modeling

In S-D, as a participant of value co-creation, enterprises play the role of proposing value propositions in the value co-creation system, and are customer-oriented and relational (FP8) with internal beneficiaries, that is to say, the value proposition put forward by enterprises should be customer-dominant. This thesis has demonstrated that customer engagement has a significant positive impact on customer participation in value co-creation activities initiated by customers, and that customer engagement has a significant positive impact on customer participation in value co-creation activities initiated by PE. Therefore, customer engagement is very important for customer participation in value co-creation and cooperation. By understanding customer preferences and participating in the knowledge development process, customers can add value to the company (Joshi & Sharma, 2004). Traditional enterprises pay attention

to customer information based on the market, linking customer information with the market, and providing customers with needed and better goods. However, in S-D logic, enterprises also pay attention to customer information, but focus more on customer value propositions, associated value co-creation with customer resources, and ensuring participants effectively exchange services.

At present, interconnection generates a lot of dynamic information on capital market and investment and financing for PE customers. According to these characteristics of PE, investment and financing are often based on each investment project or case. In view of this, customers' demands are many and change rapidly, often in many cases, the way customers express themselves varies greatly. In order to improve the effectiveness of customer participation in value co-creation process, we need to determine more accurately the customer's preferences for the project, which they have an interest in terms of investment, in order to put forward value propositions that are in line with customer preferences, carry out correct and effective value co-creation, and better serve customers.

To discover customer preferences, the active way is to use the interconnection platform, on the basis of the investigation of actual PE and virtual PE community customers, GP combines past experience and lessons with future development trends, sets up a model, feeds back relevant information to customers in real time, dynamically judges customers' preferences, and proceeds according to customers' preferences. Grouping is done to facilitate the initiation of investment and financing projects. This is an effective measure of GP's value proposition initiated in APE or VPE. LP in PE - Except for the ability to invest, the characteristics of customers' professionalism and investment ideas or preferences are prominent and participatory. The characteristics of LP in PE are obvious and different from other types of organizations. Some studies have pointed out that customers should be encouraged to actively participate in recommendation and build the relationship between similar customers. In VPE, the relationship between customer preferences and projects will gradually form over time and with the depth of customer participation. Customers with the same or similar needs - preferences will be aggregated into a "small crowd" community group. This unique

group, especially around experts, is very important for the development of VPE collaborative recommendation service and the improvement of recommendation quality. Because APE usually invests a large amount of money in projects, and LP usually forms a value proposition initiated by APE or VPE by groups with common preferences in order to avoid greater risks.

Through the specially designed description and judgment model of customer project preference (which industrial area you prefer), the database of customer preference classification is established, and suitable collaborative filtering technology is applied to discover customers with similar investment preferences and possible relationship groups. It aims to provide them with recommendation service of customer or value proposition initiated by APE and VPE, moreover, effective work and a shortcut to attracting more customers is to participate in cooperation with each other. Through tapping and meeting the potential needs of customers, purposefully categorizing services to meet preferential needs of customers is a more advanced service, which can enhance the customer's experience and fluidity of services.

● Customer Preference Modeling in Virtual Community

Customer preference modeling is used to accurately describe and locate customer preference. In the process of participating in information communication and value co-creation of the community (in this thesis, the community contains APE and VPE), customers will show their preference for investment and financing projects in the interaction process. On this basis, a reasonable customer preference model is established to manage customer preference and grasp customer preference more accurately according to information feedback and accumulation.

Customer preferences have certain complexities. Therefore, the application of Internet and computer information technology, the use of ontology to identify and recognize customer preferences, will gradually allow for revealing the intrinsic characteristics of customer preferences for customer preferences modeling. As a value co-creation system and the value co-creation system studied in this thesis, proposing or setting value propositions based on customer preferences can also be constrained by the relevant enterprises participants constraints conditions in the value co-creation. In other

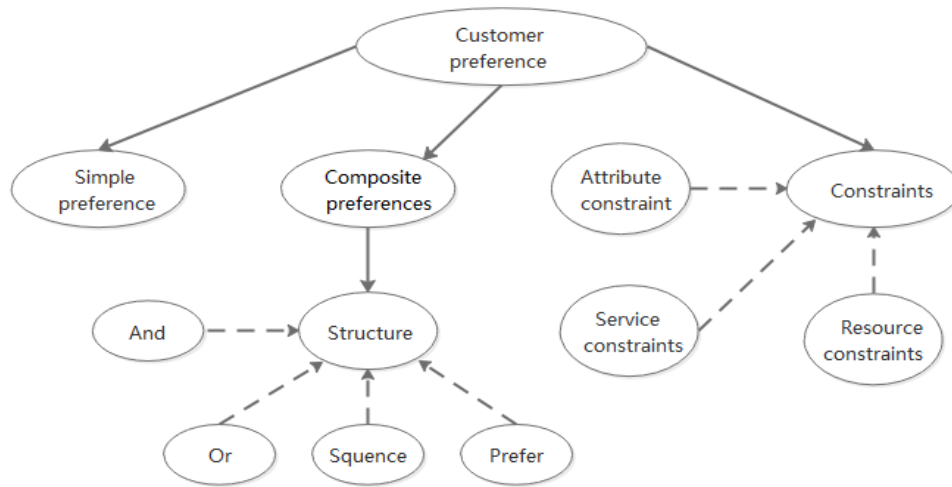
words, effective customer preference modeling considers these constraints.

Customer complex preferences are modeled and classified according to simple and complex preferences features. Simple preferences are related to constraints, and complex preferences are composed of multiple simple preferences. The model can be projected into a single-objective or multi-objective programming model to optimize the solution and obtain customer preferences in the value creation proposition, which is conducive to accurate customer investment project recommendations. As shown in the figure below (figure 4.4) , Simple preference invests and finances projects for basic units of customer preference classification, such as only invests in one project in an industry.

Composite preferences are portfolio investment and financing projects with multiple simple preference basic units. They have four types of structures: (1) The "And" structure, which means the portfolio of two or more basic units; (2) The "Or" structure, in which one basic unit satisfies the portfolio; (3) The "Sequence" structure, which means that there are two or more basic units in the portfolio. Priority weight order of the basic unit permutation combination items; (4) The "Prefer" structure, indicating that the most preferred items are not satisfied, followed by preference items can also be the recommended investment project.

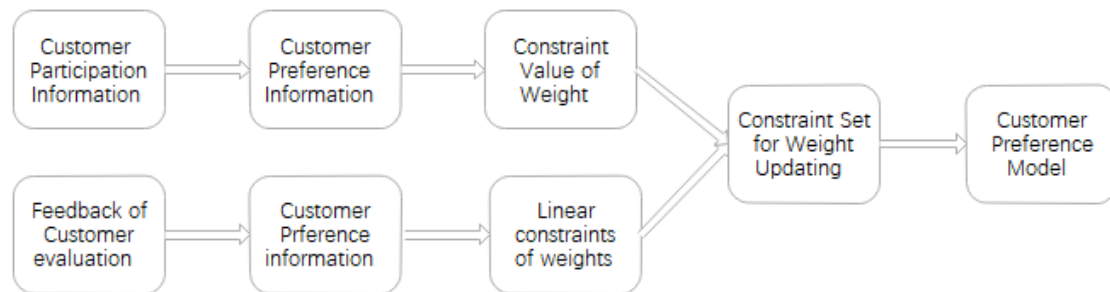
Constraints (constraint conditions) are necessary to satisfy the customer's value proposition, that is, customer preferences can only be conditionally realized in the value co-creation system. Constraints can be classified into three categories: (1) attribute constraints, the inherent requirements of matching PE business philosophy and direction of investment and financing with customer preferences; (2) service constraints, which create the capacity and scope of service system for realizing customer preferences; (3) resource constraints, which creates the necessary resources for value co-creation to meet customer preferences. Matching ability between operant resources and operand resources is also vital.

Figure 4.4: Customer Preference



There are many ways and means to model customer preferences, but the basic framework is the same (see figure 4.5):

Figure 4.5: Customer preference acquisition



- Customer Modeling Based on Project Content Analysis

According to the project content that customers have participated in and browsed in the community, the feature vectors are extracted for each subject content category, and then the final customer preference model is obtained by weighted summation of the feature vectors of the customer-related categories.

- Customer Modeling Based on Collaborative Filtering Technology

By analyzing the social relationships of customers, the community model and individual customer model are established according to the relationship strength setting and weighting. In the process of community interactions, customers are related through various interactive behaviors, reflecting the same or similar demand trends, thus

differentiating into different customer groups with different needs and preferences is possible. Customers with the same types of demand have more interactive activities, while customers with different types of demand have fewer interactive activities. Customers show the characteristics of community Clustering in social network services. Customer relationship networks are essentially a kind of complex network, so community Clustering is the characteristics of community structure in complex networks (Degenne, 1999).

The research finds that the number of customers and their information behavior in social network services are unevenly distributed. The construction of customer relationships shows an obvious tendency due to demand preference and tends to be stable. Finally, it stabilizes the regular interaction scale to consisting of about 20 people (Porter et al., 2009). In the whole community relationship network, customers form a close relationship within the community according to their needs and preferences and the frequency of interaction, which is nested in a large community relationship network. In fact, demand preferences are divided into large and small community groups. The essence of collaborative filtering is to mine and analyze the relationship between customers and neighbor customers of target customers. It can help support systems find neighbor customers with similar demand preferences accurately and lay the foundation for providing more accurate services.

- Digging Customer Behavior Preferences

In order to obtain customers' preferences, there are three hypotheses dealing with customer behavior: Firstly, on the social Internet website, customers prefer information or projects they have published or participated in more than click-through customer or community-sponsored project investment information or discussion topics; Secondly, customer participation behavior in VPEs, customer preference is buying APE investment or financing product; Finally, the longer the time is spent, the more customers prefer the product, according to customer behavior (browsing, annotation, collection, preservation, visits, residence time, etc.), keywords are extracted and combined into vectors as customer project preference model. Through continuous in-depth understanding and clustering analysis, customer preference model can be

gradually formed.

4.3.3 Collaborative Filtering Recommendation and Decision-making

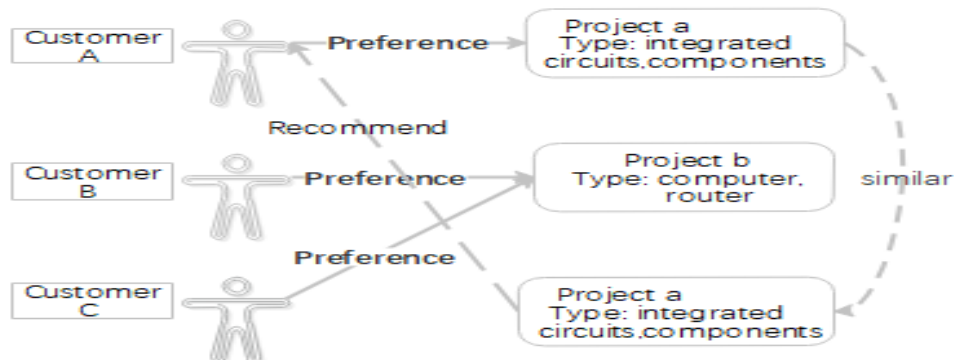
According to the previous hypothesis in my thesis: The customer participation in value co-creation has a significant positive effect on customer perceptions of relationship/support value; customer participation in value co-creation has a significant positive effect on customer perceptions of economic value; customer participation in value co-creation has a significant positive effect on customer perceptions of technology / core value. Based on these findings, this section will study the value co-creation projects formed by customers and enterprises (PE) after the completion of customer investment project preference modeling and propose the recommended value co-creation projects to the customers who meet customer preferences. The value co-creation activities will be carried out after collaborative decision-making.

Personalized Recommendation Technology is the research focus of network services, including the accuracy of customer demand trend description, the accuracy of predicting recommendation results, the real-time recommendation and the extensibility of the algorithm, etc. (Resnisk & Varian, 1997). Collaborative filtering recommendation is the most successful recommendation technology at present (Herlocker, et al, 2004). The introduction of this technology is of great significance for PE to improve the efficiency of customer participation value creation and enhance the cooperative relationship between all relevant actors.

