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INSTITUTO
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Open Innovation Development of Private Colleges in China

YAO Yiyong

Doctor of Management

Supervisors:

PhD Elizabeth Reis, Full Professor,

ISCTE University Institute of Lisbon

PhD WANG Ju, Associate Professor,

University of Electronic Science and Technology of China

June, 2022



**BUSINESS
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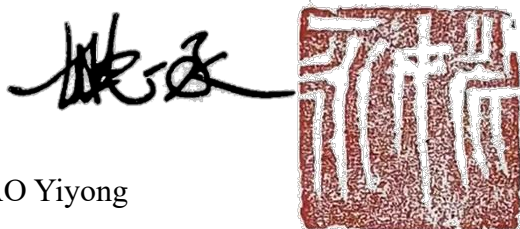
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I declare that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university and that to the best of my knowledge it does not contain any material previously published or written by another person except where due reference is made in the text.

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Date: 2022.6.22

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Abstract

Since their large-scale emergence in the 1990s, private colleges in China have achieved significant development along with the transition of Chinese higher education from the elite stage to the universal stage. However, due to institutional deficiencies and resource constraints, private colleges cannot replicate the development model of public colleges and universities. Based on the needs for development and future competition, private colleges have to seek different development paths from public universities in order to break through resource constraints and improve their own development performance. We choose Tianfu College, a private college in China, as a research case, and adopt an inductive qualitative approach and an exploratory case study strategy based on grounded theory, with the development practice of knowledge production as the research subjects. The data is formed through semi-structured interviews, on-site observations, and the collection of secondary data. The research results show that 1) Private colleges in China can achieve good development performance in knowledge production through open innovation strategy. 2) Private colleges in China can adopt resource bricolage to break through resource constraints and achieve open innovation development performance in knowledge production. 3) Top management teams with high achievement needs and high ambiguity tolerance, entrepreneurial oriented organizational culture and organic organization help the private college in China achieve open innovation development performance in knowledge production. Our findings further expand the scope of open innovation research subjects, enrich the content of research on the development model of private colleges, and have positive practical implications for the development of private colleges in China.

Keywords: Knowledge production, Open innovation, Resource bricolage, Private colleges in China

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Resumo

Desde a sua emergência em larga escala na década de 90 do século passado, as faculdades privadas na China alcançaram, no seu conjunto, um desenvolvimento significativo, que ocorreu juntamente com a transição do ensino superior chinês da fase elitista para a fase de popularização, e depois para a fase de universalização. Contudo, devido a deficiências institucionais e à limitação de recursos, as faculdades privadas não podem replicar o modelo de desenvolvimento das faculdades e universidades públicas. Com base numa necessidade de desenvolvimento realista e de concorrência futura, as faculdades privadas têm de procurar vias de desenvolvimento diferentes, de modo a ultrapassar as limitações de recursos e melhorar o seu próprio desempenho. Escolhemos Tianfu College, uma faculdade privada na China, como caso de investigação, e adotamos uma abordagem qualitativa indutiva e uma estratégia exploratória de estudo de caso baseada na *Grounded Theory*, sendo o tema de investigação a prática de desenvolvimento da produção de conhecimento. Os resultados da investigação mostram que 1) Um colégio privado na China pode alcançar um bom desempenho de desenvolvimento na produção de conhecimento através de uma estratégia de inovação aberta. 2) Um colégio privado na China pode adotar uma abordagem da bricolagem de recursos para quebrar as restrições de recursos e obter um desempenho de desenvolvimento de inovação aberta na produção de conhecimento. 3) Uma equipa de gestão de topo com elevada necessidade de concretização e elevada tolerância à ambiguidade, uma cultura organizacional orientada para o empreendedorismo e uma estrutura orgânica, são condições para se alcançar um elevado desempenho na produção de conhecimento através de inovação aberta. Os resultados permitem alargar o âmbito da investigação em inovação aberta, enriquecem o conteúdo da investigação sobre modelos de desenvolvimento das faculdades privadas, e têm implicações práticas positivas para o desenvolvimento das faculdades privadas na China.

Palavras-chave: Produção de conhecimento, Inovação aberta, Bricolagem de recursos, Universidades privadas na China

JEL: O31, O36

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摘要

中国民办高校自上世纪 90 年代大规模兴起，伴随着中国高等教育从精英化阶段到大众化阶段，再到普及化阶段，总体而言，取得了长足的发展。但由于制度缺失和资源约束，中国民办高校无法复制中国公办高校发展模式。基于现实发展和未来竞争的需求，中国民办高校必须寻求不同于中国公立高校的发展途径，以期突破资源约束，提升自身发展绩效。我们选择中国民办高校——西南财经大学天府学院作为研究案例，以其学科建设的发展实践作为研究对象，基于扎根理论，采用探索性案例研究。研究表明：（1）民办高校可以通过开放式创新模式在知识生产方面取得良好的发展绩效。（2）民办高校可采用资源拼凑，突破资源约束，实现知识生产的开放式创新发展。（3）民办高校的高成绩需求、高模糊容忍的高层管理团队、创业导向的组织文化、有机组织结构有助于达成较高的开放式创新发展绩效。我们的发现进一步拓展了开放式创新研究主体范围，丰富了中国民办高校发展模式研究的内容，对于中国民办高校的发展具有积极的实践借鉴意义。

关键词：开放式创新，资源拼凑，中国民办高校，知识生产

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值此博士论文付梓之际，回顾博士阶段学习种种，自忖天资所限，加之勤勉不足，故常感书山路窄、学海涯阔。所幸，得遇明师益友，每每于困顿处给予鄙人帮助良多，特借如下文字以抒胸臆。

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Chapter 1: Introduction

1.1 Research background

Since 1949, after more than 70 years of development, especially in the 21st century, China's higher education, including talent training, scientific research, social services, cultural heritage and innovation, and international exchange and cooperation, has made remarkable achievements.

1.1.1 Overview of higher education in China

When the People's Republic of China was founded in 1949, there were only 205 colleges and universities with about 117,000 students enrolled, and the Gross Enrollment Rate (GER) for higher education was 0.26%, which was among the most backward countries in the world (D. G. Yang & Zhang, 2009). By 2002, there were 2003 colleges and universities in China, with a total enrollment of 14,625,200 students and GER_{HIG} was 15%, which show China is moving from elite stage to mass stage in higher education. In 2019, there were 2,956 colleges and universities in China, with a total enrollment of 40.02 million, the largest in the world, and GER_{HIG} of 51.6%. China officially enters the universal stage of higher education (Figure 1.1).

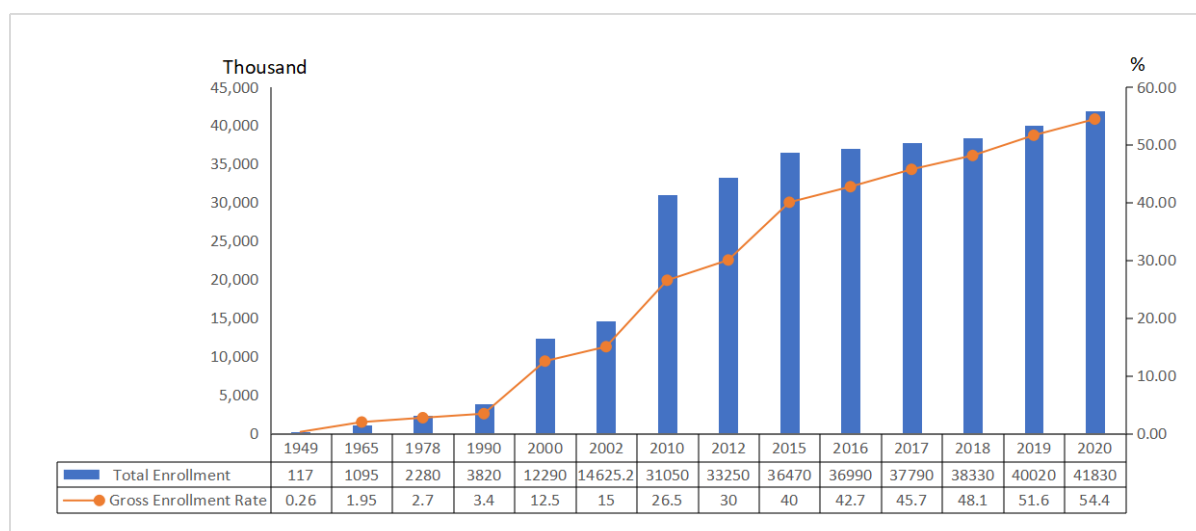


Figure 1.1 Total enrollment and GER_{HIG} in China (1949-2020)

Source: Ministry of Education of China (2020)

After more than 70 years of construction, especially after the country's reform and opening-

up, the level and quality of higher education in China has been raised to a new level. Colleges and universities have trained and attracted large number of high-level talents. Hundreds of millions of people have received higher education, and the total number of practitioners with higher education degrees ranks second in the world. Higher education has achieved connotative and leap-forward development, and the catalogs of higher education disciplines have been set up more scientifically. The reform of colleges and universities has been deepened, the level has been improved, and the ranking in the world universities has been rising. Colleges and universities have made outstanding scientific contributions, created large quantities of achievements in basic research and scientific innovation, and cultivated excellent talents in many fields. China has initially formed a higher education system that is in line with the national economic and social development (H. Wang & Sun, 2019).

1.1.2 Overview of private colleges in China

In the early years of the People's Republic of China, multiple higher education systems coexisted. Of the 205 colleges and universities in 1949, 124 were public, 60 were private, and 21 were church-based. In 1951, the state took back the educational sovereignty of 21 parochial schools, 12 of which were converted into public and 9 into private run by Chinese with financial subsidies from the government. In 1952, following the experience of the Soviet Union, China restructured the faculties of higher education nationwide and transferred private colleges and universities to corresponding public schools according to the general plan of faculty restructuring. By the end of 1952, all private colleges and universities in China were abolished (W. He & Long, 2000).

From 1952 to 1978, China's higher education system is all public, with direct government investment. After 1978, with the deepening of the Reform and Opening-up and the development of market economy in China, this system has been unable to meet the requirements of socio-economic development and the growing needs of society for diversified and multi-level education. The market's thirst for talents, the people's demand for education, and the government's insufficient investment in education are all calling for the participation of private education and the development of private colleges has become a historical inevitability (L. J. Yan, 2008).

The development trajectory of Chinese private colleges, which emerged along with the expansion of China's market economy and higher education, reflects a distinct policy orientation, and the will of the state plays a decisive role in their development (Que & Que,

2015).

The Constitution of the People's Republic of China, issued in 1982, formally recognized the legal status of socially run schools, and private schools began to appear. *The Decision on the Reform of the Education System*, issued in 1985, proposed to actively encourage local schools and schools run by social forces. In July 1987, *the Provisional Regulations on the Operation of Schools by Social Forces* were issued, which for the first time included "private schooling" in the scope of schools run by social forces.