- **Recommendation of Value Co-creation Projects Based on Customer or Community Initiation**

The recommendation of value co-creation investment projects initiated by customers or communities is to extract standardized features with customer preferences based on the content of the recommendation projects, to discover the relevance of customers based on the previous preference records of customers, and then recommend them to customers based on this relevance. The principle is shown in the figure below:

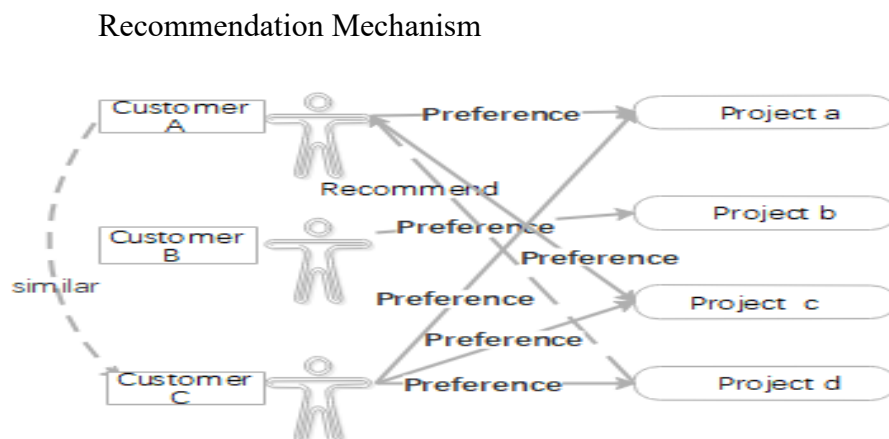
Figure 4.6: Illustrates the basic principles of content-based recommendation



- **Customer-based collaborative filtering recommendation**

The basic principle of collaborative filtering recommendation based on customers is to find "neighbor" user groups like current customers preferences according to the preferences of all customers for projects or information, and then use the algorithm of computing "K-neighbor". Then, based on the historical preference information of these K neighbors, recommend current customers, just as shown in the figure below:

Figure 4.7: Basic Principles of Customer-based Collaborative Filtering



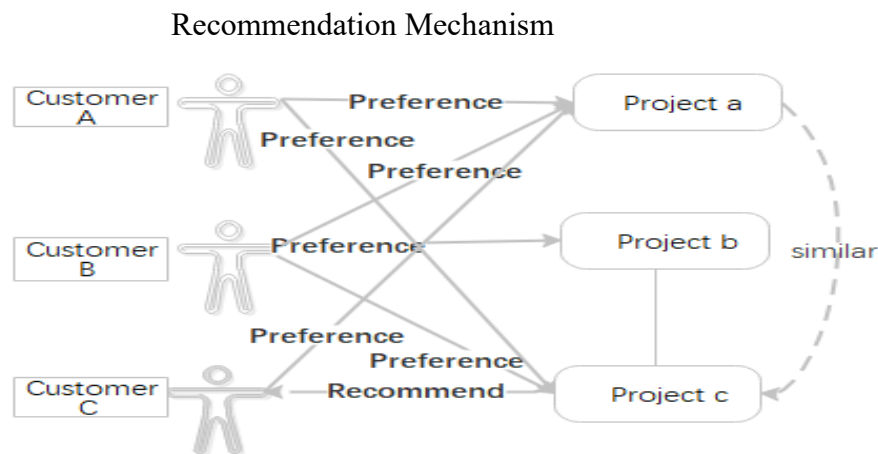
The above figure shows the basic principle of user-based collaborative filtering recommendation mechanism, with the assumption that user A likes item a; user B likes item b; user C likes item a, item C and item D. From the historical preference information of these users, we can find that user A and user C have similar preferences,

and user C also likes item d, so we can infer that user A may also like item D. Therefore, item D can also be recommended to user A.

- **Project-based collaborative filtering recommendation**

The basic principle of Project-based Collaborative Filtering Recommendation is also like that of customer-based collaborative filtering recommendation. A difference is that it uses all users' preferences for projects or information, finds similarities between projects, and then recommends similar projects to users based on users' historical preferences. Figure 4.8 illustrates its basic principles.

Figure 4.8: Basic principles of Project-based Collaborative Filtering



Usually, the priority order of recommendation based on customer and project is PE taking a project as an investment unit. Usually, the number of projects is less than the number of LPs, so project-based recommendation is better than user-based real-time recommendations.

- **Model-based collaborative filtering recommendation**

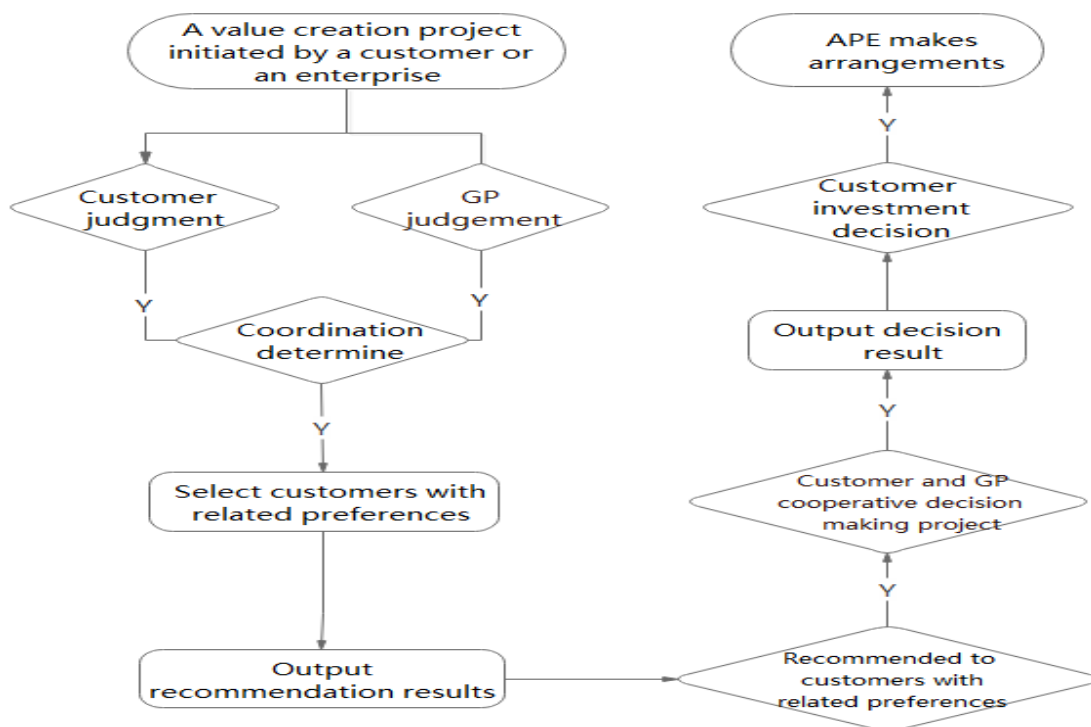
Model-based collaborative filtering recommendation is the pre-arrangement of initiative value co-creation based on VPE and APE. GP makes recommendations and predictions based on LP (customer) preferences through a case or project recommendation model. This is very helpful for VPE and APE to grasp customer needs and carry out value creation. It has the following advantages:

1. It does not require rigorous modeling of project or value co-creation content.
2. The recommendations calculated by this method are open and share other people's experience, which can support users in discovering their potential interests and preferences.
3. APE can develop and improve customer demand preferences in the process of improving value creation orientation and the validity of services.

● **Collaborative Decision-making**

Through collaborative decision-making process and institutional arrangements, resources, especially customer operant resources can be effectively integrated, also risks can be reduced, mutual understanding and trust can be enhanced in the process of interaction with customers. Value propositions can be coordinated, and value co-creation service processes can be effectively carried out. Therefore, an institutional arrangement for value co-creation is essential.

Figure 4.9: Collaborative Recommendation and Decision Flow Chart

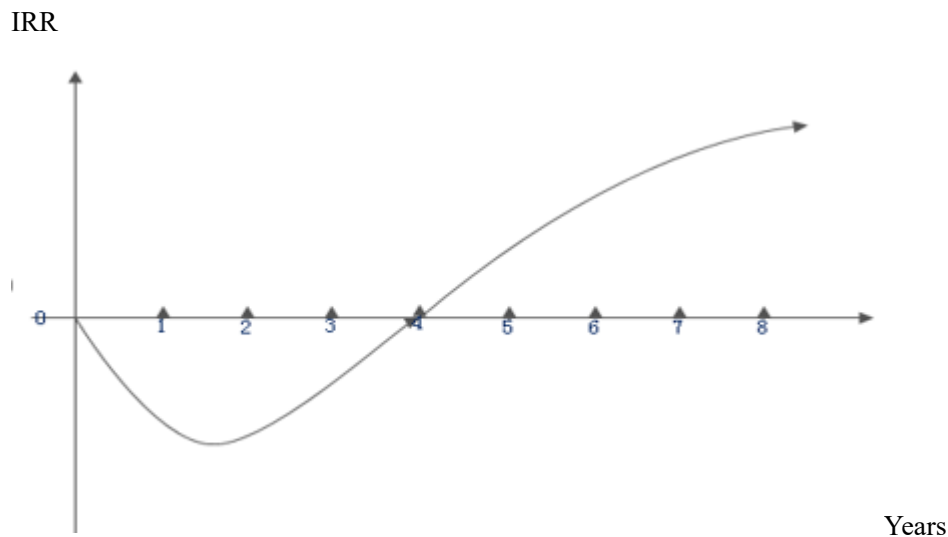


4.3.4 PE Customer's Equity Assets Matching and Transaction

Private equity funds are mostly a partnership, and customers (LP) hold PE partnership shares after joining the PE. In general, PE usually invests in enterprises to gain equity, and don't involve debt investment. PEs invest in Pre-listed or early stage companies before they list on the stock market in Shanghai and Shenzhen, then the PE fund exits from the public stock market through selling its shareholding. Finally, PE Customers receive their profit and interests, which depends on how many shares you have in this PE fund.

Internal revenue (IRR) of PE fund generally follows the "J curve" from initial fund raising to investment projects and income gains (Figure 4.10). The portfolio of funds is a linear portfolio, and they also have similar J-curve shape. The J-curve tells us that the positive profit return of PE is usually in the later years of fund life. As a result, funds usually have 7-10 years of partnership duration. Customers of the PE fund are required to wait a long time to obtain investment returns through PE liquidation.

Figure 4.10: J-curve in PE IRR



The long-term nature of PE investment should be beneficial to the success of the fund. Because investment managers will have plenty of time to find valuable investment projects and carefully cultivate projects already invested in order to get better returns

for PE customers. However, this long-term nature also brings liquidity problems for customers. There are also many reasons for investors to quit, such as the need for liquidity, loss of confidence in the GP management team, dissatisfaction with investment strategies, or to turn to investing in emerging projects. However, it is not easy to exit PE for these kind of customers as LP at present. Because of the lack of information communication and mature secondary market (public stock market) in China nowadays, but there is also involvement in the secondary market "open trading partnership" tax issues, withdrawers and buyers - new investors can only transfer by agreement in most cases, while agreement transfer lacks a fair transfer price as a reference basis, which makes many customers reluctant to pursue. Then the impact is that those who have withdrawal motives and are likely to continue to be partners of the fund because of poor withdrawal options.

They as a result may often lack motivation in making additional investments in the fund, and their investment commitments cannot be in place on time, or even fail, and this will further affect the normal operation of the fund and the promotion of the expected goals. This extreme situation is a dilemma for PE funds, where the inevitable result is the overall discount transfer or liquidation of the fund, LP suffers losses and GP loses management fees. In addition, PE institutions also have the need to transfer some or all of their shares in a timely manner, such as to reduce the risk exposure of PE while retaining some rising funds, or investing in new PE projects in order to obtain capital relief or generate new funds (Levine, 2003). From the buyer's point of view, there are also motives to buy these shares and interests, such as improving their own portfolio, or preferring a certain transfer of investment shares and interests, or completing the investment quota within the prescribed investment time limit, or hoping to achieve early returns at the end of J-curve returns and so on.

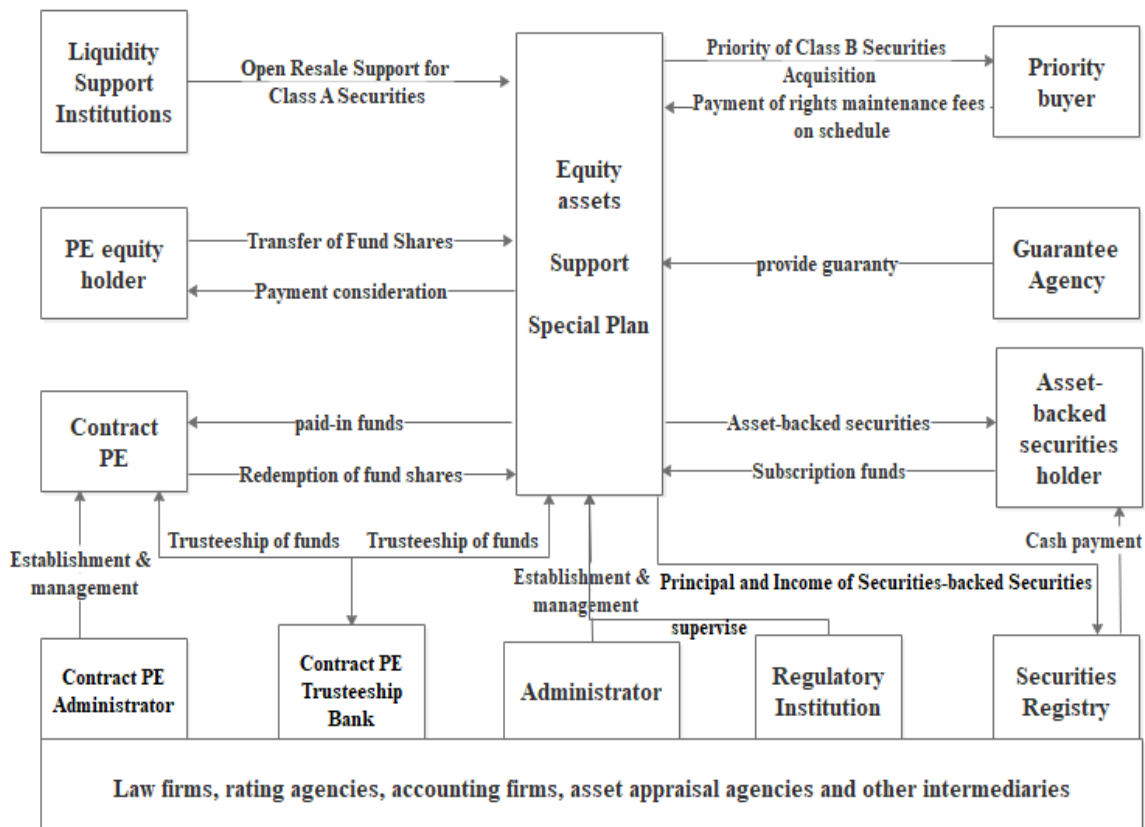
PE investment reflected in some enterprise's shares and interests can be in demand. Previous reviews believe that value acquisition is a process in which customers interact with each other from service providers or automated services. (Alter, 2008) Some others believe that the process of value co-creation is driven by use of value, but it is regulated and monitored by exchange value (Vargo et al., 2008). The transfer of

customer PE equity assets is not only the extraction of customer value from PE services, especially monetary value, but also an important way of value exchange and service exchange services. Therefore, it is beneficial for customers to participate in PE value co-creation and service system to solve the problem of PE investment shares circulation and transaction transfers and satisfy the withdrawal or entry under customer value exchange demands and needs.