In 1992, the state began to bring private higher education into the scope of unified supervision. In February 1993, *the Outline of China's Education Reform and Development*, promulgated by the Central Committee of the Communist Party of China and the State Council, proposed to gradually establish an education system in which public and private colleges co-exist. In 1997, *the Regulations on the Operation of Schools by Social Forces* was introduced, which is the first administrative regulation in China that specifically regulates the development of private education.

With the promulgation of *the Law on the Promotion of Private Education* in 2002, private higher education was given more room for growth. During this period, private higher education has been developed rapidly and the recognition of the society has become higher.

The National Medium and Long-term Education Reform and Development Plan (2010-2020) (hereinafter referred to as "Education Plan"), promulgated in 2010, places education in a strategic position of priority development, and gives a new definition to the role and status of private education in China, clearly proposing strong support for private education. Led by the blueprint drawn in the Education Plan, China's private higher education has made remarkable achievements in terms of scale, quality, structure and efficiency (Que & Duan, 2021), which has been created and developed into different forms, different training objectives, different tasks and levels of school entities, making important contributions to China's higher education entering the stage of mass and universal development.

As of the end of 2019, there were 757 private higher education institutes in China, accounting for 25.6% of the total number of colleges and universities; 7.088 million students were enrolled in private colleges, accounting for 23.4% of the total number of students enrolled in general undergraduate universities nationwide (Figure 1.2). Private higher education has become an important force in China's higher education.

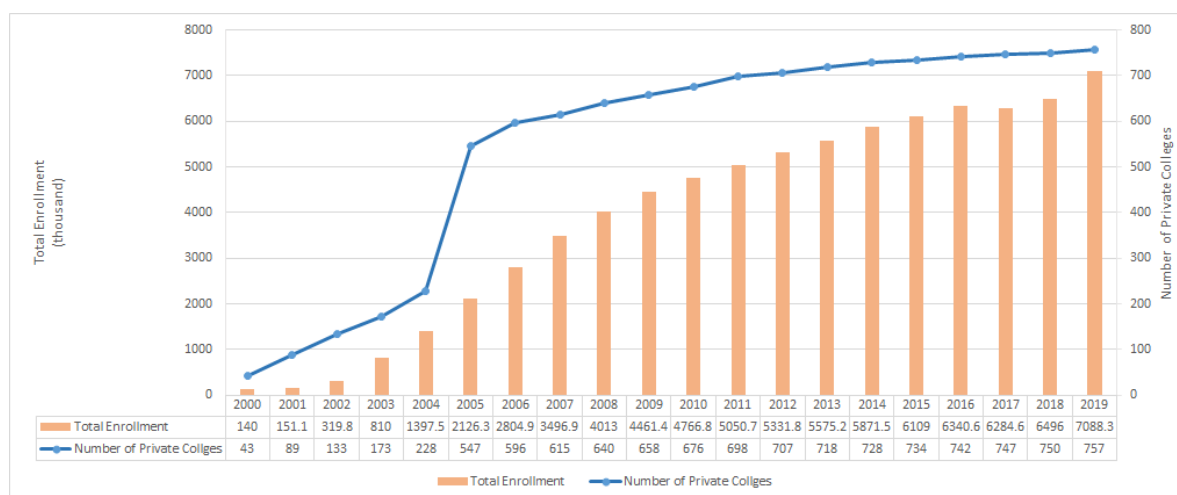


Figure 1.2 Total enrollment in private colleges & number of private colleges in China (2000-2019)

Source: China Education Statistical Yearbook from Ministry of Education of China (2020)

1.1.3 Constraints to the development of private colleges in China

Compared with public, private higher education in China has long been at the bottom of the higher education pyramid system due to its short history, thin foundation, little funding, and weak faculty, so its overall quality and social reputation are not high (Que et al., 2020). China is a developing country, and private higher education in China also has characteristics in developing. The lack of various higher education resources has become the bottleneck that restricts the development of private higher education in China (G. Li & Hou, 2008), highlighting the disadvantages in institution, funding, faculty, students and reputation.

1.1.3.1 Institution

In China, the government holds important development resources such as policies, regulations, finance and educational land, which are closely related to the operation of universities, and also influences the legitimacy of university identity and development standard, speed and scale by allocating these key development resources (Y. X. Shi & Liu, 2021).

In terms of organizers, all universities in China are divided into public, private and SFCRS (Sino-foreign Cooperation in Running School). The public university system is a quasi-bureaucracy structure with different hierarchical orders, consisting of universities and colleges under the jurisdiction of ministries and local governments (provinces and municipalities) (Y. C. Ma, 1999).

Among them, the administrative rank of university is an important political and social resource for public universities. The resources available to public colleges and universities from high to low administrative levels, including state-owned funding, academics, students etc., are

trending downward in terms of competitiveness (Chen & Zhang, 2017). The ability to enter the ranks of high administrative level universities is related not only to the administrative rank of the university president, but also to the university's position in the university system and its social reputation, and even to the performance of the university's local government (Y. Q. Zhang & Peng, 2009).

At the same time, the dependence of public universities on administrative departments has led to serious bureaucratization in China's colleges and universities (J. S. Ma & Sun, 2011). Universities show similar characteristics to government agency in terms of philosophy, function configuration, organizational structure, operation mechanism and decision-making management (H. G. Li & Zhang, 2006), which has the tendency to gradually strengthened the bureaucratization and weaken the educational and academic culture in public universities.

However, unlike public colleges and universities, private colleges have no administrative level in the institution design of the Chinese higher education system, which also determines that private colleges are largely excluded from the competitive circle of state-owned resources (W. L. Chen & Zhang, 2017).

1.1.3.2 Financial resources

It is well known that financial support from the government is an important resource dependence for the development of colleges and universities. The main financial resources for Chinese colleges and universities include financial education funds, tuition fee, loan income, research and service income, income from university-run industries, social donation and financing income. Except for a few well-known universities, whose research and service income, university-run industry income, social donation and financing income are relatively significant, for most colleges and universities, financial allocation and tuition fee are the main sources of funding (N. Zhang, 2013).

With the rapid development of China's economy, government funding for higher education has been increasing year by year. In 2010, the Ministry of Finance and the Ministry of Education issued *the Opinions on Further Improving the Per-Student Appropriation of Local Colleges and Universities*, which required that the annual per-student appropriation of local public colleges and universities should be no less than RMB 12,000 in 2012. In 2014, the Ministry of Finance and the Ministry of Education issued *the Opinions of the Ministry of Finance and the Ministry of Education on Establishing and Improving the Reform and Performance-oriented Per-Student Appropriation System to Accelerate the Development of Modern Higher Vocational Education*, which required that the annual per-student appropriation of public higher vocational colleges

should be no less than RMB 12,000 per student in 2017.

For example, from 2010 to 2012, the Sichuan Provincial Department of Finance allocated a total of 11.43 billion RMB to provincial public colleges and universities. The annual per-student appropriation of provincial public universities was gradually increased from 4,100 RMB in 2009 to 5,400 RMB in 2010, 8,000 RMB in 2011 and 12,000 RMB in 2012. In 2015, Sichuan Province issued the Implementation Opinions on Establishing the Per-Student Appropriation System for Provincial Public Vocational Colleges from of Sichuan Provincial Department of Finance and Sichuan Provincial Department of Education, required that the average per-student appropriation of public vocational colleges in Sichuan province reached 12,000 RMB in 2017. By the end of 2018, the average per-student appropriation of public vocational colleges in Sichuan province had reached 14,400 RMB per student. The huge financial allocation has provided a strong guarantee to improve the quality of higher education comprehensively for public universities.

Correspondingly, private colleges need to invest heavily in both hardware facilities and internal construction to achieve stable development, such as expanding campuses, building excellent faculty groups, and constructing practical training laboratories, which all require large amounts of financial support. The development experience of international private higher education has well demonstrated that there is a high positive correlation between the development trend of private education and the amount of government funding (Zhuang & Bo, 2008). There are many factors that contribute to the prosperity of private colleges and universities in the United States, but it is one of the most important factors that government funding to support private colleges and universities and provide a favorable institutional environment for their development (H. Y. Wang, 2013). In 1972, The Higher Education Act of United States require the government to provide unconditional funding to all colleges and universities, including private colleges. Until now, government funding has been one of the most stable sources for private colleges in the United States (M. B. Hu et al., 2018). In India, 90% of private colleges are classified as "publicly funded private colleges" and receive financial support from the government (X. J. Qiu, 2010).

However, the policy status of private colleges in China does not lead to the same financial funding treatment as public universities. Although the Law on the Promotion of Private Education clearly stipulates that the government may set up special funds to finance the development of private schools. But these principle provisions are only a call to action without mandatory, abstract and lacking in operability. Therefore, in the practice of running schools, private colleges have almost no connection with government financial allocation (W. L. Chen

& Zhang, 2017). For example, as of June 30, 2020, there are 131 colleges and universities in Sichuan province, and none of 51 private colleges has received annual per-student appropriation of RMB 12,000 from the government.

At the same time, the social influence of private colleges is not high and their ability to absorb social donations is not strong (Geng, 2021). In terms of funding, private colleges rely heavily on tuition fees and have not yet formed effective diversified funding channels (Bao, 2011). However, the current management mechanism of higher education in China has a strong color of planned economy, and the tuition fee standard of colleges and universities is reviewed and set by the government price management department. This one-size-fits-all approach has resulted in tuition standards that do not accurately reflect the true cost of operation of each college or university, which further aggravates the difficulties of private colleges in financing their operations.

1.1.3.3 Faculty

For colleges and universities, teachers are the first resource, and the stability and comprehensive quality of the faculty determine the level of education and teaching and the quality of talent cultivation in schools (H. W. Wang, 2019). As mentioned earlier, the absence of institution status, insufficient funding and weak academic accumulation of private colleges give teachers in private colleges have obvious gaps in career development, social status, salary and social security compared with teachers in public colleges and universities. It has led to the existence of persistent problems such as the lack of backbone teachers, difficulties in introducing high-level talents and serious brain drain in private colleges, which seriously affects the development of private higher education (C. Li, 2019).

Table 1.1 Statistics of faculty and students of some college and universities in Sichuan Province in 2018

Institutions	Organizer	Position	Total Faculty	Total Students	Teacher-student Ratio	Faculty with Senior Titles	
						Amount	Percentage (%)
Sichuan University	Public	National	4511	62455	1:17.4	3590	79.6
Sichuan Normal University	Public	Local	3122	40560	1:13	1085	34.8
Tianfu College	Private	Local	910	20800	1:22.9	140	15.4

Source: 2018 Sichuan Education Yearbook

Taking Sichuan province as an example (Table 1.1), both in terms of the amount of faculty and the teacher-student ratio, Sichuan University, the representative of national public universities, and Sichuan Normal University, the representative of local public institutions, have

a huge advantage over Tianfu College, the representative of private colleges. Especially regarding the item of the percentage of faculty with senior titles, Tianfu College is far behind public universities.

1.1.3.4 Quality of students

According to the current admission policy of National College Entrance Examination (NCEE) in China, the number of enrollments admitted to colleges and universities each year is allocated by the education authorities according to the enrollment plan determined in that year. The admission is based on provinces, and the provincial education authorities divide the batches of colleges and universities that admit new students within the province. More than one batch can be set for the same academic level and the admission control line of each batch is set by the education authorities. After the admission of new students in the previous batch of colleges and universities, the admission of new students in the next batch of colleges and universities can be made, and so on. Compared with public colleges and universities, private colleges are mainly admitted in the last batch of the same academic level, which makes private colleges unable to compete with public colleges and universities in terms of quality of students due to the institution design (Table 1.2), and further leads to the low recognition of private colleges in the society in general, forming a vicious circle.

Table 1.2 Admissions score of national colleges entrance examination in Sichuan universities and colleges (2018-2020)

Institutions	Organizer	Position	Admission Batch	Admissions Score Line*					
				2018		2019		2020	
				Arts	Science	Arts	Science	Arts	Science
Sichuan University	Public	National	The first batch (Undergraduate-4years)	609	635	614	649	601	638
Sichuan Normal University	Public	Local	The first batch (Undergraduate-4years)	569	572	562	575	551	567
Tianfu College	Private	Local	The second batch (Undergraduate-4years)	512	484	493	486	480	466

* The full score of National Colleges Entrance Examination in Sichuan province is 750.

Source: Education Online of China

1.1.4 Development mode of private colleges in China

Today, the marketization of higher education is a fundamental reality that cannot be avoided by colleges and universities. Richard Dorest, the former president of Carnegie Mellon University, pointed out that we must face the fact that universities and colleges are in a competitive market

(Keller, 2005).

The competition of China's private colleges in higher education mainly includes the competition with public colleges and universities, the competition with private colleges, and the competition with SFCRS. With decades of development, strong government financial resources, and superior teaching and research conditions, public colleges and universities have much higher status and influence than private colleges. In recent years, due to the lack of relevant regulations and experience, the disorderly development among private colleges has made mutual competition more cruelly. In addition, some outstanding foreign universities are looking at the huge market of talent training in China, and SFCRS are dividing the market share of higher education (Xing, 2007).

Facing the competitive environment and resource constraint, every manager of China's private colleges must deeply consider whether to simply imitate public colleges and universities, implement catch-up strategy and follow the road of convergence, or to be unique and implement differentiation strategy and follow the road of characteristic and personalized development (H. Feng, 2014), in order to form their own competitiveness for surviving and developing in the increasingly fierce higher education.

1.1.4.1 Discipline construction

The operation of a university is a complex system composed of many elements and its conception, institution and implementation can all form their own characteristics, which can be reflected in the school's positioning, development ideas, campus culture, rules and regulations, management system, discipline construction, major setting, teaching reform, scientific research and social service (Y. M. Tan, 2020). Generally speaking, the disciplines, research and social services of a college or university can most directly reflect its characteristics. Specialized disciplines including majors are often the lifeline and core competitiveness of a university's development, with irreplaceable and indisputable status and qualities, and are also the most easily recognized by the outside world. The disciplines competitiveness of a college or university represents the competitiveness of the college or university and the most informative value for evaluating goodness of a college or university is the goodness of its disciplines (Y. N. Li & Dong, 2019).

Majors are at the intersection between the disciplinary system and the needs of social profession. From the university's perspective, majors are set up for the discipline to assume the function of personnel training. From the society's view, disciplines and majors are set up to meet the training needs that must be received to engage in a certain type or a certain social

occupation. (X. D. Feng, 2002). The capabilities of knowledge production and creation are the foundation of university disciplines and majors, and the evolution of knowledge production patterns has a direct impact on the paradigm change of university discipline and major construction (L. Z. Guo, 2021).

The main contents of discipline construction are the formulation of professional training objectives, teaching plan adjustment, curriculum development, textbook compilation, laboratory building, internship base construction, faculty formation, and innovation of teaching methods. Among them, curriculum development, faculty formation, and teaching environment construction are the key points (H. Y. Liu & Zeng, 2007).

1.1.4.2 Application oriented

Boyer (1990) divided university scholarship into four categories: discovery, integration, application and teaching. Among them, research universities are mainly based on the scholarship of discovery, i.e., mainly on the continuous construction and creation of new knowledge; while applied universities are mainly based on the scholarship of integration and application, i.e., the integrated application and development of knowledge, analyzing problems and solving them with an applied perspective. The applied university does not mainly aim at knowledge creation and production, but focuses on creatively applying knowledge to practice and promoting the development of practice. At the same time, it constantly discovers new problems and explores new knowledge in the process of practice. The two aspects promote and support each other, which together form the knowledge creation and application system of applied universities (Y. Q. Cai, 2016).

The applied university is a product of the catalytic demand of industrial development to improve quality and efficiency, emphasizing application and active contact and interaction with industry (H. W. Huang et al., 2011). Compared with traditional research universities, the special feature of applied university is that the logical starting point of development is to run school for service industry, the fundamental path of development is to deepen the interaction with industry, and the basic direction of development is to closely follow the development situation of industry. The prerequisite and core support for the construction of an applied university to achieve excellence lies in the ability to build first-class applied disciplines and specialties with strong industrial background and deep integration with industry, i.e. The level of integration between the disciplines, specialties and industry fundamentally determines the development quality of an applied university (L. Z. Guo, 2021).

Since 2013, China government has realized that society will increasingly need application-

oriented talents in the future development. Colleges and universities need not only to continue the traditional cultivation of academic talents, but also to focus on cultivating students' hands-on and innovative abilities (S. Y. Wei, 2021). Private colleges are relatively weak in academic strength, and it is more appropriate to transform into application-oriented colleges to significantly distinguish themselves from academic research universities and highlight their own positioning (He, 2018). Therefore, starting from 2013, private colleges in China began to transform into application-oriented universities (Pan & He, 2019).

1.1.4.3 Open innovation development

In the 21st century, society enters the era of knowledge-based economy (Guan, 1999). As the core part of knowledge-based economy, colleges and universities become one of the most important supports of knowledge society (Ren & Yu, 1999). The role of higher education on social economy, politics, culture, science and technology, move from the periphery to the center of society, and increasingly become the power source of the development of knowledge-based economy and society (J. F. Fu, 2004).

Due to the institution deficiencies and resource constraints, China's private colleges cannot imitate or replicate the closed-loop development model formed by public colleges and universities mainly around the competition for public resources market centered on the state financial allocation and the bureaucratization administrative management of public colleges and universities. Instead, only by liberating the mind and striving for innovation can private colleges survive the ranks of mass higher education and achieve rapid, healthy and sustainable development (W. M. Gao, 2004). The open innovation theory with the core concept of "openness and innovation" provides a very meaningful development model for private colleges to break through the resource constraint to develop in high quality.

Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology (Chesbrough, 2003). Unlike the "closed innovation" model that emphasizes the self-sufficiency of an organization's innovation ideas and does not open to the outside world, open innovation does not have clear innovation boundaries, emphasizes that an organization should combines internal and external ideas into a system, and compensate for the lack of internal innovation ideas through a large amount of external knowledge and technology innovation ideas, so as to accelerate the integration of internal and external ideas, the process of R&D and commercialization process of the organization (Chen & Chen, 2006). The essence of this theoretical perspective is the flow of knowledge inside and outside the organization

boundary, which is reflected in the form of outward penetration of organizational boundaries and expansion of organizational relationships.

Specifically for China's private colleges, it has enriched the R&D knowledge of colleges and improved their innovation to integrate external knowledge sources (Zhang et al., 2019). At the same time, the discipline as the core promotes the accumulation and systematic integration of various innovation elements, and promotes the synergistic innovation of various research elements across disciplines, schools, colleges, regions, departments, borders and countries (He, 2018). It provides a highly relevant reference model and development path for China's private colleges to make up for the disadvantages of internal and external development resources, build applied characteristic disciplines and majors, and enhance their own core competitiveness.

1.1.4.4 Resource bricolage

Lack of resources is an endogenous problem of entrepreneurial activity (Isenberg, 2010). Resource bricolage can effectively address the dilemma of resource constraints in social entrepreneurship (W. Peng et al., 2018). It is the link between opportunity discovery and resource development, reflecting the choice of resource use and the way to view resource use as a way to discover, create, and develop opportunities (X. Yu et al., 2017). By introducing constructivist ideas, resource bricolage theory incorporates the dynamism of action agents and emphasizes the process of new enterprises or nascent organizations creatively using existing resources to gain competitive advantage at lower costs and faster response times (Z. Liu et al., 2019).

A history of the development of private colleges in China is a history of innovation and entrepreneurship (Que, 2021). Excellent universities are usually piled up with high-quality resources, often gathering abundant funds, advanced instruments, first-class facilities and famous scholars. In contrast, the shortage of resources and the lack of access to resources are the bottlenecks for the development of private colleges. The entrepreneurs use "knowledge at hand" (Schutz, 2001), that is, they combine with their own common sense, knowledge level and professional experience, and adopt innovative ways to obtain and use resources, following the principle of not seeking all but seeking to use them. Y. D. Lu and Sun (2013) found that companies with only ordinary resources can be combined, compounded and integrated ordinary resources to produce extraordinary performance effects, and proposed the "Compound Foundation Concept". So, private colleges can maximize the effectiveness of resources through bricolage, integrating and innovative use of internal and external resources to construct unique competitive advantages.

1.2 Research questions

In conclusion, under the real situation of the development of Chinese higher education from mass to universal, private higher education as a whole has become an important part of Chinese higher education. However, due to institution deficiency and resource constraints, there is a huge gap between private colleges and public universities in China in terms of resources closely related to the discipline construction, mainly including financial resource, faculty, and quality of student. Therefore, private colleges cannot duplicate the development model of public universities, but urgently need to find different development paths from public universities in order to survive and develop in the increasingly competitive higher education market.

In response to the aforementioned development dilemma of Chinese private colleges, this study focuses on a specific group of private colleges in China, selects the private college with good innovation development performance as the case, takes its discipline construction practices as research samples, conducts an inductive theoretical study based on grounded theory, and mainly discusses:

- (1) How can a private college achieve its own innovative development within the constraints of internal and external resources from the perspective of knowledge production?
- (2) What are the structural elements and interaction mechanisms in the process of innovation development of the private college from the perspective of knowledge production?

1.3 Research significance and contribution

In previous studies of organizational innovation development, the research objects have often focused on the corporate sphere, ranging from large multinational corporations to small and medium-sized enterprises, from high-tech industries to traditional industries, and then expanding to regional, national and even global as the objects of innovation development. Higher education institutions, on the other hand, are usually regarded as a pole in the innovation ecology that exports innovation resources to other organizational entities.