● **Liquidity of PE Equity Assets**

For a long time, many innovative schemes have been designed to deal with PE shares and interests. Unfortunately, little has been achieved so far. Under the restriction of current laws and regulations in China, the securitization of equity rights is usually adopted. In order to meet the requirements of stock exchange regulations and PE equity securitization itself, the securitization process and transaction process has no choice but to impose many links, complex structures, long cycles, and many credit checks. It directly leads to high costs during the PE shares or interest’s transactions.

Figure 4.11: Securitization of Equity Assets



In the process of securitization and securitization trading, the PE equity corresponds to the portfolio formed by investing in multiple projects. Therefore, the PE fund provides the buyer with neither details of investment projects nor the dynamic value of PE shares, because it is difficult to obtain the history of the investment project, the track of its value formation and the possible related expectations of the evaluation in the SPV (Special Purpose vehicle) and so on. Moreover, value is very complex, the corresponding rights and interests before and after securitization have a lack of reference, and there are many uncertainties, which seriously affects the enthusiasm of both buyers and sellers. In terms of taxation in China, PE fund as a legal entity pays tax when its shares have been transferred, and then LP as PE customers they also must pay tax when they receive dividends from the PE, resulting in double taxation of Private Equity Funds. Moreover, as a fund, a GP may be unwilling to disclose and reduce the scale of management of sensitive internal information brought about by such open transactions, which is negatively questioned and unwilling to pay attention to and influence their decisions.

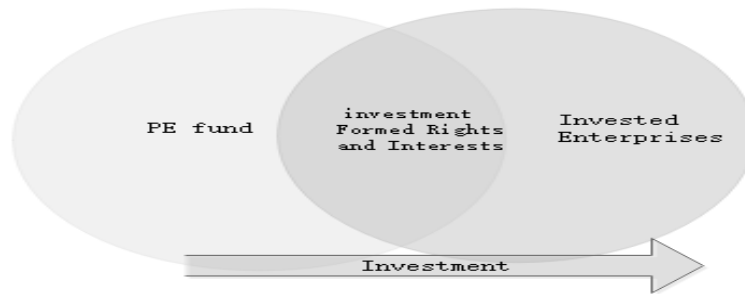
Therefore, the structure of PE equity securitization is complex, involves many factors, long trading chains, higher professional requirements, difficult securitization, difficult sales and are difficult to carry out. Up to now, there are few successful cases in China except for the securitization of real estate-related funds.

Therefore, in order to solve the tradability of equity rights and interests formed by customers participating in PE, it is necessary to dealing with the PE equity rights and interests value which can be traded with fair value; secondly, it is necessary to solve the problem that the equity rights and interests value can be easily circulated by the trading media. Therefore, this thesis will explore the possibility of applying complex numbers to PE portfolio projects with reference to fair value and block chain technology to PE equity value trading media-tokenization, so as to make equity trading feasible and convenient, and become an important part of the support and service system for customers to participate in PE value co-creation.

- **Referable Fair Value for PE Equity Shares and Interests**

PE fund acquire equity and corresponding shares and interests after investing in enterprises. In addition to mergers and acquisitions, PE investment holds no more than 20% of the company's equity. When the investment is completed, the fund intersects with the invested enterprise in value as shown in the following figure:

Figure 4.12: PE Equity Shares and Interests



As shown in the figure, PE investment enterprises are to obtain the expected returns after being listed in the public stock market, which is the original intention of most PE funds in China. The value intersection of PE investment enterprises should have not only the equity capital value of the initial invested enterprises, but also the expected value of the future of the enterprises. It believes that the equity value of an investment enterprise should be the sum of these two values (Damodaran, 2010)

$$\text{Equity value} = \text{initial invested equity capital} + \text{expected excess return valuation} \quad (1)$$

a) We set up:

CV = initial invested equity capital (initial invested value);

EV = estimated expected excess return.

Formula (1) can be expressed as follows:

$$\text{Value Return of equity in } K \text{ enterprises invested by fund} = CV_k + EV_k \quad (2)$$

b) Valuable assets should be showed in a different entity; otherwise, assets are invaluable if the market lacks liquidity. Therefore, we need to calculate the "fair value" according to the market price for these sorts of flowed assets. International Accounting Standard 39 (IAS) recognizes the fair value of valuation techniques. When using technology valuation, if the latest fair market transaction information is available, then the fair value can be calculated by referring to the fair value of

the transaction, cash flow discount analysis and option pricing model. Similarly, China's Enterprise Accounting Standards (convergence with IAS) No. 39 - Article 18 of Fair Value Measurement, which is Enterprises should adopt valuation techniques that are applicable in current circumstances and supported by sufficient data and other information to measure assets or liabilities at fair value. The purpose of using valuation technology is to estimate the price of an asset sold or a liability transferred by market participants in an orderly transaction under the current market conditions.

According to the International Accounting Standards and Chinese Enterprise Accounting Standards, several PE fund management companies listed in the equity trading system of small and medium-sized enterprises stock market in China jointly adopt the asset-based method to evaluate the fund portfolio as follows:

$$\text{Fair Value of Each Fund} = \sum_{k=1}^n (\text{Valuation of the Invested Enterprise in the Project under Management} \times \text{Proportion of the Fund's Holdings in the Enterprise}) - \text{Operating Cost of the Fund} \quad (3)$$

c) From formula (3), we can get that:

$$\begin{aligned} \text{Fair Value of Each Fund} &= \sum_{k=1}^n (\text{Valuation of the Invested Enterprise in the Project under Management} \times \text{Proportion of the Fund's Holdings in the Enterprise}) - \text{Operating Cost of the Fund} \\ &= \sum_{k=1}^n (\text{Initial invested equity capital} + \text{the expected excess return valuation of the invested enterprise}) - \text{Operating cost of the fund} \\ &= \sum_{k=1}^n \text{Initial invested equity capital} + \sum_{k=1}^n \text{The expected excess return valuation of the invested enterprise} - \text{Operating cost of the fund} \\ &= \sum_{k=1}^n \text{Initial invested equity capital} + \left(\sum_{k=1}^n \text{The expected excess return valuation of the invested enterprise} - \text{Operating cost of the fund} \right) \end{aligned}$$

$$= \sum_{k=1}^n CF_k + \sum_{k=1}^n FV_k \quad (4)$$

In the formula:

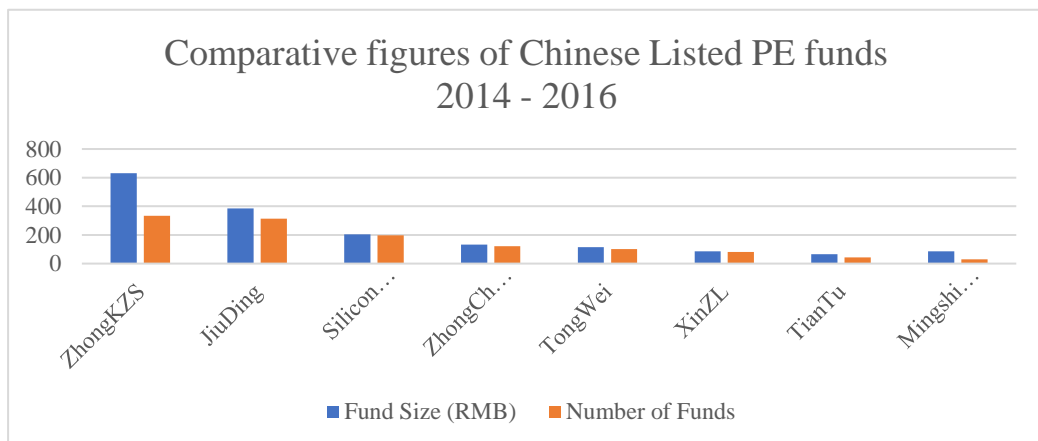
$$\sum_{k=1}^n \text{Initial invested equity capital} = \sum_{k=1}^n CV_k \text{---initial invested value}$$

$$\sum_{k=1}^n (\text{The expected excess return valuation of the invested enterprise - Operating$$

$$\text{cost of the fund}) = \sum_{k=1}^n FV_k \text{---Expected Excess Value}$$

Formula (4) is derived from the valuation model of listed companies, which coincides with the meaning of Formula (2). Zhong-KZS (Z) Fund is the one of largest RMB fund in China. Until 31st August, 2014, there were 233 investment projects under the management of the fund ZhongKZS, with an accumulated investment amount of 18.246 billion RMB. Among them, 32 projects have been completely withdrawn and 14 projects have been already listed in the Chinese stock market. The fund divides the investment industry into seven major industries. It is also a listed company in China, so it is easy to get its public information such as IPO prospectus from Chinese Security Regulatory Commission website, data from this prospectus also calculates the fair value of the fund according to formula (4) at the time of IPO (see Table 4.1).

Figure 4.13: Comparative figures of Chinese Listed PE funds 2014 - 2016



Source: Guangzheng Hengsheng, 2017

Table 4.1: Valuation of Z Fund

No.	Industry	Number of investment projects (enterprise)	Valuation (RMB 100 million)	Initial investment Capital (RMB 100 million)	Expected Excess Return (RMB 100 million)	Overall IRR
1	Cultural Consumption	40	75.88	46.71	29.17	15.23%
2	Electronic Information	43	57.53	24.37	33.16	24.09%
3	Health medicine	20	20.65	11.59	9.06	21.49%
4	Energy saving and environmental protection	22	33.82	19.66	14.16	19.14%
5	Advanced Manufacturing	51	37.50	37.50	43.25	22.61%
6	Modern Agriculture	12	22.39	11.61	10.78	21.67%
7	New Material	13	41.85	14.85	27.00	36.26%
Total		201	332.87	166.29	166.58	22.01%

Source: IPO Prospectus of Zhong-KZS (Z) Fund (15th Feb, 2015)

As we know from the table, Z fund exactly uses the formula of the initial investment capital value and the expected excess return value as the fair value of this PE fund when valuation is the same as formula (4).

According to Chapter 7, Fair Value Level Article 24 of Accounting Standards for Enterprises No. 39 from the Ministry of Finance of the People's Republic of China, an enterprise shall divide the input value used in fair value measurement into three levels,

first using the input value of the first level, secondly using the input value of the second level, and finally using the input value of the third level. The first level of input value is the unadjusted quotation of the same assets or liabilities that can be obtained on the measurement day in the active market. Active market refers to the market where the transaction volume and frequency of related assets or liabilities can provide pricing information continuously. The second level input value is the direct or indirect observable input value of related assets or liabilities in addition to the first level input value. The third level of input value is the unobservable input value of related assets or liabilities. Article 25 further states that "the input value at the first level provides the most reliable evidence of fair value."

Due to the lack of active market references and other subjective and objective reasons, many enterprises adopt the first level of input value in formula (1) when calculating their equity value, and the second or third level of input value in expected excess return valuation. Because of the complexity of the second or third level as input value, there are no mature valuation methods, standards and regulations to follow, and improper valuation and prediction have a way to invade "fair value"; in addition, improper valuation and prediction can be smoothly mixed into the algebraic sum of the term fair value, which are "initial equity capital value" plus "expected excess return valuation". In this way, the subjective and objective motives of improper valuation and prediction, access channels and invisibility in the "fair value" may lead to the "fair value" may be seriously distorted and unreliable, and it is difficult to distinguish and prevent. It is difficult for managers, investors or stakeholders to know the composition of value and the distortion of "fair value" unless they adopt complex and cumbersome in-depth adjustment (often after the emergence of major problems that must be paid attention to). So that in the US financial crisis in 2008, the "fair value" of improper valuation and prediction was regarded as the "culprit" and suffered a lot of negativity as a result.

The reliability of fair value is determined by the reliability of valuation techniques and the reliability of input values used. However, in fact, the initial investment capital and the expected excess return value belong to two different

meanings or two totally different states of value - the determined value that has occurred and the expected uncertain excess value that will occur. However, the current value or valuation of equity assets is based on a simple addition-algebraic sum. The value of equity assets is a mixture of two different meanings. It is difficult to intuitively know the initial investment capital and to judge the basis of initial investment capital. The expected excess earnings and the direction and pace of equity growth can be obtained. In order to clearly express the two state values constituting PE equity asset value, this thesis introduces the complex number on the basis of the above, and uses the real part of the complex number to express the determined initial investment value-(real value) that has occurred; use the imaginary part of the complex number to express the dynamic and uncertain expected excess return value-(imaginary value); and use the modulus of the complex number to express the composite vector, which formats by initial investment value-(real value) and uncertain expected excess return value-(imaginary value). This complex modulus represents the current value of PE equity assets in order to provide a reference of fair value for the funds concerned by PE customers.

- **Complex Expressions of Referable Fair Value**

The "fair value" of equity assets consists of the initial investment capital and the expected excess return valuation. Initial investment is already real value and expected excess quotation value is expected to occur in uncertain "virtual" value, which belongs to two completely different state values. When calibrating their real and virtual values in the coordinate system, they can only belong to the direction of two state values of real and virtual values. Therefore, it is worth discussing that we simply regard the two state values as algebraic sum and "fair value" of equity assets.

The complex number is a number in the form of $a+ib$, where the a is the real part, b is the imaginary part, and i is the imaginary unit. According to the characteristics of real part and imaginary part of complex number, we use complex numbers to express the two state values of funds. That is to say, the initial investment value of the fund in the real part expression of complex number formula (5) - the "real value" that can be confirmed in the current period; the imaginary part expresses the expected excess value

- the "imaginary value" that cannot be confirmed in the current period. That is to say, the plural expression of formula (5) is as follows:

Total Fair Value of Equity shares and Interests of N Enterprises Invested by Fund

$$\begin{aligned}
 &= \sum_{k=1}^n (CV_k + iFV_k) \\
 &= \sum_{k=1}^n CV_k + i \sum_{k=1}^n FV_k \quad (5)
 \end{aligned}$$

In the formula:

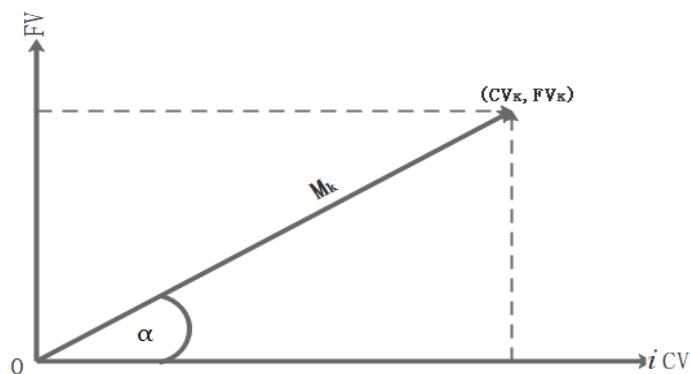
Real Part of Complex: CV as Initial investment Value

The imaginary part of the complex number: iFV is the expected excess return value
 For the convenience of application, we transform formula (5) into triangular form and exponential form of complex numbers.

On the asset complex plane composed of current value and expected excess value (see figure below), the current value (CV_k) and expected excess value (iFV_k) obtained by the fund for investing in K enterprises, the resultant vector (\vec{M}_k) formed by the sum of two states or vectors:

$$\vec{M}_k = \vec{CV}_k + \vec{FV}_k$$

Figure 4.14: Description of M_k



On the complex plane the figure above, the relationship between CV , iFV and M can be seen intuitively.

$$M_k = \sqrt{CV_k^2 + FV_k^2} \quad (6)$$

Therefore, M_k is the modulus of resultant vector which is composed of two states of initial value $\overrightarrow{CV_k}$ and $\overrightarrow{FV_k}$ expected excess return value or two vectors, rather than the scalar algebra sum of initial value and expected excess return value of existing technology. In this way, (5) Formula can be transformed into the triangular form of complex numbers:

Fair Value of Equity shares and Interests of K Enterprises Invested by Fund

$$\begin{aligned} &= CV_k + iFV_k \\ &= M_k \cos \alpha_k + M_k i \sin \alpha_k = M_k (\cos \alpha_k + i \sin \alpha_k) \end{aligned} \quad (7)$$

And there are:

$$\begin{aligned} \operatorname{tg} \alpha_k &= FV_k / CV_k \quad (8) \\ \alpha_k &= \operatorname{Arctg} (FV_k / CV_k) \end{aligned}$$

Further, the exponential form of formula (8) can be obtained:

Fair Value of Equity shares and Interests of K Enterprises Invested by Fund

$$= M_k (\cos \alpha_k + i \sin \alpha_k) = M_k e^{i\alpha_k} \quad (9)$$

Similarly, from equations (5), (6), (7), (8), and (9), we can get three complex expressions of the fair value of the portfolio of funds:

Total Fair Value of Equity shares and Interests of N Enterprises Invested by Fund

$$\begin{aligned} &= \sum_{k=1}^n CV_k + i \sum_{k=1}^n FV_k \\ &= Mn (\cos \alpha_n + i \sin \alpha_n) \\ &= Mn e^{i\alpha_n} \end{aligned} \quad (10)$$

In the formula:

$$Mn = \sqrt{\left(\sum_{k=1}^n CV_k\right)^2 + \left(\sum_{k=1}^n FV_k\right)^2} \quad (11)$$

$$\text{tg}\alpha = \frac{\sum_{k=1}^n FV_k}{\sum_{k=1}^n CV_k} \quad (12)$$

If a LP wants to transfer his PE fund shares L, then:

LP Transfer Fund Partnership Share Reference Fair Value = L* Fund Fair Value

$$= L * \left(\sum_{k=1}^n CV_k + i \sum_{k=1}^n FV_k \right) = L * Mn e^{i\alpha n} \quad (13)$$

Moreover, when we compare the current value (J2) with the initial value (J1) or two values, Application (10) can be expressed as follows:

$$J_2/J_1 = (M_2/M_1)e^{j(\alpha_2 - \alpha_1)} \quad (14)$$

In this formula, M2 and M1 are the synthesized values (Modula) of current value (J2) and initial value (J1), respectively. Like root locus and complex frequency domain analysis, M2/M1 is the amplitude-frequency characteristic of value and $\alpha_2 - \alpha_1$ is the phase-frequency characteristic of value. Through the amplitude-frequency characteristics, we can conveniently and accurately analyze or judge the development trajectory and stable conditions of the value system. Similarly, singularities in value systems can be monitored (e.g., when improper valuation and predictive conditions occur). That is to say, the amplitude-frequency characteristics of value system reveal the dynamic and steady-state characteristics of the system, which judges the influence of some links or parameters on the dynamic and steady-state characteristics of the system simply and quickly, and indicate the direction of improving the system. When the series method of Euler formula is further expanded, the spectrum analysis of value can be carried out to obtain more information and application.

In this way, first of all, formula (10) can clearly express the value of initial value and expected excess value; secondly, formula (11) M can express the composite value of initial value and expected excess value, which are composed of two different states; thirdly, formula (12) can express the positive and negative direction and extent of value

development. Fourthly, (15) The composition and development trend of PE equity assets value are expressed more accurately in multiple directions. It provides customers with more information from different perspectives, which is convenient and beneficial to customers in approaching decisions.

● **Practical application**

Using the fund fair value expression formula of the complex (10), the valuation of Z fund is as follows (Table 4.2)

Among them:

$$\begin{aligned}
 \text{Fair Value of Fund} &= 166.29 + i 166.58 \\
 &= 235.37 [\cos (0.786) + i \sin (0.786)] \\
 &= 235.37 e^{i 0.786} \tag{15}
 \end{aligned}$$

$$\text{tg}0.786 = (CV/FV) \approx 1.0 \tag{16}$$

From formula (15), we can see that at the time point of the reporting period of the fund, the current invested equity capital of the fund is 166.29 billion RMB, the expected excess value is 166.58 billion RMB, and the composite equity value of the current invested equity capital and the expected excess value is 235.37 billion RMB. The difference between the fair value of Table 4.1 (332.87 billion RMB) and that (97.50 billion RMB difference) is 1.4 times of the complex composite value.

From the result of formula (15) - the tgα column in table 4.2, we can see that the ratio of the expected excess value of the fund to the initial value (invested equity capital) is 1, and the expected total return at this point is twice that of the input capital - the

Table 4.2: Fair Value Statement of Complex Expressions of Z Fund Company

Industry	Quantity of Investment	Investment capital	Expected excess value	Fund Value in Complex formula	Fund value in Trigonometric function expression	Fund Value in Exponential expression	M Value	tgα Value	Arctgα Value
Cultural Consumption	40	46.71	29.17	46.71+i29.17	55.07(cos0.56+isin0.56)	55.07e ^{i0.56}	55.07	0.62	0.56
Electronic Information	43	24.37	33.16	24.37+i33.15	41.15(cos0.94+isin0.94)	41.15e ^{i0.94}	41.15	1.36	0.94
Health medicine	20	11.59	9.06	11.59+i9.06	14.71(cos0.66+isin0.66)	14.71e ^{i0.66}	14.71	0.78	0.66
Energy saving and environmental protection	22	19.66	14.16	19.66+i14.16	24.23(cos0.62+isin0.62)	24.23 e ^{i0.62}	24.23	0.72	0.62
Advanced Manufacturing	51	37.5	43.25	37.5+i43.25	57.24(cos0.86+isin0.86)	57.24 e ^{i0.86}	57.24	1.15	0.86
Modern Agriculture	12	11.61	10.78	11.61+i10.78	15.84(cos0.75+isin0.75)	15.84 e ^{i0.75}	15.84	0.93	0.75
New Material	13	14.85	27	14.85+i27	30.81(cos1.07+isin1.07)	30.81e ^{i1.07}	30.81	1.82	1.07
Total	201	166.29	166.58	166.29+i166.58	235.37(cos0.79+isin0.79)	235.37e ^{i0.79}	235.37	1	0.79

Unit: Billion RMB

Source: IPO Prospectus of Zhong-KZS (Z) Fund (15th Feb, 2015)

input-output ratio is 2. Among them, projects investing in new materials and electronic information have the fastest expected growth in excess value ($tg\alpha \geq 1$) and the best returns.

For the fair value of PE portfolio at different time points (t), we can easily use Formula (10) to obtain. The real and imaginary complex numbers express the expected excess value of the initial investment capital and the reference value of the current open market respectively. Investors can see the expected excess return FV of the initial investment capital, the initial investment value CV, and the total value of the combination of the two values. Moreover, if the current $M_1 >$ early M_0 indicates that PE investment projects are developing in a good direction, and vice versa; then the development trend can be judged, and the ratio of expected excess value to initial investment capital at T-Time point can be obtained by $tg_\alpha (=FV / CV)$ - value composition structure and growth rate, which is the objective basis for the beneficial participants especially PE customers.

According to basis of the above PE equity refer to the fair value expression, this thesis further studies the PE equity assets transaction.

PE Equity and Asset Transaction—— EQUITY Assets Value Tokenization and Transaction Method and System Based on Block Chain Technology

● Transaction Media and Credit Construction

From an economic point of view, credit is always accompanied by the whole transaction process. Money, as a medium of transaction and a measure of value of transaction, is based on the credit of both participants in the transaction. In this section, this thesis will start with the basic data of PE equity value to build a credit base. The authorized intermediaries will record the initial value of assets and the expected excess return value by using the complex number and calculate the corresponding fair value. They will also use the token as the vehicle of the transaction according to the demand. Then, they will use the token as the vehicle of the transaction; Finally, in the process of asset formation, tokenization and transaction, the "honest data system of asset value" is constructed by block chain technology, which lays a good technical and credit foundation for PE equity

assets token transaction.

Block chain is a kind of linked data structure which combines data blocks orderly according to the time sequence and guarantees non-tampering and non-forgery distributed accounts by cryptography. Broadly speaking, block chain technology is a new distributed infrastructure and computing method of technology that uses block chain data structure to verify and store data, uses distributed node consensus algorithm to generate and update data, uses cryptography to ensure data transmission and access security, and uses intelligent contracts composed of automated script codes to program and operate data. (Yuan & Wang, 2016) The application of block chain technology can establish a decentralized data recording and storage system, and time stamp the blocks to form a continuous, coherent and honest data recording structure, forming a data system to ensure honesty (Chen, 2017). In some cases, block chains can reach the previously untapped supply of resources and create new markets.

The same idea is to endow a database technology that is essentially new and can be adopted by multiple organizations. Block chains can build the basis for solving problems or opportunities that existing systems are unable to achieve. The "honest data system" based on block chain technology has achieved significant performance in many applications. Bitcoin, a virtual currency, is one of the best examples. Although Bitcoin is a kind of virtual currency, the "computational power" of creating Bitcoin and the record through the block chain are real, visual, traceable and untampered. The history of its formation and the virtual value created in the case are traceable and credible. Credit is not only the cornerstone of transactions, but also the medium of transaction credit. The trader accepts it not because of its physical characteristics, but because of its credit characteristics, just as paper money can replace gold physical currency. It is precisely artificially designed virtual feature with high credibility that Bitcoin as a trading medium has been recognized by many traders. Traders are also willing to exchange and trade with traditional trading media such as the US dollar currency formed by the traditional credit system.

Therefore, according the idea of Bitcoin, this thesis will study the value tokens of PE equity assets, which will provide new ideas and means for PE equity assets

trading.