In essence, as the knowledge-producing organization, universities and colleges serve the society through innovative knowledge by knowledge creation (S. H. Lu et al., 2020). Their own survival and development also face the choice of development mode and path, and need the support of corresponding internal and external resources. This study takes private colleges in China as the research object of innovation development and tries to sort out and summarize the inner process logic and outer organizational structure of the innovation development of the case

private college, based on their realistic needs to break through resource constraints and achieve their own development, through a grounded theoretical analysis of the innovation development behaviors carried out by the case college in its growth process. This research perspective expands the scope of sources for the subject of innovation development and further enriches the content and field of research on innovation development.

At the same time, this study is able to present the sources of innovation and the innovation process from the perspective of a new research object, thus refining, revising and verifying the relationship between the elements of the innovation organization structure, by expanding the sources of resources for innovation development and taking into account the dynamic demand for resources by innovation organization subjects at different stages of development, thus refining, revising and verifying the relationships between the elements of innovation organization structures.

It has a more intuitive practical value in the increasingly competitive social atmosphere for resources by Identifying and extracting the sources of these successful innovations (Li & Huo, 2015a). The study provides corresponding practical insights and references for the innovative development of other Chinese private colleges.

1.4 Structure of the thesis

This paper is divided into five main chapter for the discussion of the study.

Chapter1: Introduction. In this chapter, through a brief review of the development of Chinese higher education for more than 70 years, based on the development of private education in China, we extracted the shackles of development faced by private higher education in China, including institutional dilemmas and insufficient resources. From this, we propose the main research questions, research objectives, research methods and approaches of this paper, and explain the depth of theoretical value and practical guidance significance of this study by comparing and analyzing the existing domestic and foreign related studies. In turn, the research roadmap is constructed as the general outline of the subsequent chapters.

Chapter2: Literature Review. This chapter mainly reviews, composes and summarizes the relevant theoretical concepts involved in this study as well as the current status of the research. Combined with the research questions, the deficiencies and gaps of previous studies are presented, and the theoretical framework of the study is constructed as the theoretical basis and support for the subsequent research.

Chapter3: Research Methods. This chapter introduces the research methods of this study,

which mainly involves the selection of the sample, the identification of the study subjects, the method and process of collecting the study data, the method and process of analyzing the raw data, and the initiatives to increase the reliability and validity of the study.

Chapter4: Results and Discussion. This chapter mainly applies the research method introduced in Chapter 3 to address the research question of how a private college in China achieve innovative development, focusing on the selected case, analyzing the data of the research subjects of the case, excavating the structural elements of its innovative development, and constructing the interaction mechanism of the elements of its innovative development.

Chapter5: Conclusion. This chapter systematically reviews and summarizes the origin, process, and findings of the study, and further discusses the theoretical value and practical guidance implications of this study. At the same time, we analyzed the shortcomings of this study in terms of the limitations of the research perspective, the timeliness of the research content, and the applicability of the research method, and proposed further work prospects and directions for the next phase of the study.

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Chapter 2: Literature Review

This study focuses on how a Chinese private college achieve innovative development in the real situation of resource constraint and their interaction mechanisms among internal structure elements, based on the perspective of knowledge production in the context of the leap from the mass to the universal stage of Chinese higher education.

In response to the research questions, we focus on the research areas such as open innovation, resource bricolage, knowledge production, and the development of private higher education in China.

2.1 Open innovation

2.1.1 Origins and connotations

Initially, scholarly research on innovation focused on R&D in industrial areas and the role of scientific and technological innovation in economic productivity. Common to these early conceptions of innovation was that innovation had little interaction with external organizations, was a closed, intra-organizational, linear process (Cainelli et al., 2004), and that the new technologies required for the process were developed internally (Ahlstrom, 2010). Firms gain competitive advantage through control or exclusive intellectual property rights in this closed innovation model.

With the accelerated globalization of knowledge flow and the shortening of product life cycles, the traditional top-down, closed innovation model, which is based on internal R&D, is unable to meet the innovation requirements of enterprises and the demand of customers for their innovative products. To get rid of this dilemma, some leading enterprises have started to cross organizational boundaries and adopt a more open innovation approach, strengthening the iterative updating of knowledge, technology, and resources through cooperation with external stakeholders, and actively utilizing external knowledge to improve the innovation performance.

At the same time, scholars have recognized that linear models of innovation no longer adequately explain modern innovation activities (Feldman & Florida, 1994; Teece, 1986). New approaches need to be found to enhance the innovation potential of companies. The concept of open innovation has been proposed and is receiving increasing attention.

Compared to traditional closed innovation, open innovation opens up new avenues for organizational innovation through the acquisition and use of external resources, emphasizing the openness of the organizational innovation process to its environment. Based on the perspective of resource theory, Chesbrough (2003) defines open innovation for the first time as a process in which an organization makes full use of internal and external innovation resources in the innovation process and commercializes the integration of internal and external resources. It can be said that open innovation aims to obtain external resources through different paths to compensate for the lack of its own knowledge and accelerate the speed of innovation through the integration of internal and external knowledge resources.

Grant and Baden-Fuller (2004) explain the purpose of establishing strategic cooperative alliances from a knowledge perspective. They argue that firms are willing to open their organizational boundaries to some extent because they can broaden their knowledge networks through inter-organizational communication and that firms are more motivated to explore knowledge than to acquire it directly. Lichtenthaler (2011) argues that open innovation is the process of knowledge flow within and outside the organization, including the exploration, storage and redevelopment of knowledge. Chesbrough and Bogers (2015) propose that open innovation is an innovation process based on the management and distribution of knowledge flows between firm boundaries. As the research on open innovation continues to deepen, more and more scholars have studied the definition of open innovation based on different perspectives or theoretical foundations and have continuously expanded and enriched the concepts and connotations of open innovation. Table 2.1 lists some representative definitions of open innovation

2.1.2 Types

Based on the perspective of resource base and according to the direction of value chain extension, the open innovation model can be divided into the following three categories: first, vertical resource integration of value chain, second, horizontal resource integration of value chain, and third, multiple resource integration of industry chain.

The vertical resource integration model of the value chain, i.e., including suppliers, distributors, users, etc., assists enterprises in the production and helps them realize the dynamic process of value creation. In this process, the company cooperates extensively with various players in the vertical value chain to stimulate and explore the unique value of different members in different positions of the value chain, thus achieving the purpose of value addition

(Vargo & Lusch, 2004).

Table 2.1 Summary of the connotation of open innovation

Source	Connotations about Open Innovation
Chesbrough (2003)	Firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.
West and Gallagher (2006)	Integrate corporate capabilities and resources with externally acquired resources, and develop market opportunities through multiple channels.
Chesbrough (2006a)	Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively.
Gassmann and Enkel (2004)	Companies need to open their boundaries to allow external valuable knowledge from partners, customers and/or suppliers to be brought into the innovation process of the company and for this external knowledge to be fully utilized and marketed as soon as possible.
Perkmann and Walsh (2007)	Innovation can be seen as being generated by distributed inter-organizational networks rather than coming from a single company.
Terwiesch and Xu (2008)	Increasingly, the innovation process relies on creation from outside the company and the selection of the best option from these alternatives for further development.
West and Gallagher (2006)	Widely and orderly explore innovation opportunities from internal and external sources of innovation, consciously combine the explored resources with internal capabilities and resources, and utilize marketability through multiple channels.
Dittrich and Duysters (2007)	In new product development, the permeability of its boundaries determines its openness, where some ideas generated in an innovation project are initiated by other parties before entering the internal funnel; and further developed by other parties after the project leaves the funnel.
Lichtenthaler (2011)	Open innovation is defined as systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process.
Chesbrough and Bogers (2015)	Open innovation is a distributed innovation process that relies on purposively managed knowledge flows across organizational boundaries, using pecuniary and nonpecuniary mechanisms in line with the organization's business model to guide and motivate knowledge sharing.
Chen and Vanhaverbeke (2019)	Open innovation is a microscopic concept of the innovative system of an organization and is also the precondition for achieving synergies within the national innovation system.

The horizontal resource integration mode of value chain is the collaborative innovation mode of industry-university-research. Industry, universities, and research institutes are different in nature, objectives and organizational forms, and the combination of these three brings new vitality and adds new connotation to the traditional production activities and industry-university relations. The collaborative innovation model of industry-university-research is a prominent manifestation of open innovation across industrial boundaries and is a typical example of heterogeneous resource integration.

Multiple resource integration mode of industrial chain, i.e. cooperative innovation,

technology mergers and acquisitions, strategic alliances, etc. between enterprises. Based on the purpose of market entry, market expansion and technology absorption, enterprises often adopt such methods as cooperative innovation, technology mergers and acquisitions and strategic alliances for open innovation. Through cooperation, mergers and acquisitions or establishment of alliances, enterprises cooperate extensively with other enterprises to achieve such purposes as rapid entry into new product markets, access to technology resources and brand channels, and reduction of R&D costs.

Based on the external network perspective, open innovation models can be divided into inbound, outbound, and couple according to the direction of knowledge flow. The inbound open innovation model refers to the innovation behavior in which a company transfers technology, knowledge and information obtained from external practices into the company for internal R&D. Its emphasis is on how to internalize external knowledge and technology and how to effectively acquire and absorb external knowledge and technology, which is typical of technology external development, and its main forms are non-equity strategic alliance, purchase of technology services, and purchase of technology license. The outbound open innovation model refers to a company that not only relies on internal means to expand its market, but also actively seeks suitable external organizations to commercialize and productize its internal knowledge and technology at the right time. Its emphasis is on the external development and exploitation of internal knowledge and technology, mainly in the form of non-equity strategic alliances, the provision of technology services, and the sale of technology licenses. External to make it more difficult for competitors to imitate or replicate the technology. The couple open innovation model refers to both inward and outward open innovation. In this model, enterprises cooperate and communicate with the outside world at a higher level, integrate external innovation resources into the enterprise, and at the same time, strategically export and commercialize internal knowledge, mainly in the form of joint ventures and alliances.

Based on the organizational learning perspective, open innovation models can be divided into four types according to the different ways of knowledge acquisition and release: capture, pure sourcing, selling, and revealing (Dahlander & Gann, 2010). Among them, knowledge acquisition is divided into capture and pure sourcing, where capture emphasizes the active acquisition of external knowledge resources, while pure sourcing emphasizes the exploration of external knowledge sources rather than just the knowledge itself; knowledge release is divided into selling and revealing, where selling emphasizes the transactional nature of knowledge resources, while revealing does not necessarily have a transactional nature.

2.1.3 Motivation and influencing factors

Open innovation is the process of sharing ideas, processes, and technologies with outsiders to drive innovation, with the aim of accelerating innovation growth and differentiation. Companies that do not operate in a more open and collaborative manner may face serious competitive disadvantages, including the risk of losing their ability to innovate in the long term (Enkel et al., 2009).