Keynes (1946) believed that "the importance of money comes mainly from the connection between the present and the future" and that the most important attribute of money lies in skillfully linking the present and the future. The modulus M of complex numbers is used to express the composite vector modulus of initial investment value (real part) and expected excess value (imaginary part) more accurately, which is composed of two different state vectors (see formula 12). It replaces the simple algebra of estimating initial investment capital and expected excess return and expressing the value of equity. With synthetical value, the equity asset owner determines the number of tokens for issuing to match their portfolio equity. Then, the synthetical value is divided by the number of tokens, and the value per token for the unit's rights and interests to be traded is obtained; Or, the value per token for unit's equity is set, it is easy to get numbers of token for issuing after the synthetical value is divided by the value of a token for unit's rights. Thus, the value of equity assets can be tokenized (hereinafter referred to as "M currency"). That is to say, the application of complex numbers lays an important foundation for the tokenization of PE equity assets. Next, this thesis will study the application of block chain technology as a trading medium - M currency credit enhancement.

The application of block chains to M currency and trading systems (see figures below) can provide the following support for their credit:

Figure 4.15: Network schematic diagram of trading system

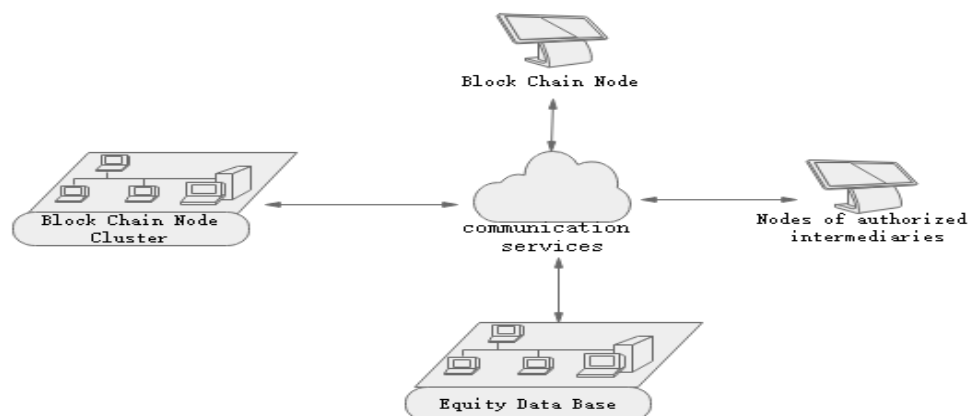
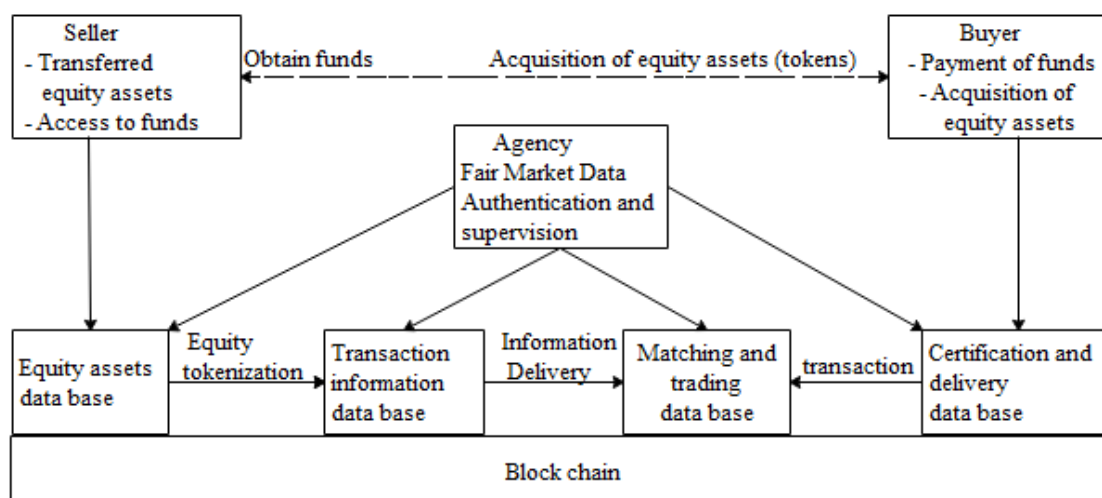


Figure 4.16: Schematic diagram of trading system



(1) Information symmetry and credit. Transactions need information, and the ability to collect and authenticate customer information is limited. The investment and financial management of customer-entrusted PE is also affected by GP's subjective effort, opportunism, and whether it has done something harmful to the interests of clients, that is, information asymmetry affects credit. The application of block chain technology links internal and external relevant information and records information. Its information is transparent, tamper proof and traceable to the relevant parties. GP credit risk can be reduced, the cost of negotiation and decision-making will be reduced, the trust between customers will be increased, and the enthusiasm of customers to participate in cooperation and application of M-currency transactions will be enhanced.

(2) Establishment and accumulation of credit. Using block chain technology methods, the details of customer participation, value creation, value accumulation, value exchange and so on are recorded in the interactive process of value creation in the whole process. Records based on block chains are tamper proof, offer permanent preservation, transparency, auditability and traceability, which ensure the reliability of value information generated by value creation interaction and co-creation. From

this, we can generate the reliable information of the two main dimensions (K.R Ranjan & Read, 2017) of value co-production and the indicators of knowledge sharing, equity and interaction, experience, personalization and relationship, respectively. This information can be used not only as the basis for evaluating the effect of value creation and improving the effectiveness of value creation, but also as the basis for analyzing and judging the causes of value formation, value effectiveness and credit formation of PE in the process of customer participation in value co-creation. It can also bring positive support dealing with solutions to asymmetry of information, fairness of transaction, accumulation of participant's credit, increasing customer's continuous cooperation due to credit accumulation and etc.

- (3) Compulsory intelligent contract. Complete and credible information is conducive to foreseeing possible events within the contract period, being willing to abide by the terms of the signed contract and being able to enforce them when disputes arise. Intelligent contract generation is beneficial to effective execution. The rigidity of the intelligent contract makes the intelligent contract mandatory. Its institutional arrangement promotes customer participation in the value co-creation of PE equity assets, which is emphasized by the service logic (FP11).

M currency credit guarantee in the trading system (see flow chart below Figure 4.16):

- (1) Through institutional arrangements (S-D, FP11), establish a "consensus mechanism" for transactions and designate authorized intermediaries to host and operate servers and manage corresponding databases in accordance with their functions and powers.
- (2) Intermediaries, such as accounting firms, are authorized to record audited initial investment capital and relevant financial fair value data to the Equity Assets Database, and to enter real-time reference fair current excess return valuation of PE-related investment projects from the open market. Among them, the complex number

accounting method is applied: the real part records the initial investment capital, and the imaginary part records the fair current excess return valuation.

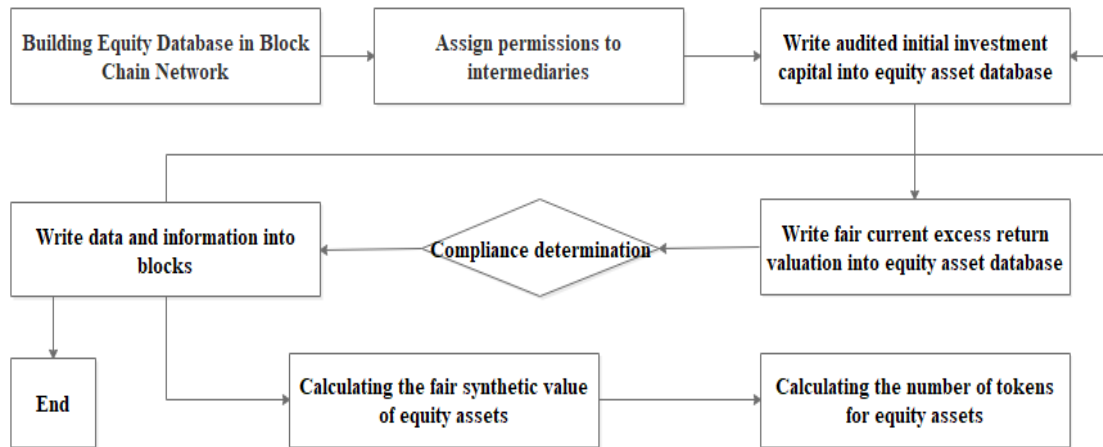
- (3) PE inputs the relevant information of the portfolio to be sold and the equity rights and interests into the equity assets database. The computer automatically calculates the initial investment capital and the expected excess value of the equity portfolio assets based on the basic data. The reference fair composite value (the real part of the initial investment capital) and the expected excess value (imaginary part) is a composite vector modulus composed of two different state vectors.
- (4) PE determines the number of tokens for issuing in the portfolio equity based on fair composite value. There are two methods to achieve this purpose. Firstly, we can divide the fair composite value by the number of tokens to get the reference fair equity value of one token of the unit's rights and interests to be traded. The second method is setting one token value, which can refer to the value of the fair equity token; then the number of tokens issued can be obtained by dividing the total value of equity by the value of each token.
- (5) When the information and data of the portfolio or the token to be traded of the fund are confirmed by the intermediary agency hosting the "transaction information database", the information is timestamped, the technology of block chain is applied, and the computer automatically determines the conformity according to the "consensus mechanism", and after the decision is passed, the information is distributed. Recorded in four databases or specified databases and marked as "for sale" in the "transaction database".
- (6) All the actions during the transaction such as login, contract generation and distribution, identity identification, buyer's capital confirmation, rights and interests and transaction authentication of the participants in the transaction system are all carried out under the supervision of the third-party intermediaries, with the

participation of time stamp, block chain technology and computer to automatically determine the conformity according to the "consensus mechanism". After passing this stage, distributed records are recorded in four databases.

- (7) Buyers and sellers make trading decisions and relevant trading conditions based on information and data on the fund equity assets of "to be sold" mark. And then stamp the time, apply block chain technology, and the computer automatically determines the conformity according to the "consensus mechanism". After the judgment is passed, it is distributed and recorded in four databases as well just same process in above. In the database of authentication and delivery data model, the seller's delivery conditions are marked as "to be bought" or "to be sold" respectively.
- (8) The computer automatically sends the "transaction database" marked as the feature mark to be sold into the "authentication and delivery database" in real time and matches with the condition information marked as "to be bought" and "to be sold" in the database. At the same time, the "authentication and delivery database" will be matched. The corresponding information of the two sides of a successful transaction is labeled as the characteristic mark of the success, and then the information of the success is sent to the relevant parties of the transaction through information and communication technology.
- (9) The relevant procedures of the "matching transaction database" will automatically generate intelligent contracts, push them to the parties to confirm the transaction and verify them by third-party intermediaries, and mark the successful or unsuccessful transaction results in the "authentication and delivery database".
- (10) Finally, after the successful completion of the transaction, the seller obtains money, the buyer obtains the equity assets tokens, the transaction results are timestamped, and the block chain technology is applied to distribute and record in four databases.

(11) All information is based on block chain technology. Computers automatically make conformance judgment according to the "consensus mechanism". After the judgment is passed, distributed records are recorded in four databases. In the process of value tokenization and transaction of equity assets, block chain technology is fully utilized, which organically integrates server physical isolation, information and communication technology, encryption technology, authentication and supervision of intermediaries, and provides credit guarantee for PE equity value tokenization and M token transaction through supervision and facilitation measures.

Figure 4.17: Securitization flow chart for equity interests



By introducing the complex number, expressing the initial investment capital of equity assets with the real part, expressing the expected excess value with the imaginary part, and expressing the equity value of two different states differently, it is beneficial for traders to make objective judgments on the direction and pace of the increase of the equity value of transactions that were difficult to achieve in the past. The modulus of complex numbers can more accurately express the composite vector modulus, which is composed of two different state vectors of initial value (real part) and expected value (imaginary part), instead of the simple algebra of initial investment capital and expected excess value and the method of expressing the value of equity.

Moreover, the value of PE equity assets is tokenized by composite value, and tokenization is used instead of securitization, which eliminates many complicated and

cumbersome intermediate links, reduces costs, improves efficiency and lays a foundation for real-time transaction of equity assets. Based on the organic integration of server physical isolation, information and communication technology, block chain technology, encryption technology and the introduction of third-party authoritative intermediaries to participate in real-time fair value data entry and authentication and supervision, the intelligent and convenient real-time transaction of M-equity tokens (assets) with guaranteed credit has been constructed in an all-round way. Real-time Trading system provides an operable scheme for the matching transaction and transfer of PE and customer's equity assets, and it also provides new ideas and methods for value exchange and service exchange in the process of value co-creation, is a means to promote customer participation in PE value co-creation, as well as an important part of value co-creation service system.

4.3.5 Construction of Knowledge Sharing and Learning Community

In the process of customer participation and value creation, enterprises and customers establish a continuous interactive learning relationship. This learning relationship is based on two elements; Firstly, adaptive learning, which enables enterprises to better adapt to customer needs; secondly, learning new things by reviewing the past, which enables enterprises to re-examine existing conditions and standards. In order to create conditions for developing new enterprise capabilities and gaining competitive advantage, enterprises should better understand and meet customers' demands in the process of mutual learning (Prahalad & Hamel, 1990). A virtual community is an effective place for participants to develop knowledge, skills, innovate and formation of collective wisdom. The number of virtual community members is huge, and their interests are different.

Gathering the community members with similar specialties, interests or learning preferences to construct learning community dynamically will play an important role in the construction of cognitive network (Yang, 2012). Influenced by the development

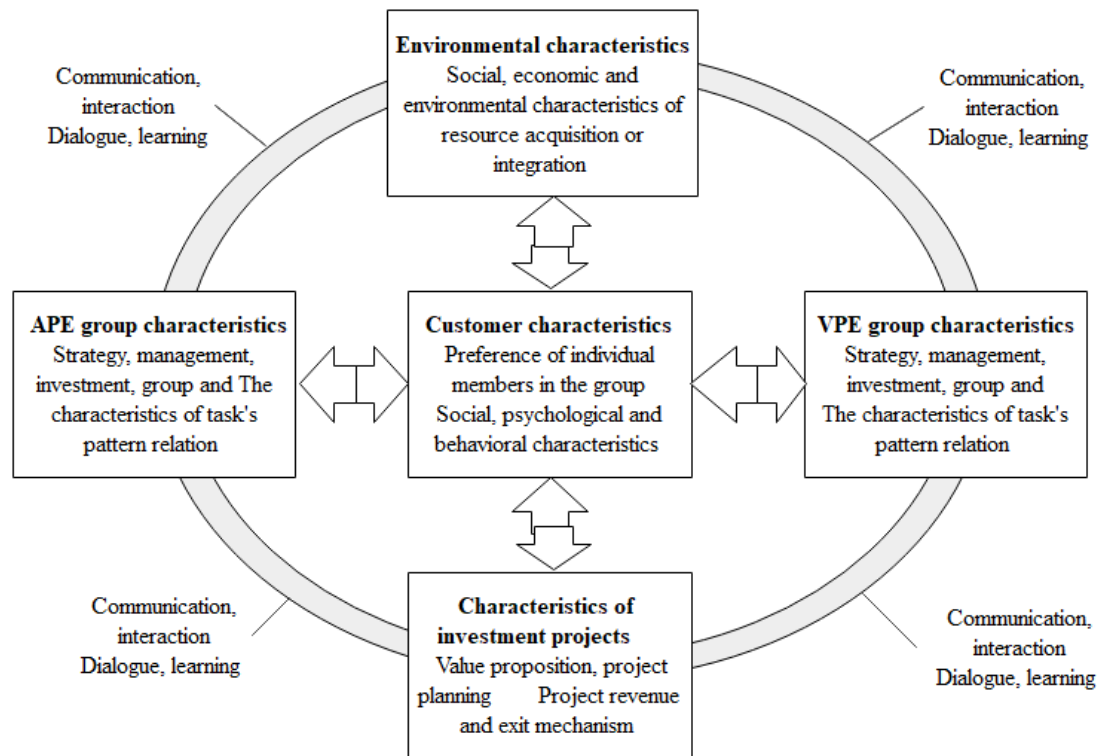
of Internet technology and the methods of community information dissemination, people's learning concepts and modes have changed dramatically. For example, the process of knowledge construction of individual community participants has gradually shifted to participating in social group interaction to improving their knowledge construction, from individual learning through to community learning. Individual "single-play" learning modes cannot effectively meet the individual needs of learners and the needs of social cognitive construction. The application of a virtual community based on the Internet has promoted the emergence of various learning communities. Virtual learning communities are the inevitable result of group collaboration, group wisdom creation and sharing under the information technology environment.

In VPE, the number of members is large, the preferences and operant resources are different. If we can gather the community members with similar value propositions, professional relevance and similar preferences in the dynamically constructed learning community through the interaction of communication and learning it will continue to help virtual community members deepen and improve their knowledge and ability, which is bound to be more effective in the interaction in value co-creation. The improvement of service systems can be regarded as a learning organization (March, 1999). This is also the demand of the learning virtual community.

Customers who intend to participate in APE usually not only have high investment awareness and ability, but also are company's executives or experts in many industries. Their investment preferences are shaped by their knowledge and skills. To find and excavate the knowledge points corresponding to their preferences from these influential customers, especially in a certain customer group is a key goal. Based on the research results of VPE and APE managers, a community of sharing and learning based on customer preference knowledge points is recommended to customers (figure). In order to actively initiate targeted interactive discussions and learning activities, form a community of collaborative knowledge sharing and learning between customers and customers, customers and VPE or APE, lays the foundation for future value co-creation to form high-cost operant resources of enterprises, and make value co-creation more effective. The value is more attractive during service exchange services process.

Therefore, it is very important to build a knowledge sharing and learning community and make it an important means to ensure customer participation in value co-creation. It is also an important part of value co-creation service systems.

Figure 4.18: Construction of PE Community and Learning Community



4.4 Concluding Remarks

Value co-creation is an extended exchange process of co-production and customer value (Ranjan & Read, 2017). In addition, value co-creation and service are a continuous process. The participation of customers, integration of resources, exchange of services and values, coordination mechanism of participants, etc. all need to be guaranteed or supported by a service system. Therefore, value co-creation system jointly constructed by VPE and APE also needs to be connected and provided by a service system.

This thesis demonstrates that customer engagement is an important prerequisite

of value co-creation initiated by customers. Customer engagement implies the external performance of customer psychological factors. Through the discovery and Clustering modeling of customer demand preference in a service system, and with the help of modern intelligent technology and communication means, the potential customer demand can be found or mined. Guided by the open value proposition or potential value demand of customers, this starts a value co-creation process in the proper way and promotes the effective development of value co-creation. There is no doubt that it is beneficial and practical for PE to adopt this method.

Moreover, this thesis also demonstrates the importance of collaborative mechanisms in value co-creation. In the service system of this thesis, collaborative filtering recommendation and decision-making are constructed. This thesis focuses on the mechanism of collaborative decision-making when PE initiates value co-creation projects, this mechanism is not only beneficial, but also practical and has reference value for non-PE enterprises.

Customer participation in value co-creation needs to obtain benefits, and value co-creation is always exchanged or transferred. Alter (2008) pointed out that value acquisition is a process in which customers interact with benefits from service providers or automated services. In the process of value co-creation between VPE and APE, there must be value exchange, especially when identity is transformed from customer to partner. Anderson (1993) pointed out that value when measured in monetary units, this is perceived value. Sweeny and Soutar (2001) also believe that the functional value in perceived value is the value of money processing ability. value co-creation may be accumulated or reflected in PE equity. However, the valuation and securitization of PE equity assets have always been difficult, which has seriously hindered the transfer or transaction of equity assets and greatly affected the confidence of PE investors.

This thesis illustrates the complex number is used as a tool of PE equity asset securitization, a new method of asset securitization, asset token and matching trading system. It is proposed that the "fair value" of PE equity assets should not be the scalar algebraic sum of initial value + expected excess return value, but the vector sum (module) - composite value of complex number. The fair value of equity assets

expressed in complex number is not only more scientific, but also more informative, which is beneficial for customers to make investment decisions on this basis. According to this, equity asset securitization is realized by tokens. With the support of the third-party authorized intermediary as a technical and credit investigation means, the input value of the current period is controlled, and the synthetic value and the number of tokens is calculated dynamically. At the same time, blockchain technology is used to guarantee honest data, and the "creation, transaction method and system of equity asset value token based on blockchain" is established. It provides a more scientific, convenient and reliable scheme for PE equity asset securitization, and lays a better foundation for promoting customers to participate in PE value co-creation.

In the face of rapid development, specifically in the PE industry, no knowledge will always be effective and not backwards. In the service system of this thesis, the knowledge sharing and learning community between customers and enterprises is constructed. With the support of Internet technology and the virtual community of value co-creation system, PE and customer actively launched proper interactive discussion, learning activities, and make progress together; finally, lay the foundation for value co-creation to form advanced operant resources for PEs.

-Chapter Five-

Summary & Conclusion

5.1 Overview of Thesis

At present, China's private equity investment fund still adopts a GP closed management mode. However, against the background of unprecedented changes in information technology and various R & D, new products and new formats with revolutionary and aggressive nature emerge endlessly, meaning complexity and uncertainty continues to increase, so more knowledge and skills are needed for information acquisition, mining, analysis and ability to match this uncertainty; At the same time, changes in the external environment, especially the information society, gives customers multiple perspectives with which to evaluate PE operational methods and working results, customers have higher requirements and expectations for PE performance. Traditionally for PE and GP it is difficult to achieve the expectations from LP or customer, because GPs themselves do not have enough resources integration abilities and management skills in today's circumstances. Therefore, facing the current situation of PE, in order to seek ideas and methods of PE development and innovation channel, this thesis introduces and examined the service dominant logic.

In the first chapter, based on the systematic and in-depth study of the relevant literature of service dominant logic, this thesis gave an overview and summary of the service dominant logic. In view of the management mode and existing problems of PE, this thesis reviewed the application of service dominant logic theory and viewpoints, and designed a step-by-step demonstration, theoretical analysis and empirical research leading towards practical application. In order to integrate the operant resources of customers, the theoretical model of value co-creation of customer participation in PE has been put forward and verified.

In the second chapter of the thesis, the effectiveness of value co-creation was studied, and the virtual VPE the vehicle of value co-creation was put forward. In addition, the theoretical and empirical research on customer engagement and value co-creation value activities in VPE was carried out. In the third chapter, the service system that guarantees the interaction between actual APE and virtual vehicle VPE has been illustrated, and then it is clear to understand that PE value co-creation system is formed by APE + VPE + service system.

Therefore, the following conclusions can be reached,

- a) **Customer participation in value co-creation is a very important segment, and it is necessary for PEs to provide services for customer participation in value co-creation processes**

Service dominant logic focuses on the use value of products or services, and the use value is jointly created by customers and PE – (value co-creation). In value co-creation processes, customers play an active role in creating value with the company (Kohler et al., 2011; Prahalad & Ramaswamy, 2004). Customers participate in the value co-creation of enterprises with operant resources, the value comes from the operant resources or the transfer of operand resources. Customer participation in value co-creation brings more operant resources outside the enterprise and realizes the combination and co-cultivation of resources with the enterprise (Håkansson & Waluszewski, 2002). This jointly produces more value, thus promoting more customers to participate in value co-creation, which is conducive to the efficient and sustainable development of the PE industry. Therefore, it is very important for customers to participate in the PE value co-creation process. In order that customers can participate in value co-creation processes, it is necessary to ensure that customers can carry out resource integration and service exchange together in the process of participating in value co-creation interactions. PEs need to provide basic services for customer participation. Based

on the research of service logic and related literature, this thesis constructs a theoretical model of customer participation in value co-creation and obtained the empirical data through online questionnaire research of GP, LP, managers and customers want to join PE. The empirical results show that PE service based on its operant resources has a significant positive impact on customer value co-creation with operant resources. Moreover, the empirical data also shows that GP and customers agree on the value that co-creation process needs customer participation.

Through further analysis of the empirical results, the conclusion that customer participation is PE's "full mediation effect" of customer perceived value based on operant resources was obtained, rather than the half mediation or adjustment role proposed of previous research by Liu (2014). This conclusion confirms that PE's service based on operant resources is the antecedent of customer participation value, and customer perceived value is the consequence of customer participation. The antecedents and consequences of customer participation in value co-creation not only shows the causal relationship, but also points out the effective pathway of value co-creation. This conclusion changes the original view that GP makes value alone for PE, and customer perception of its original value is that PE and GP provide services for customer participation in the context of participation value co-creation process. Such paths and results are very important for PE. This not only provides empirical support for the relevant theory of service logic, but also provides a strong basis for PE application to examine the strategy and management under service dominant logic, change the original value of GP, and provide a strong basis for customer participation in value co-creation.

b) VPE is necessary to establish a co-creation vehicle for customers to participate in value co-creation process

The next step of this thesis was to identify a vehicle for value co-creation process for PE customers. From the perspective of practice, this thesis proposed to establish a virtual PE (VPE) community with specific value purpose initiated by the actual PE as a vehicle for customers to participate in value co-creation processes,

including customers that have not yet become the LP of an actual PE. The vehicle for interaction and value co-creation with the actual PE, it's also the vehicle for customers identity transformation for value exchange between the actual PE and VPE. In addition, actual APE can obtain more operant resources are through VPE this platform, not only as a complement of resources for APE, but also the interaction and new combination of operant resources, it makes the high-level integration and optimization of resources. The continuous combination and integration will bring unexpected creativity to PE. At this time, the core competitiveness of PE will be composed of actual APE and virtual VPE, which greatly improves the survival and development ability of Chinese PE.

c) Customer engagement is the precondition of value co-creation of PE, and it is also important condition to cooperate value co-creation initiated by customers.

The key for enterprise to carry out value co-creation activities is to mobilize customers to cooperate in value co-creation process (Normann & Ramirez, 1993). Customer engagement (CE) is a kind of psychological state, which occurs in the relevant interaction that customers participate in the enterprise or initiated by customers. That means value co-creation activity, which can be transformed into action. Using the VPE of a virtual community to understand customer's psychology and related behaviors and grasp customer's psychology and related activities are the preconditions for carrying out value co-creation. The empirical results of this thesis show that customer engagement has a positive impact on customer participation in value co-creation process, which is initiated by enterprises and customer engagement has a positive impact on customer participation in value co-creation process, which is initiated by customers. This is the precondition for value co-creation beginning. But how to initiate value co-creation? When demonstrating the relationship between customer-initiated value co-creation and enterprise-initiated value co creation, through further analysis of empirical data, this research demonstrates the "partial mediation effect" of customer-initiated value co-creation for customer engagement and customer participation in enterprise-initiated value

co-creation.