Open innovation has been widely debated in the management of the innovation literature. While numerous scholars have confirmed the advantages of open innovation such as accelerating the speed of innovation in firms, there is also some empirical data suggesting that as the costs of openness exceed the benefits, the margins of return on innovation diminish. The research highlights the large heterogeneity in open innovation performance among firms, suggesting a large degree of variability in how firms respond to openness-related challenges.

The effectiveness and viability of an innovation model lies in its ability to significantly improve innovation performance; therefore, many scholars consider exploring the relationship between open innovation and innovation performance or firm performance to be a central issue.

Laursen and Salter (2006) pioneered the introduction of two indicators of openness as well as depth and revealed an inverted U-shaped relationship between innovation openness and innovation performance. Leiponen and Helfat (2010) found through a social survey in Finland that the two parallel path strategies, including open sources of information and openness of innovation paths, have a positive impact on the success of innovation. At the same time, they found that "over-exploration" may hinder innovation performance, i.e., there may be a point where openness beyond a certain breadth and depth may have a negative impact on innovation performance.

In China, Y. F. Chen and Chen (2008) empirically demonstrated the inverted U-shaped relationship between openness and innovation performance based on Chinese high-tech enterprises and suggested the contribution of the heterogeneity of innovation resources provided by different types of innovation openness elements to innovation performance. Based on a game theory approach, T. Wei and Lu (2011) analyzed an open innovation model with multiple participants at different levels of openness and found that as the openness of the innovation model increases, the welfare of the participants and the performance of the focal firm also increases. For example, Chen et al. (2016) verified that the degree of openness and innovation performance of firms with technology-driven, a management philosophy that pushes for development of new goods or services based on firm's technical abilities instead of proven

demand (Rosenzweig, 2015), were found to be an inverted U-shaped quadratic curve, while in experience-driven firms, the relationship between the degree of openness and innovation performance was positive and linear.

In fact, the extent to which firms adopt open innovation varies widely, and external sources of innovation and openness vary with technological maturity and internal organizational capabilities. Chesbrough et al. (2006) suggest that firms need to investigate their external environment when conducting internal R&D, and by creating synergies between internal processes and external ideas. By creating synergy between internal processes and external ideas, it will help firms to benefit from external innovations and generate new products and services. In addition, some researchers suggest that the number of partners and the methods chosen by firms at different stages of innovation vary, and that different external partners have different effects on innovation performance. It is found that the cooperation of vertical firms has a greater impact on innovation performance than the horizontal cooperation of firms to obtain external resources. Chen and Wang (2011) suggest that companies should adjust their partners in the process of innovation, focusing on universities and related research institutions in the basic research and testing stage, transitioning to related companies and customers in the same industry in the application development and improvement stage, and obtaining more government support in the international competition stage.

In addition, scholars have conducted in-depth research on the impact of organizational capabilities on open innovation performance. Behnam et al. (2018) proposed open innovation based on four capabilities, including network capabilities, capability mapping, relationship capabilities, and desorption capabilities, through a survey of the open innovation literature and qualitative research from firm field studies. The findings suggest that desorption capabilities (the ability to coordinate/empower external access to internal resources) need to emphasize coordination with the external environment, while network capabilities, capability mapping, and relationship capabilities reflect a firm's ability to create partners, maintain relationships, and access external resources and opportunities. Chen and Miao (2012) defined technological capabilities as dynamic endogenous capabilities, which include technological search, technological selection, technological absorption, technological learning, technological creation, technological transformation and technological diffusion, which help firms achieve technological innovation and create greater profits. At the same time, they further suggested that open innovation can further contribute to innovative performance through firms' technological capabilities.

Absorptive capacity is another representative view that open innovation depends on

whether firms can effectively utilize external resources. Chen et al. (2016) suggested that without sufficient absorptive capacity, external knowledge exploration becomes inefficient. Considering the current situation of weak independent innovation capability and the insufficient absorptive capacity of firms' technological knowledge. Chen and Wang (2011) argue that knowledge absorptive capacity has a positive contribution in innovation performance. In contrast to absorptive capacity, the Not-Invented-Here (NIH) syndrome perspective suggests that a greater focus on external resources may ultimately affect firm performance by creating internal resistance to technicians who fully support internal knowledge monopolies and resist new external ideas.

H. Yue et al. (2018) proposed the influence of partner differentiation on open innovation performance, in which it was argued that the differentiation of organization types provides the possibility for organizations to contact and acquire more external resources, and that differentiated organization types will form a strong combination of advantages by establishing a stable cooperative relationship through alliances. With the development of theories such as alliance innovation, regional collaborative innovation, value co-creation, openness, and interaction in the field of innovation research have become new trends in the study of firm behavior, and also indicate that the network of relationships between firms and their external environment plays an important role in the formation of performance.

In general, open innovation has a positive contribution to firms' innovation capability, new product development, and firm performance. Meanwhile, from the literature review, we found that scholars have explored the relationship between open strategy and innovation performance in terms of openness of open strategy, degree of openness, and open objects. The rational formulation of open strategy, the control of degree, and the selection of partners are used to monitor the smooth implementation of open innovation activities. In addition, the identification and study of key factors of open innovation performance provide a basis for exploring the implementation and operation of corporate innovation strategies to obtain the expected innovation performance and new product development performance.

2.1.4 Knowledge management in open innovation

Knowledge and innovation management are two strongly intertwined streams of research. In fact, knowledge is increasingly considered as the most important resource of a company in the management literature, mainly because it is considered as the driving force and source of innovation and maintenance of competitive advantage for companies. Based on the knowledge

flow perspective, the open innovation model is defined as purposefully managing the inflow and outflow of knowledge in order to accelerate its internal innovation process and the reuse of internal and external knowledge after integration, and ultimately to enhance a firm's competitive advantage. In the past few years, scholars have increasingly recognized the importance of knowledge management practices for the improvement of corporate innovation performance.

2.1.4.1 Knowledge management in inbound open innovation

Inbound is characterized by the process of internalizing knowledge from the outside. Inbound open innovation is considered to acquire more external knowledge in order to update or expand the firm's knowledge and improve the firm's innovation capability. To achieve this goal, the knowledge management system needs to facilitate the enterprise to manage internal and external knowledge in terms of knowledge acquisition, dissemination, sharing, and transfer. Lichtenthaler and Ernst (2006) argue that the introduction of knowledge in open innovation usually encounters two problems of non-admission and over-acquisition of external knowledge, namely "Not Invented Here "(NIH) and "Buy In" (BI). The former reflects the negative attitude of employees towards external knowledge, and even information that is valuable to the company may encounter difficulties in the process of absorption and integration, while the latter reflects the overly positive attitude of the company towards acquiring external knowledge. In both cases, enterprises may miscalculate the value of external knowledge, which leads to underutilization or unnecessary acquisition of knowledge originating from outside their organizational boundaries, respectively.

A. Y. H. Wu et al. (2016) argue for establishing a specific process for evaluating feedback on external knowledge provided by internal and external participants in order to identify market opportunities that may be encountered. Meanwhile, Borjigen (2015) proposes a step-by-step knowledge expansion processing chain approach that is not limited to internal employees or professionals, which may help firms avoid NIH and BI syndromes. Of course, it has also been argued that the knowledge acquired, and the type of external knowledge sources are related to a firm's strategic orientation, such that firms with innovative, proactive, and risk-taking characteristics tend to have access to a wider range of resources, while firms focused on customer value creation are more likely to utilize market-related knowledge. On the contrary, companies that adopt a "technology-driven" strategy place more emphasis on R&D and advanced technologies in new products and choose to cooperate with research institutions and universities.

2.1.4.2 Knowledge management in outbound open innovation

Outbound refers to the flow of open knowledge from inside the firm to the external environment. As in inbound open innovation, firms may also face different problems in outbound open innovation, such as “only use here” (OUH) and “sell out” (SO) syndrome (Lichtenthaler & Ernst, 2006). The former refers to a negative attitude towards the commercialization of internal knowledge because of the fear of losing the rewards of future development due to the externalization of knowledge. In contrast, the SO syndrome represents an overly positive attitude towards external commercialization of knowledge. Both syndromes may lead to, for example, underutilization of the IP portfolio and overestimation of the potential benefits of knowledge externalization.

Fiegenbaum et al. (2014) argue that firms can adopt knowledge management practices to overcome these problems to facilitate the successful implementation of outward-oriented open innovation. Lichtenthaler (2007) suggests three strategic fits for firms' knowledge retention and selling decisions: external knowledge exploitation and internal knowledge development for consistency (coordination); internal decisions on knowledge asset retention or commercialization (centralization), and cooperation between R&D, marketing, and other areas (collaboration). Meanwhile, in the process of knowledge externalization, scholars generally agree that knowledge desorption capability includes the stage of identifying external opportunities, which can effectively implement such strategic fit and improve the effectiveness of outward-oriented open innovation. And knowledge desorption capability is built on the basis of knowledge management practices for enhancing the management of internal R&D outputs.

2.1.4.3 Knowledge management in couple open innovation

The couple open innovation process involves the joint use of knowledge by different organizations for innovation, and thus the process involves both the inflow and outflow of knowledge. In this model, knowledge may be shared and managed among organizations or institutions with different cultures, structures and strategic directions, and thus will facilitate the accumulation and dissemination of knowledge among different organizations, while the management of knowledge will become more complex.

In this context, the degree of corporate control over knowledge sharing is particularly important. If it is not managed properly, the syndromes about “All Store Here” (ASH) and “Relate Out” (RO) may occur (Lichtenthaler & Ernst, 2006). The former refers to organizations having too much control over knowledge sharing, resulting in inaccessibility to other partners; the latter refers to innovative firms avoiding the use of knowledge provided by partners, thereby

missing opportunities to apply that knowledge and lose learning from partners.

Relative capacity and connective capacity have been found to help mitigate the control problems of shared knowledge sharing between different organizations. Relative capacity is a means of improving the ability of organizations to share knowledge, ultimately avoiding the risk that only one (or a few) organizations actually utilize the knowledge. Connected capacity is defined as the ability to retain and acquire knowledge developed in inter-organizational relationships, rather than owning it. The process of controlling knowledge sharing requires a management platform to manage and disseminate knowledge, support co-development among partners and thus enhance dual flexibility at the organizational level, which has a positive impact on financial and innovation capabilities. Innovation based on a socially driven logic has confirmed the need for effective connectivity, according to which innovation is seen as a social innovation process with increasingly blurred organizational boundaries and conceptualized as network-to-network knowledge management. And knowledge management in relational networks is more effective only when there are strong interactions and connections between partners.

Therefore, the purpose of knowledge management in innovation research is to create a "framework condition" through which the organization and its internal employees are motivated to participate in an interactive and iterative process of knowledge creation, development, and storage. In such network alliances to jointly develop solutions, information technology is important in maintaining the transfer of information, coordination and interactive participation related to knowledge management (Eseryel, 2014).