Customers can spontaneously claim the proposition of value co-creation. However, customers lack the ability for matching and resource integration. Moreover, they cannot develop effective value co-creation process by themselves, especially in real enterprises. Therefore, unlike other research on "parallel" self-initiated value co-creation by customers (Li, 2014), the path of customer-initiated value co-creation in this thesis is through "serial" initiation by enterprises (see chapter 2), which is confirmed by application of empirical research. Only the right combination of resources can achieve a competitive advantage (La-vie, 2006). That is to say, the value co-creation initiated by customers promotes the value co-creation initiated by PEs, and "increment" of value co-creation for PEs is the supplement of value co-creation initiated by current PEs alone. PEs need to coordinate customer engagement and value co-creation initiated by customers to effectively carry out value co-creation process. The customer engagement and the value co-creation initiated by the customer are both originated from the potential or open value proposition of the customer, which is emphasized and important by the service dominant logic.

As such through the analysis of empirical data, this thesis proves that customer engagement has a significant positive impact on value co-creation initiated by customers, and the value co-creation initiated by customers has a significant positive impact on the value co-creation initiated by PEs, which is the precondition for PEs to carry out value co-creation - derived from customer value proposition. At the same time, it also confirms the path of customer-initiated value co-creation, which is through PE collaborative initiation

d) Service system is the guarantee of effective development for value co-creation process

How to guarantee the development (working) of value co-creation? Because this process involves the participation of customers, the integration of resources, the exchange of services and values, the interaction between value co-creation and

services is a continuous process. In order to ensure the effective development of value co creation, we need to build a value co-creation service system. Based on the results and insights of the previous theoretical and empirical research, this thesis studies the key points in the service system. Firstly, aiming at the development of customer engagement and value proposition, this thesis focused on the research of customer demand preference discovery and Clustering modeling in the constructed service system, in order to find out potential customer needs and their value proposition. This process can make ensure the accuracy of value co-creation.

Secondly, this thesis also studied collaborative filtering recommendation and decision-making, discussion effective value co-creation process for PE in this collaborative decision-making mechanism. Thirdly, this thesis proposes and proves that the "fair value" of PE equity assets should not be the scalar algebraic sum of the current prevailing initial value + expected excess return value, but the vector sum (module) - composite value of the complex number. The fair value of equity assets expressed in complex number is not only more scientific, but also more informative, which is beneficial for customers in making decisions. According to this theory, based on server physical isolation, information and communication technology, blockchain technology and encryption technology, with the help of third-party authorized intermediaries as technology and credit investigation means, the current input value of control input is calculated dynamically, and the composite value and the number of tokens are transferred as individuals or as a whole with the "fair value" of transaction tokens at the time of transaction. The target is to build a trading system of customer value exchange in the process of value co-creation. Fourthly, it studied the construction of knowledge sharing and learning community between customers and PEs, in order to carry out joint learning around the knowledge renewal of value co-creation and lay the foundation for value co-creation to form unique operant resources of PEs.

Service dominant logic is an evolution, not a revolution, which is based on "intangible and dynamic resources, input of value co-creation, relationship,

economic and social process" (Gummesson et al., 2010). The enlightenment that service dominant logic brings to us with new ideas is that we can reflect and plan the current business activities from the logic of service (economy), encourage and guide customers to participate in value co-creation processes, and supplement this with the corresponding foundation; we can initiate value co-creation in accordance with the value proposition of customers. And then construct a service system, realize the participation of participants including customers and Pes in value co-creation, integrate the operant resources of participants, exchange services and values in the process of service interaction, realize value co-creation and sharing, embed institutional arrangements, and ensure value co-creation process working.

5.2 Implication

- a) PE should fully realize the importance of customer participation in value co-creation and take effective measures to provide effective services for customer participation in value co-creation process.**

Today, with increasingly fierce market competition and the specialization of labor division, the knowledge and skills of the enterprise itself are not enough to meet its or its system survival needs. Using their own knowledge and skills to participate in the exchange of services and services will help market participants to enhance the system viability. The focus of S-D strategy is to improve the ability of resource integration and value co-creation by exchanging services in complex dynamic system. Customer participation in value co-creation has become a source of new competitive advantages (Prahalad & Ramaswamy, 2004).

Resources integration and value co-creation are aimed at customers who have knowledge and skills. It should be said that customer participation is not only an important factor of customer satisfaction, but also the core of value co-creation (Vargo & Lusch, 2004a). Enterprises should provide and create conditions for customers to

participate in value co-creation. On the one hand, customers engagement applies modern technology to uncover customer needs and value propositions, and carries out value co-creation in a proper way; on the other hand, they provide high-quality services, including hardware and software, to create a friendly value co-creation scenario, so that customers can perceive value in the participating scenario. In the process of customer participation in value co-creation, perceived value is beneficial in enhancing the cooperative relationship and promote customer participation. Thirdly, enterprise (PE) should improve the ability of resource integration in the value co-creation process, that means developing operant resources and impacts that can manipulate participant's operant resources (Madhavaram & Hunt, 2008). Value co-creation processes are necessary to cooperate with all participants in an interactive way, contribute resources, integrate their skills, knowledge, innovation ability and entrepreneurial ability to create value together, and finally integrate other actors to provide services. This integration and optimization of interrelated operant resources will give enterprises competitive advantage in the market.

b) PE are responsible for initiating value co-creation in a proper way

The construction of virtual VPE with specific value purpose by actual PE not only avoids the institutional obstacles, makes VPE become the common value co-creation vehicle of APE members and customers who have not yet become APE members, but also becomes the vehicle of service exchange, value exchange and identity transfer between VPE and APE, innovatively constructs the value co-innovation mode of virtual and real interaction between VPE and APE. In this way, PE gets more operant resources from other participants than APE itself in value co-creation process, while the value co-creation activity of virtual and real interaction brings operant resources for interaction between participants and organizations - two or more different basic resources interaction groups significantly. This is the highest level of resource advantage theory, which will greatly increase the sustainability of competitive advantage of enterprises (Madhavaram & Hunt, 2008). In order to realize more and more combinations and co

cultivation of resources, it should promote more participants to participate in value co-creation (Håkansson & Waluszewski, 2002). VPE + APE model is not only beneficial for PE, but also for other non-PE entities, from solving the problem of customer participation in value co-creation vehicle to resource integration, to match market changes and ensuring the sustainable development of PE or enterprises. VPE is the vehicle of value co-creation and running value co-creation process with participants or actors.

How to carry out value co-creation effectively is one of the priority questions in this thesis. In this empirical study, it has been demonstrated that customer engagement has a positive impact on value co-creation initiated by PE and customers. From the perspective of the empirical value co-creation path, no matter the value co-creation is initiated from the customer engagement, or from the value co-creation initiated by the "mediation" customer, it all originates from the customer, not the PE itself. That is, the value proposition of the PE is "customer-oriented". Just as the service-dominant logic points out that enterprises cannot create value alone but provide value proposition and participate to guarantee value co-creation processes are working. That is to say, the value proposition by customers is co-created with PE. In other words, the value co-creation carried out by PE should create value for customers, while the value of PE is obtained through the exchange of services in the process of creating customer value.

Therefore, the PE needs to coordinate the value co-creation initiated by the customer engagement and the customer spontaneously to carry out value co-creation in a proper way. The former involves the performance of the potential behavior of customers, and the latter involves the behavior that has occurred to customers. The illumination is that the value co-creation carried out by PE, whether initiated by PE in accordance with customers or by PE in collaboration with customers, is initiated by collaboration rather than independently. Therefore, the collaborative mechanism of value co-creation is important. First, the customer's value proposition is inconsistent and needs to be coordinated. Secondly, the feasibility and effectiveness of value co-creation need to be coordinated. Thirdly, the idea of value co-creation of innovation also needs the coordination of innovation systems and institutional arrangements.

Therefore, PE should take the initiative responsibility of initiating and developing value co-creation.

It is valuable to set up a mirror VPE of an actual APE, and value co-creation can be carried out in the VPE in advance or in collaboration. We can carry out non ownership value co-creation, ownership value co-creation and ownership transactions. It gives customers more choices across a wider range, attracts more customers to participate in value co-creation, integrates more resources, and establishes more in-depth relationships with customers through interaction. In non-ownership value co-creation, APE and customers do not have a strict legal relationship in VPE, which is more favorable for enterprises to approach customers. With the help of advanced technology and equipment and means, we can have in-depth exchanges and interactions in knowledge, skills, experience and other aspects, which can improve the effectiveness of the value proposition initiated by PE and reduce the negative impact of uncertainty.

c) Value transfer and exchange mechanism of value co-creation

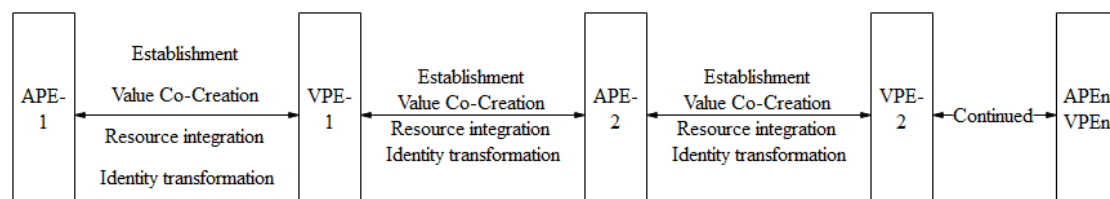
The customer input cannot be taken for granted or go unrewarded - engaging them in the firm's activities must be done in a way that is enticing and beneficial for both parties (Saarijärvi et al.,2013). The participants or actors of value co-creation have clear economic demands and participating in value co-creation is the process of creating value as well as pursuing and acquiring value. Actors will participate in value co-creation for different reasons and will also withdraw from value co-creation for various reasons. The actual situation of PE tells us that the entry and exit mechanisms of customer participation in value co-creation are of great concern and key factors for all participants. The value of value co-creation production is continuous and accumulated, and the subject matter of value co creation may even cover each other. In addition, whether customers participate in the entry and exit of PE value co-creation, which involves the transfer of equity assets issues. However, the transfer of equity assets has not been well solved, and investors must wait 5 years or even longer when the fund is closed. Even when it comes to the closing time of the fund, there are still difficulties in the transfer of the overall equity assets of the fund, which will seriously affect the

enthusiasm of customers to participate in value co-creation.

This thesis proposes and proves that the "fair value" of PE equity assets should not be the scalar algebraic sum of the current prevailing initial value + expected excess return value, but the vector sum (module) - composite value of the complex number. The fair value of equity assets expressed in complex number is not only more scientific, but also more informative, which is beneficial for customers to make decisions. According to this theory, based on server physical isolation, information and communication technology, blockchain technology and encryption technology, with the support of third-party authorized intermediaries as technology and credit investigation, the current input value of control input is calculated dynamically, and the composite value and the number of tokens are transferred as individuals or as a whole with the "fair value" of transaction tokens at the time of transaction.

This method makes the securitization of equity assets more scientific, convenient and reliable, and can promote customers to participate in the value co-creation of PE. Applying the ownership transfer brought by the token transaction of equity assets, the identity of APE and its mirror VPE customers can change between them, so that the APE life cycle can continue or iterate (Figure 5.1). The continuity brought about by this, which is conducive to the continuous integration and optimization of GP and customer's operant resources, the continuity of its co-creation value activities and customer relations, the accumulation and development of co-creation value and service capital, which lays the foundation for further efficient development.

Figure 5.1: APE Life Cycle with the Help of Mirror VPE



d) **Research and application of service system**

According to the service-dominant logic, all economies are service economies and service is the basic element of economic activities. The actors or participants will form a service process around the goal of economic activities -- customer-oriented value proposition. The service process is also a process in which participants, including customers, enterprise and all participate in value co-creation. Participants are resource integrators, and this sort of resources are operant resources, which are the fundamental source of strategic interests. The integration and optimization of operant resources must be systematized because of its huge amount and complexity, and the result of systematization is to build an "ecosystem". In the process of this trend and its formation, the competition for the acquisition and control of element resources will intensify, and every enterprise will become either have operand resource or the operant resource. If we choose the latter one, we can use service dominant logic to reflect and plan PE's strategy and business activities.

In order to integrate more operant resources in the main direction to respond to complete customer value proposition. It is necessary to change the current GP value originality of PE to co-create value with customers and participants. Value co-creation exists in the process of interaction, and participants' participation in value co-creation originates from its internal basic motivation and perceived value in the process of interaction. Therefore, PE should accurately build the interaction process that suits customers and build a friendly experience situation for participants in the interaction process, to ensure the effectiveness of participants in resource integration. All of these rely on the service system. In other words, service systems are an indispensable method to build the process of value co-creation and guarantee this value co-creation process. Therefore, PE GPs should carefully study the value proposition of customers and build a service system to realize the value proposition.

The service process constructed by the service system can match the customers' demands, effectively integrate the operant resources of the participants, guarantee the participants in value co-creation, exchange services and values in the process of service

interaction, realize value co-creation and sharing, and use institutional arrangements to ensure the formation of the service process and the effectiveness of value formation. This is not only the requirement of integrating participants' resources to create value together, but also the foundation of forming "ecosystem" for future development.