Von Krogh (2012) suggests that social media has advantages in terms of knowledge accessibility and ease of use as a tool for managing knowledge in a web-based environment. Similarly, considering the emotional, social and psychological needs of individuals, more Web 2.0 tools are being applied by companies to support the effective exchange of knowledge in collaborative innovation communities. Moreover, it is argued that knowledge management needs to consider the classification of different types of knowledge (explicit, tacit, radical and incremental) to ensure adequate interpretation and effective use of knowledge in open innovation (Natalicchio et al., 2017).

2.1.5 Process evaluation of open innovation

The process of open innovation encompasses multi-stage and multi-dimensional elements, and scholars have defined the stages of the open innovation implementation process based on their

own research perspectives. Chesbrough (2003) proposed the open innovation sieve model as a complement to other traditional innovation models, in which open innovation activities link the firm to the outside and penetrate organizational boundaries, and the whole process of its innovation is very different from the funnel model of closed innovation. Enkel et al. (2009) identified three main open innovation processes, including: outside-in open innovation, which attracts the inflow of external innovation resources and fuses them with internal innovation resources for innovation activities; inside-out open innovation, which encourages the outflow of internal resources from the firm for external innovation activities; and coupled open innovation, which is co-creation with complementary partners.

Among them, regarding the assessment of the outside-in open innovation process, West and Gallagher (2006) suggest that the application of open innovation by open-source software firms covers the three processes, including finding creative ways to exploit internal innovation, incorporating external innovation into internal development, and motivating outsiders to supply an ongoing stream of external innovations. Slowinski and Sagal (2010) proposed a four-step model of "good practices" for open innovation, which consists of "Want, Find, Get, Manage". Dahlander and Gann (2010) indicate two inbound processes of open innovation: sourcing and acquiring. Chiaroni et al. (2011) proposed that the innovation requirements of customers for products and services force firms to change in innovation. It reveals four key dimensions that have a significant impact in the implementation of open innovation, namely, innovation networks, organizational structures, evaluation processes, and knowledge management systems.

In a review of academic research findings, West and Bogers (2014) proposed an integrated four-step model for outside-in open innovation, as shown in Figure 2.1, focusing on the logic of using external knowledge sources to encourage the integration of external innovation knowledge into the firm's internal knowledge to ensure the success of innovation.

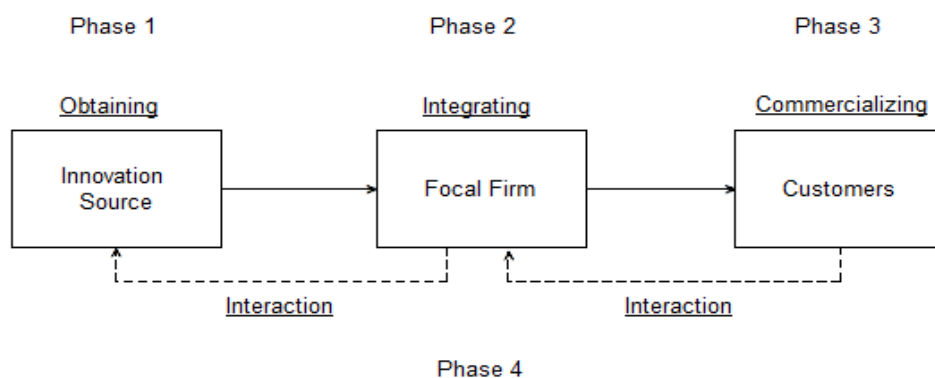


Figure 2.1 A four-phase process model for profiting from external sources of innovation

Source: West and Bogers (2014)

The model includes all previous open innovation models based on external sources and

includes the following four phases. (1) Obtaining innovations from external sources. In this case, innovation is understood as new knowledge, ideas or technologies. This stage includes searching, acquiring, enabling, promoting and coordinating knowledge (using and enhancing coordination of external resources). (2) Integration of innovations. The stage of integration of innovative resources includes factors that promote the integration of knowledge and factors that create obstacles to the integration of knowledge (unfavorable), and changes in the company's activity and competitiveness after the combination of these two factors. (3) Commercializing innovations. This stage involves testing and bringing to market innovations that reveal a key innovation goal, namely value creation. (4) Interaction mechanisms. They occur at any stage of the innovation process. It involves feedback on interactions between internal and external co-creators, and can occur among external innovation networks, communities, and customers.

2.2 Resource bricolage

Since its introduction, the resource bricolage (Lévi-Strauss, 1966) has generated a wide research boom in social psychology, innovation management, and entrepreneurship research in the social sciences, and has received more extensive attention in the field of organizational management (Duymedjian & Rüling, 2010). Resource bricolage is seen as an important way for start-ups to dissolve institutional and resource constraints.

2.2.1 Concept and connotation

Lévi-Strauss (1966) stated that the way in which people behave under the influence of their environment to use all available resources at hand to accomplish a task as a bricolage. He pointed out that resource bricolage would deconstruct, recognize, and integrate existing uses of resources to create new rules of use or combinations of uses. Subsequently, scholars have interpreted and defined the concept of bricolage from philosophical theoretical perspectives, organizational social perspectives, and entrepreneurial perspectives (Table 2.2).

Table 2.2 Evolution of the concept of resource bricolage

Scholars	Theoretical Perspective	Conceptual Definition
Lévi-Strauss (1966)	Cultural Anthropology	Bricolage is using all available resources to accomplish the task.
Derrida (2004)	Philosophy	Bricolage is a deconstructionism that deconstructs and integrates the use of resources.
Weick (1993)	Organizational Sociology	The act of bricolage goes hand in hand with improvisation, emphasizing that organizational planning and execution are closely linked, and

Scholars	Theoretical Perspective	Conceptual Definition
Kallinikos (1998)	Dynamic Resource Base View	that bricolage is a way for an organization to take immediate action in the face of the unexpected. Bricolage is a resource innovation approach.
Garud and Karnoe (2003)	Technology Entrepreneurship	Bricolage focuses on leveraging existing resources and addressing new challenges and opportunities by building a portfolio of resources. Bricolage is a dynamic process that includes four stages: resource integration, task identification, solution proposal, and effect evaluation.
Loarne (2005)	Behavioral Psychology	Bricolage is the process of integrating and using existing resources at hand to solve new problems or develop new opportunities.
Baker and Nelson (2005)	Entrepreneurial Management	Bricolage is closely related to the organizational context and is a new configuration of the organizational situation.
Duymedjian and Ruling (2010)	Organization Theory	

Derrida (2004) defines the concept of bricolage from a philosophical theoretical perspective. He considers bricolage as a kind of deconstructionism, an act of deconstructing and integrating the use of resources and an innovation strategy. Weick (1993) analyze bricolage behavior from an organizational sociological theory perspective. Garud and Karnoe (2003) suggest that bricolage focuses on using existing resources and responding to new challenges and opportunities by building a portfolio of resources from the perspective of technology entrepreneurship and entrepreneurial management. Loarne (2005) from the perspective of behavioral psychology theory, proposed that bricolage is a dynamic process that includes four stages: resource integration, task identification, proposed solution, and effect evaluation.

2.2.2 Dimensions

Baker and Nelson (2005) proposed three dimensions of resource bricolage: make doing, resource at hand, and combination of resources for new purposes. (1) Make doing means that the entrepreneur will subjectively take an impromptu and aggressive action to act proactively to seize potential opportunities. It is not necessarily to pursue the optimal solution, but to act immediately and not to give up any possible opportunity. (2) Resource at hand, which are resources that already exist but have been neglected in value, include material resources and intangible resources. Existing resources include many non-standardized resources, such as abandoned or idle resources. (3) Combination of resources for new purposes means to re-identify the non-standardized uses of resources according to the new market demand, and by recombining resources to achieve the capture of new market opportunities.

Di Domenico et al. (2010) further explain the meaning of make doing as an immediate action taken by the entrepreneur in the face of new opportunities and challenges, as a process

of regrouping resources in new ways. The process consists of three possible paths of resource acquisition and resource environment construction. 1) Creating something out of nothing. It means that the entrepreneur identifies new market opportunities and meets new market needs by providing new products or services. 2) Using unneeded and unused resources of others to make new resource combinations. 3) Finding and identifying potentially valuable resources that have been overlooked by others and tapping into them. resources with potential value and explore new uses of existing resources.

Di Domenico et al. (2010) proposed two key dimensions: “improvisation” and “a refusal to enact limitations”, based on the three dimensions of resource bricolage proposed by Baker and Nelson (2005). In organizational management, improvisation refers to a new paradigm in which organizations respond to dynamic and complex environments by breaking away from the original "planning before execution" model and acting without prior agreement and careful planning. Improvisation is characterized by spontaneity, innovation, time aggregation, and resource concentration (Miner et al., 2001). Improvisation in the entrepreneurial context refers to the immediate adaptive and creative actions taken by entrepreneurs in the face of new opportunities and challenges. Di Domenico et al. (2010) defines "a refusal to enact limitations" as the entrepreneur's iterative exploration of how to break the constraints of the previous institutional, political, and resource environment (disruptive innovations in organizational structure and business model) through trial and error, iterative innovation, to obtain valuable resources bricolage portfolio. The definition is twofold: first, the entrepreneur will consciously and continuously try to discover the boundaries of the constraints of the bricolage action; second, the entrepreneur will change the traditional thinking and behavior to build a new resource portfolio.

2.2.3 Types

Studies have been conducted to distinguish and identify different types in terms of scope, object, motivation, and resource sources about bricolage. Baker and Nelson (2005) found that firms exhibit two different choices when performing bricolage. One is parallel bricolage, in which multiple projects are bricolage simultaneously. The other is selective bricolage, where only one item is bricolage at a single point in time. Baker and Nelson (2005) found that selective bricolage has a better effect on firm growth, while parallel bricolage has a less significant effect. Li and Huo (2015a) showed that selective bricolage facilitates product innovation in SMEs. Parallel bricolage negatively moderates the relationship between resource scarcity and product

innovation, while selective bricolage positively moderates the relationship between resource scarcity and product innovation.

From the perspective of bricolage objects, resource bricolage can be divided into material bricolage, human bricolage, skill bricolage, network bricolage. Material bricolage refers to the dynamic process of transforming ordinary or non-conventional resources into quality resources by bricolage material resources that are undervalued or neglected, creating new resource inputs. Human resource bricolage refers to the inclusion of relevant stakeholders such as customers and suppliers into the bricolage scope, creating new human input. Skill bricolage is the process of encouraging employees to use their self-taught knowledge and skills in their work, thus creating more useful services. Network bricolage refers to the use of resources from personal relationship networks in resource bricolage activities of the company.

From the perspective of bricolage motivation, resource bricolage can be divided into necessity-based bricolage and ideational bricolage (Desa & Basu, 2013). Necessity-based bricolage refers to the process by which the bricolage reduces the resource dependence on the resource provider by reducing the requirement for resource quality and by bricolage the available resources to achieve the requirements of an acceptable task. This kind of bricolage reduces the time spent on finding quality resources and can reduce the resource input cost, but the final product or service provided is not an optimal solution but a suboptimal one. Ideational bricolage refers to identifying and discovering undervalued resources by re-examining and judging their value, and using them purposefully to develop new products or provide new services. Ideational bricolage is usually easy to occur in companies with redundant resources. By rediscovering the value of redundant resources, a firm can integrate existing resources to develop new opportunities through the act of bricolage together. Redundant resources can be divided into two categories: absorbed redundant resources and unabsorbed redundant resources (J. Tan & Peng, 2003). Absorbed redundancy refers to resources that are already owned by the firm but not yet fully utilized. Unabsorbed redundancy refers to resources that are not yet used by the firm, but can be freely used by the firm's managers and have the flexibility to change their use. Studies have found that absorbed redundant resources are more conducive to Ideational bricolage, where firms create new products or services that meet market needs by newly connecting idle resources with market needs (Zhao et al., 2017).

Depending on the source of resources, resource bricolage is divided into two types: internal bricolage and external bricolage (Vanevenhoven et al., 2011). Internal Bricolage refers to resource integration activities by entrepreneurs using personal idiosyncratic resources, such as prior market experience, life experience, educational background, and expertise. External

Bricolage refers to the activities of entrepreneurs who use the resources available in the external environment. Entrepreneurs can integrate their own resources at hand or obtain resources or knowledge from external stakeholders and then integrate these resources to achieve innovative use.

J. Q. Zhang et al. (2015) explored the matching relationship between material bricolage and creative bricolage inside and outside the enterprise through case studies from the perspective of integrating internal and external resources, and proposed four bricolage models: stable, risky, creative-focused, and material-focused. Among them, the stable bricolage of material resources and ideas come from within the enterprise, and the enterprise mainly adopts the utilization type of learning to transform the resources, which can achieve the effect of bricolage innovation. The risky bricolage refers to the fact that both resources and ideas come from outside the enterprise, and the enterprise mainly adopts exploratory learning to develop new knowledge to transform the resources. It is a relatively risky exploratory behavior and faces greater uncertainty. The creativity-focused bricolage means that creative resources come from outside the enterprise, while material resources come from inside the enterprise. By adopting utilization-based learning to transform internal material resources while adopting exploratory learning to transform creative resources outside the enterprise, enterprises can realize the balanced advantages of exploration and utilization. The material-focused bricolage means acquiring material resources from outside the enterprise and creative resources from inside the enterprise. This model can also achieve the integration of exploratory and utilization learning approaches, which can bring more innovative results for the enterprise.

2.2.4 The process of resource bricolage

Regarding how bricolage is carried out, Baker and Nelson (2005) constructed a model of the entrepreneurial bricolage process for start-ups in a resource-poor environment. The model summarizes three paths that entrepreneurs can take to meet new challenges in the face of resource constraints: 1) they can solve the resource constraints by using a bricolage approach to integrate existing resources; 2) they can acquire new resources to meet new challenges through continuous resource search; 3) they can avoid challenges by adopting negative approaches, such as maintaining the status quo, downsizing, and dissolving the business. Meanwhile, the five competencies that entrepreneurs should have to successfully achieve bricolage are creativity, improvisation, resource integration, adversity frustration, social network and necessary social skills

Senyard (2015) further parsed the process of resource bricolage and constructed a four-stage process model of resource bricolage: gather resources, forming and managing a resource trove, experimenting with resource combinations, and implementing resource strategies. First, entrepreneurs will consciously gather various idle resources through family/friends, relationship networks, and other channels to form an alternate resource trove of various potentially valuable tools, items, skills, and ideas collected (Baker & Nelson, 2005; Stinchfield et al., 2013). Then, from time to time, a series of management actions such as organizing, sorting, splitting, valuing, and deciding to keep or discard the resources in the resource trove will be performed with the aim of retaining the resources that are currently needed or potentially needed in the future. Secondly, the entrepreneur will try several experiments of combining and recombining resources to achieve new purposes of resource use. The process of resource combination includes selecting resources, iteratively evaluating and refining ideas, deciding on the final bundle of resources, and developing a final resource portfolio in response to opportunities and challenges (Desa & Basu, 2013). The act of resource portfolio often manifests as an improvisational act, an activity of iterative trial and error and iterative adjustment. Finally, the feasible combination of resource will be implemented.

F. Su et al. (2016) identified a three-stage process model for SMEs to carry out bricolage in an environment of dramatic environmental change, and analyzed in detail the two types of bricolage activities, namely, selecting resources and combining resources, from three stages: discovering opportunities, seizing opportunities, and developing opportunities, respectively. In the stages of opportunity discovery and opportunity seizure, the firms' bricolage behaviors are more based on the firms' past experiences, while in the stage of developing opportunity, the firms' bricolage behaviors show the characteristics of matching with the firms' strategies, and the firms start to implement planned bricolage activities.

2.2.5 Influencing factors

2.2.5.1 Individual Level

The influencing factors operating at the individual level are individual trait and individual competencies:

Individual Trait. Resource bricolage is a knowledge creation process that requires certain qualities and competencies for the entrepreneur to be better able to start. Entrepreneurial awareness and alertness of existing resources will help entrepreneurs to identify new uses and values of resources (Baker & Nelson, 2005). Entrepreneurs with high resource alertness are

more likely to engage in bricolage activities; entrepreneurs with human capital such as rich prior experience (Fuglsang, 2010), entrepreneurial experience and industry knowledge (Zhao et al., 2016) are more inclined to achieve entrepreneurial activities through resource bricolage. Stenholm and Renko (2016) found that entrepreneurs' enthusiasm drives them to adopt resource-bricolage behavior. Case studies show that charismatic leaders are more inclined to lead firms in resource bricolage to improve efficiency (B. H. Fu et al., 2018).

Individual competencies. From the perspective of competency characteristics, entrepreneurship, including innovativeness, risk-taking, and adventure spirit, drives entrepreneurs to break through the resources constraint through resource bricolage (Salunke et al., 2013). Entrepreneurial creativity and collaboration (Banerjee & Campbell, 2009), the ability to integrate and utilize available resources (Senyard et al., 2010), the ability to identify opportunities, entrepreneurial awareness, and other entrepreneurial competencies (Y. Wei, 2014) will help entrepreneurs identify new opportunities for entrepreneurship and drive creative bricolage behavior. However, the entrepreneurs' ability to assimilate (Banerjee et al., 2009), their ability to perceive value through prior experience, is not conducive to bricolage activities. Baker and Nelson (2003) found that the size and strength of social networks affects entrepreneurs' bricolage behavior. Y. Wei (2014) found that relational networks will provide bricolage resources for entrepreneurs and are an important factor in stimulating bricolage behavior, and that relational networks have a more pronounced effect on the bricolage of human and market resources. Miner et al. (2001) found that improvisation is often accompanied by bricolage activities and can effectively facilitate the unfolding of bricolage behaviors.

2.2.5.2 Organizational level

Organizational capabilities, atmosphere and external environment are the three influencing factors operating at the organizational level.

Organizational capabilities. Ferneley and Bell (2006) found that organizational learning and organizational trust positively affect a firm's resource bricolage, while bricolage also contributes to firm innovation and promotes the adoption of enterprise management information systems. Banerjee and Campbell (2009) found that organizational creativity and collaboration are conducive to resource bricolage, while assimilation is detrimental to resource bricolage. Zuo and Zhou (2017) constructed an empirical model of cognitive flexibility, entrepreneurial bricolage and new business performance following the theoretical paradigm of cognitive-behavioral-performance and found that organizational cognitive flexibility, i.e., the ability to adapt cognitive processing strategies to novel and unexpected situations in the environment,

has a positive effect on entrepreneurial bricolage. Entrepreneurial orientation is a strategic decision-making concept and model with innovation, early action, and risk-taking adopted by firms entering new business areas, which helps firms maintain sensitivity to new things, knowledge, and opportunities, build an open and failure-tolerant corporate environment, and can facilitate the development of entrepreneurial bricolage activities (Z. F. Zhu, 2015).

Organizational atmosphere. Resource bricolage is a creative resource reorganization activity, and the internal atmosphere of an organization has a significant impact on whether employees adopt resource bricolage behaviors. Ferneley and Bell (2006) found that an organization's culture of building trust can motivate employees' resource-bricolage behaviors. Zhao et al. (2016) explored the impact of organizational structure and cultural atmosphere on the implementation of resource bricolage in companies, and they found that companies with participatory decision-making were able to provide more practical experience and knowledge for resource bricolage because of brainstorming, which facilitated resource bricolage behavior. The higher the degree of interdepartmental linkage, the greater the opportunity for firms to achieve cross-functional resource reorganization, making it easier to discover new value in resources. The more tolerant an organization is on failure, the better the chances for employees to engage in trial and error and find workable solutions. The stronger the learning climate in the organization, the more employees are inspired to act on resource bricolage. G. Chen (2017) found that an organization's entrepreneurial atmosphere of innovation incentives, organizational support, and external orientation is more conducive to its resource-bricolage performance.

Organizational external environment. Desa and Basu (2013) empirically studied the prior conditions of two processes, including resource optimization and resource bricolage, for resource mobilization by social organizations from the perspective of the organizational external environment, and found a U-shaped relationship between organizational prestige and environmental permissiveness and resource bricolage, while a positive influence relationship with resource optimization. When the reputation of social organizations is low, it is more difficult to obtain standard resources from society, so they tend to use resource bricolage to obtain low-cost resources. When the social reputation of organizations increases, they can use their status to obtain various desired resources more easily, and their reliance on resource bricolage decreases. However, when the reputation of organizations increases, they accumulate a large amount of redundant resources, so they rely on redundant, and then the behavior of resource bricolage relying on redundant resources increases. Environmental munificence refers to the ease of access to important resources. When the environmental munificence of the organization is very low, it means that the organization faces fierce competition and can obtain

fewer resources, so the organization will tend to break the pressure of resource constraints through resource bricolage; when the environmental munificence increases, it becomes easier for the enterprise to obtain resources, so it will reduce the dependence on resource bricolage. When the environmental munificence is high, the enterprise has an abundant number of resources and a large number of redundant resources, which will stimulate the firm to bricolage its own idle resources. Senyard et al. (2010) found that the value attributes of the firm's existing resources and the resource constraints faced by the firm are also front-end drivers of entrepreneurial bricolage strategies.

2.2.6 Boundaries and conditions

In terms of the scenario factors of resource bricolage, the three main perspectives include organization, team, and environment.