5.3 Future Research

Despite the advancements and contributions in this thesis, there are still issues which need attention and which will be addressed undoubtedly in the future.

- **Expand the research area and make the research results more universal**

The research area of this thesis is PE, and the samples are also taken from PE industry. Therefore, with the support of the existing research results, the following research could be extended to other or related industries, such as PE invested enterprises. In order to conduct more in-depth research and make the research results more universal, it should have more research evidence to prove these theories, especially for non-financial industries.

- **Research on value co-creation from the perspective of value co-creation system**

According to the service dominant logic, all economies are service economies, and all enterprises are service industries. What we need is a kind of logic, not to abandon goods dominant logic, but to transcend it and realize the primary position of resources is Service (Vargo & Lusch, 2014). Build the basic structure for more industry of value co-creation system, which is actual enterprise + virtual enterprise + service system. Applying service dominant logic to guide the systematic research on value co-creation process. Firstly, it studies the organizational structure of the new value co-creation system and the coordination mechanism under the organization. Secondly, research the service standards and processes of service system under the new organizational

structure and coordination mechanism to ensure the effective value co-creation. Thirdly, the effective interaction method and process of value resource combination and value production in value co-creation system should be constructed. Fourth, provide institutional arrangements for customer participation in value co-creation. The normative experience and system in the process of value co-creation interaction are important for the trust and effectiveness of enterprises to customers, which will affect the cooperative relationship (Dai et al., 2013).

- **Applying service science to develop the research of value co-creation support system -----Service system**

Service system is the support system of value co-creation process. Many related activities of value co-creation, such as the entry point of customer participation in value co-creation, value co-creation initiation, interaction process of value co creation, integration of resources, exchange of services, institutional arrangement, etc., are guaranteed by the service system. In other words, the service system is the main underwriter and supporter of value co-creation; service systems are a very important segment to value co creation also. PE or investment enterprises usually have provisions on the time duration for involvement. How to extend the time duration of APE with the support of the mirror VPE, APE needs to study the methods and measures to ensure resource integration, value co-creation, customer identity transformation, etc. from the organizational and institutional arrangements. This requires the study of flexible "smart service systems" to adapt to it, with the support of modern high-tech method to build smart collaboration mechanism to meet the demands of value co-creation.

Service dominant logic is the foundation of service science, which is research on the value creation of service system (Maglio & Spohrer, 2008). IBM calls Service Science (Service Science, management, and Engineering, SSME for short), "service science is the study of business technology industrial innovation which creates value and shares value through the cooperation of agents and suppliers. The Cambridge SSME special report believes that service science is the study of service system and value proposition. The application of service science research value co-creation service

system is of great value both in theory and practice. Therefore, in future research, more relevant factors should be applied and explored within this research structure which should aim to find more results for implement applications in the PE industry.

Appendix

问卷

尊敬的女士/先生:您好!

感谢你百忙之中抽出时间回答问卷。我正在进行《顾客参与私募股权投资基金(以下简称“PE”)价值共创》的研究,调查的对象是PE的普通合伙人(GP)、PE管理公司管理人员、PE的一般合伙人(LP)和有意愿参与PE的顾客。本问卷采用匿名调查的形式,所搜集的数据仅用于学术研究不会用于,任何商业用途,你的作答将被完全保密,请放心!所有题目没有对错之分,请您按照您的实际情况作答即可,再次感谢你的鼎力支持。

Distinguished Ladies/Gentlemen:

Thank you for taking time out of your busy schedule to answer the questionnaire. I am conducting a study on Customer Participation in Private Equity Funds (PE) Value Co-creation. The subjects of this study are the general partners (GP), managers of PE management companies, limited partners (LP) of PE and customers willing to participate in PE value co-creation. This questionnaire is conducted in the form of anonymous survey. The data collected will only be used for academic research and will not be used for any commercial purposes. Your answers will be completely confidential. There are no right or wrong questions. Please answer them according to your actual situation. Thank you again for your support.

第一部分: 基本信息

1、您是PE的普通合伙人(GP)?

Are you a general partner (GP) of PE?

否 是 从业时间: 1年以下 2-3年 3年以上

2、您是PE基金管理公司管理人员?

Are you a managerial staff of PE?

否 是 从业时间: 1年以下 2-3年 3年以上

3、您是PE的一般合伙人(LP)?

Are you a limited partner (LP) of PE?

否 是 已加入时间: 1年以下 2-3年 3年以上

4、在条件适合时,您意愿加入PE吗?

Would you like to join PE when the conditions are right?

是 否

5、您的学历:

What is your education background?

硕士及以上 本科 大专 高中/中专/技校 初中及以下

第二部分：顾客参与 PE 价值共创

序号	问项内容：参与 PE 设立的社区活动	1 完全 不同意	2 不太 同意	3 不确定	4 同意	5 非常 同意
		1.Totally Disagree	2. Disagree	3. Not Sure	4. Agree	5. Definitely Agree
1	我会花大量的时间参与 PE 社区的活动 I spend a lot of my discretionary time in the PE community.	1□	2□	3□	4□	5□
2	我对参与 PE 社区活动十分着迷； I am heavily into the PE Community activities	1□	2□	3□	4□	5□
3	我非常热衷参与 PE 社区的活动 I am passionate about the PE Community activities	1□	2□	3□	4□	5□
4	参与 PE 社区活动是我的生活中重要的部 分； Enjoy PE community activities is an important part of my life.	1□	2□	3□	4□	5□
5	我想要更多地了解 PE 社区活动； I would like to learn more about the PE Community activities	1□	2□	3□	4□	5□
6	我非常关注 PE 社区； I pay a lot of attention to anything about the PE Community activities	1□	2□	3□	4□	5□
7	我乐于和朋友一起参与 PE 社区； I love to join PE Community activities with my friends	1□	2□	3□	4□	5□
8	当我身边的人也加入 PE 社区时，我会觉 得更加有趣 Join the PE community is more fun when other people around me do it too	1□	2□	3□	4□	5□
		1 完全 不同意	2 不太 同意	3 不确定	4 同意	5 非常 同意
		1.Totally Disagree	2. Disagree	3. Not Sure	4. Agree	5. Definitely Agree
9	我会经常参加 PE 社区发起的新金融投资 产品意见征集活动 I will often participate new financial investment product discussion and creative solicitation activities, which sponsored by PE community.	1□	2□	3□	4□	5□
10	我会经常参加 PE 社区发起的新金融产品	1□	2□	3□	4□	5□

	<p>评测活动</p> <p>I will often participate new financial product evaluation activities in PE community.</p>					
12	<p>我会经常参加 PE 社区发起的新项目或者金融产品的推广路演活动</p> <p>I will often participate new investment projects or financial product promotional roadshow activities, which sponsored by PE community.</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
13	<p>我会经常将自己对于新产品的创意在 PE 论坛中与成员分享</p> <p>I will often share my ideas about new products with members in PE community forum.</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
14	<p>我会经常在 PE 社区中发起 PE 品牌或者产品的相关的话题</p> <p>I will often launch discussions about the PE brand or product related topics in PE community.</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
15	<p>我会经常积极回应 PE 社区中其他成员的话题</p> <p>I will always respond the demands positively from other members of the PE community.</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
16	<p>我会经常在 PE 社区中帮助其他成员解决投融资等相关问题</p> <p>I will often help other members in PE community to solve problems related to investment and financing.</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
	问项内容：能力	1 完全不同意	2 不太同意	3 不确定	4 同意	5 非常同意
		1.Totally Disagree	2. Disagree	3. Not Sure	4. Agree	5. Definitely Agree
	顾客所提供的服务中运用了很多知识					
17	<p>顾客有大量的相应经验来响应 PE 的需求</p> <p>Customers have a lot of relevant experience to respond to the needs of PE</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
18	<p>顾客拥有充足的行业知识</p> <p>Customers have enough industry</p>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>

	knowledge					
19	顾客拥有响应 PE 需求的专业技能 Customers have professional skills to respond to the needs of PE	1□	2□	3□	4□	5□
20	PE 有足够的生产要素来提供服务 PE has enough production factors to provide service	1□	2□	3□	4□	5□
21	PE 可以提供有质量保障的服务 PE can provide service with quality assurance	1□	2□	3□	4□	5□
22	PE 可以根据顾客的需要配置适当的资源 PE can configure the appropriate conditions according to the needs of the customer	1□	2□	3□	4□	5□
23	PE 所提供的服务中运用了很多知识 A lot of knowledge is used in the services provided by PE	1□	2□	3□	4□	5□
24	PE 有很多相应经验来响应客户的需求 PE has a lot of relevant experience to respond to customer needs	1□	2□	3□	4□	5□
25	PE 拥有充足的行业知识(需要客户与管理者分开回答同样的问题吗?)	1□	2□	3□	4□	5□
26	PE 拥有响应我们需求的专业技能	1□	2□	3□	4□	5□
	与其他 PE 相比, 这家 PE Compared with other PE s , this PE's ...	1 完全 不同意 1.Totally Disagree	2 不太 同意 2. Disagree	3 不确定 3. Not Sure	4 同意 4.Agree	5 非常 同意 5.Definitely Agree
27	提供最佳价值 provides the best value	1□	2□	3□	4□	5□
28	这家 PE 提供的产品物有所值 provides better value for the money	1□	2□	3□	4□	5□
29	提供性价比高的产品 provides low hight quality for the price					
30	提供的服务收取合理的费用 charges a reasonable price for the services provided	1□	2□	3□	4□	5□
	Compared with other PE s , this PE's support service... 与其他 PE 相比, 这家 PE...	1 完全 不同意 1.Totally Disagree	2 不太 同意 2. Disagree	3 不确定 3. Not Sure	4 同意 4.Agree	5 非常 同意 5.Definitely Agree
31	和顾客有更好的工作关系 has a better working relationship	1□	2□	3□	4□	5□

	with us					
32	对顾客的服务需求做出更快捷的反应 responds to our service needs more promptly	1□	2□	3□	4□	5□
33	有需要时，会回访我们 visits our location when needed	1□	2□	3□	4□	5□
	让我们更好地了解新的发展动态 keeps us better informed of new developments	1□	2□	3□	4□	5□
	Compared with other PEs, this PE's service providers... 与其他 PE 相比，这家 PE...	1 完全 不同意	2 不太 同意	3 不确定	4 同意	5 非常 同意
35	are more competent 更称职	1□	2□	3□	4□	5□
36	are more professional 更专业	1□	2□	3□	4□	5□
37	have better overall job performance 有更好的整体工作表现	1□	2□	3□	4□	5□
38	have better attitudes on the job 有更好的工作态度	1□	2□	3□	4□	5□
39	如果需要，我会增加购买这个 PE 的产品 份额。 If necessary, I will increase the purchase of this PE fund share.	1□	2□	3□	4□	5□
40	在所有条件（价格、质量等）相等的情 况下，更愿意购买这个 PE 的产品 If all conditions (price, quality, etc.) are equal, I am more willing to buy this PE product.	1□	2□	3□	4□	5□
41	我坚信，与这个 PE 的关系将持续下去 I firmly believe that the relationship with this PE fund will continue.	1□	2□	3□	4□	5□
42	非常愿意再次购买这个 PE 的产品 I am willing to buy this PE product again, if there is an opportunity.	1□	2□	3□	4□	5□
43	如果有机会，我还会再次选择购买这个 PE 的产品或者成为它的客户； I would choose to become its customer again.	1□	2□	3□	4□	5□
44	与其他 PE 相比，我还会选择这个 PE； I would like to choose this PE fund product, which compared with	1□	2□	3□	4□	5□

	other PEs.					
45	我会主动向亲朋好友推荐这个 PE; I will take the initiative to recommend this PE to relatives and friends.	1□	2□	3□	4□	5□
46	我会口头主动向其他人推荐这个 PE; I will recommend this PE orally and voluntarily to others.	1□	2□	3□	4□	5□
47	如果有成员想要退出这个 PE, 我会劝说其留下 If a member wants to quit the PE, I will persuade him to stay.	1□	2□	3□	4□	5□
48	我会向该区其他成员介绍 PE 好的项目 I will introduce PE good projects which I believe to other members in the community.	1□	2□	3□	4□	5□
49	我会向该社区其他成员介绍加入 PE 的方法 I'll introduce other members of the community to how to choose a PE to join.	1□	2□	3□	4□	5□
50	我会主动向社区其他成员介绍 PE 先进软硬件和使用心得; I will take the initiative to introduce to other members of the community PE advanced hardware and software and use experience;	1□	2□	3□	4□	5□
51	我会主动向 PE 社区其他成员介绍 PE 的服务特色 I will take the initiative to introduce the service features of PE to other members of PE community.	1□	2□	3□	4□	5□
52	我会在 PE 社区向 PE 社区提供建议以帮助 PE 提高服务质量; I will provide advice to PE community in PE community to help PE improve its service quality.	1□	2□	3□	4□	5□
53	我会在 PE 社区向 PE 提供服务补救的建议; I will provide remedial advice to PE in PE community	1□	2□	3□	4□	5□
54	我会积极在 PE 社区中向 PE 提出新服务的建议	1□	2□	3□	4□	5□

I will actively recommend new services to PE in the PE community.
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