Organizational scenario factors. Organizational life cycle, organizational structure, cultural atmosphere, and organizational management style all have an impact on the role of resource bricolage on firm performance. From an organizational life cycle stage perspective, Senyard (2015), Z. F. Zhu (2015), Z. D. Zhu and Li (2014) found that resource bricolage has different effects on the role of start-up and growth firms. For start-ups, it is more difficult to obtain new resources as they are more significantly constrained by nascent weakness and nascent smallness, and thus the resource bricolage approach can greatly improve their resource acquisition efficiency and significantly contribute to their performance in the start-up phase. For growing firms, their ability to acquire new external resources is enhanced, and resource bricolage is a transitional solution, and therefore less significant in contributing to their performance. Zhao et al. (2016) investigated the moderating role of organizational structure and cultural atmosphere between resource bricolage and firm performance from the perspective of matching organizational strategy and organizational structure, and obtained four conclusions: first, the higher the firm's tolerance for innovation failure, the easier it is for the firm to obtain better solutions through repeated trial-and-error behavior in the resource bricolage process, and the enhancement effect on firm performance is more obvious. Second, the better the dynamic learning atmosphere of the enterprise, the more conducive to the accumulation of experience in each resource bricolage activity, which is conducive to the process of knowledge creation of the enterprise. Third, the more employees participate in decision-making, the richer the experience and knowledge from the work practice of the enterprise, which can be conducive to the effect of resource bricolage. Fourth, the higher the degree of communication and integration

between different functional departments, the more conducive to the utilization of the existing resources of the enterprise and integration, the better the bricolage effect. From an organizational management style perspective, Ferneley and Bell (2006) found that a flexible management style, which motivates employees to take ownership of bricolage and creativity, facilitates resource bricolage activities. Chen (2017) found that an entrepreneurial atmosphere with innovative incentives, organizational support, and external orientation plays a positive moderating role between entrepreneurial bricolage and entrepreneurial performance.

Team scenario factors. Ruef et al. (2003) and Senyard (2015) found that team structure also has a weighting effect on the relationship between resource bricolage and firm performance. The size of the entrepreneurial team negatively moderates the relationship between resource bricolage and firm performance, i.e., smaller teams are more flexible and more conducive to resource bricolage behavior. In contrast, the tightness of the entrepreneurial team network structure and the degree of functional heterogeneity of team members positively moderate the relationship between resource bricolage and firm performance. The tightness of relationships among team members will facilitate resource bricolage, while the higher the heterogeneity of team members, the more beneficial the effect of resource bricolage.

Environmental scenario factors. The relationship between bricolage and new firm performance is also influenced by the weighting of environmental volatility, industry attributes, and other factors. From the perspective of industry attributes, resource bricolage is more appropriate for firms with rapid product or service renewal and high levels of competition. Garud and Karnoe (2003) found that entrepreneurial bricolage is more often adopted by dynamically changing firms, which face rapid product replacement. Uncertainty in the external environment, rapid changes in customer needs, and rapid technological updates all drive firms to adopt resource-bricolage strategies to address dynamic change. Senyard (2015) found that environmental dynamism negatively affects the relationship between resource bricolage and firm performance. In a changing environment, entrepreneurs need to increase the number of trials and errors in order to achieve bricolage behavior, which increases the cost of bricolage and thus diminishes the effectiveness of bricolage.

2.2.7 Impact effects

As far as the impact effect of the resource bricolage, it mainly focuses on the interrelationship between firm innovation, firm competitive advantage, firm performance and firm legitimacy.

Resource bricolage and firm innovation. The relationship between resource bricolage

and firm innovation performance has not yet formed a consistent conclusion. A part of the studies concluded that bricolage can stimulate product innovation (Li & Huo, 2015b), enhance firms' internal R&D capabilities (Banerjee & Campbell, 2009), and have a positive effect on the overall innovation performance of start-ups and new ventures (Fuglsang & Sorensen, 2011; Senyard et al., 2011). In further looking at the effect of bricolage on each type of innovation in firms, L. Wu et al. (2017) found that resource bricolage accelerates the speed of new product development in manufacturing firms, but the relationship with new product development effectiveness is inverted U-shaped, and the relationship between resource bricolage and new product development speed and new product development effectiveness is also positively moderated by technological turbulence. Senyard et al. (2014) found a positive relationship between resource bricolage and product innovation, process innovation, and marketing approach innovation, but an inverted U-shaped relationship with market innovation. Salunke et al. (2013) studied innovation in service firms and found that resource bricolage plays a direct positive contribution to supportive innovation and also an indirect contribution to interactive innovation through supportive innovation. Overall, resource bricolage will contribute to a firm's innovation performance in three ways. First, resource bricolage is a kind of immediate action, which can improve innovation efficiency as companies can carry out innovation activities immediately without waiting too much. Second, resource bricolage is mainly to revalue and recombine the existing resources on hand, which has the advantages of cost saving and time saving compared with obtaining new resources. Third, resource bricolage is an innovation process of breaking the rules and repeatedly iterating trial and error, which may lead to unusual innovation results.

At the same time, the relationship between bricolage and innovation performance is also influenced by factors such as organizational structure and culture (Zhao et al., 2016), environmental turbulence, relationship attributes, and team heterogeneity (Senyard, 2015), and over-bricolage can have a negative impact on innovation. The reasons for this are: first, resource bricolage is a temporary and potentially ineffective way of "making do" in a resource-starved environment. Second, the innovative behavior generated by resource bricolage may be short-lived, limited, and not widely applicable. Third, the over-reliance on resource bricolage may reduce the demand for standard resources and tend to provide "non-standard products or services", which is not conducive to the development of innovation in the long run.

Resource bricolage and firm competitive advantage. Differences in the way existing resources are utilized can affect the stock of resources and the construction of a firm's competitive advantage (Smith & Baker, 2010). Firms that adopt a bricolage strategy have

resources that are more inimitable and non-substitutable, which are more conducive to the formation of a unique competitive advantage (Hindle & Senderovitz, 2010; Steffens & Senyard, 2009). The creative use of redundant resources can help companies form unique business models and facilitate the construction of competitive advantage (Zhang et al., 2009).

Resource bricolage and firm performance. Research on bricolage and overall firm performance has also not produced uniform conclusions. Most of the studies support that bricolage is beneficial to the overall performance of start-up firms. Mair and Marti (2009) found that resource bricolage can help nonprofit organizations gain social recognition, which in turn facilitates their growth. Kickul et al. (2010) found a significant positive effect of bricolage on organizational growth rate. Senyard et al. (2015), Steffens and Senyard (2009) found a power-change effect of bricolage, whereby resource bricolage positively affects the performance of start-ups at first, but diminishes as the start-up grows and negatively affects the performance of the firm at a later stage. Z. F. Zhu (2015), Z. D. Zhu and Li (2014) also found that entrepreneurial bricolage positively affects the financial performance of both start-up and early growth stage new ventures, and positively affects the growth performance of start-up new ventures, but not significantly affects the growth performance of early growth stage new ventures. In general, the relationship between resource bricolage and firm performance is not a simple linear causality; resource bricolage has both positive and negative effects on the overall firm performance. Its effect is affected by situational variables. Therefore, the relationship between resource bricolage and firm performance can be better explained by finding the situational factors on which resource bricolage works.

Resource bricolage and firm legitimacy. Z. Q. Wang et al. (2017) found that Necessity-based resource bricolage facilitates the acquisition of regulatory legitimacy and cognitive legitimacy by start-ups, but is detrimental to the acquisition of normative legitimacy. Ideational resource bricolage, on the other hand, facilitates the acquisition of normative legitimacy by start-ups but is detrimental to the acquisition of regulatory legitimacy.

2.3 Knowledge production

2.3.1 Concept and characteristics

Although the function has been noticed earlier, there has not been an accepted and consistent result in the interpretation of the concept of knowledge production. According to R. Gao (1985), knowledge production refers to the condition of exploring natural objects into something

needed by human beings, and it is the process of people's activity of exploring objective laws with the help of instruments and equipment, or with the help of information. Its products are intangible mental entities, including theories, ideas, models, methods, and techniques. Knowledge production has three main characteristics: informativeness, exploration and inheritance. According to Organization for Economic Co-operation and Development (1996), knowledge production is developing and providing new knowledge (Y. S. Du, 1999). believes that knowledge production is the enhancement of knowledge, that is, the production of new knowledge. He defines the concept of knowledge production in terms of intellectual property ownership, knowledge production process, production element composition and value creation of knowledge products, and proposes that knowledge production has the characteristics of primacy, non-entity, uncertainty and discontinuity. According to J. C. Li (2001), knowledge production is the process of people creating new knowledge through mental labor and the process of discovering new knowledge on the basis of existing knowledge (W. Xu, 2005). defines knowledge production in a narrow sense and a broad sense. Knowledge production in the narrow sense refers to the production of new knowledge. Knowledge production in the broad sense refers to the sum of original and replicative production processes of knowledge. S. B. Liu (2005) refers to the various results of scientific and technological research and development and spiritual activities, including literature and art, as knowledge products in general; the production of scientific knowledge and cultural products such as literature and art is called knowledge production. According to D. Feng (2009), knowledge production refers to the process of invention, creation, innovation and reproduction of various types of knowledge, such as truth, principles, ideas and information, in human activities. It includes not only the creation of original new knowledge, but also the knowledge that is produced through the process of reproduction and transmission based on existing knowledge. Knowledge production is characterized by diversity, i.e. diversity of knowledge forms, diversity of production subjects and diversity of production purposes. According to J. Wang (2009), knowledge production is the process of people recognizing, reflecting and reproducing the objective world, including the natural world, human society and people themselves, which is essentially a subjective spiritual activity of human beings. As a social activity, knowledge production includes the dissemination, research and application of knowledge in terms of process. This is a broad understanding of knowledge production. From the process point of view, knowledge production is innovative, uncertain and accumulative; from the result point of view, the products of knowledge production are non-physical and transformable.

Combining several definitions of knowledge production mentioned above, we define

knowledge production as the process of invention, creation, innovation and replication of various types of knowledge in human activities, including not only the creation of original new knowledge, but also the knowledge produced through the process of reproduction and transmission based on existing knowledge.

2.3.2 Classification

For the classification of knowledge production, numerous scholars have studied it from different perspectives. Among them, R. T. Zhang et al. (2005) classified knowledge production activities into basic research, applied research, and development research. J. H. Li (2008) also classifies knowledge production into three categories. The first category is exploring unknown fields and so-called pure theoretical or basic research. The second category is transferring existing knowledge that has been recognized, such as new discoveries and inventions, to the unknown, including education and learning in a broad sense. The third category is using existing basic knowledge to make speculations, guesses, and hypotheses, and conducting experiments, improvements, falsifications, and other knowledge in technical and business fields production activities. C. X. Fu et al. (2009) divided knowledge production into 1) original knowledge production, i.e., using existing knowledge base to create new knowledge products; 2) replicative knowledge production, i.e., the production of simple copies of existing knowledge products; 3) customized knowledge production, i.e., using existing knowledge to produce knowledge products that meet the requirements of customers according to their customized characteristics. In addition, knowledge production can be classified as new knowledge production and compensatory knowledge production, private knowledge production and public knowledge production, and cost-saving knowledge production and demand-discovery knowledge production (Teng & Ren, 2010).

2.3.3 Models

The knowledge production model refers to the way in which knowledge is produced and created, and is a framework for explaining knowledge formation and development (Y. Huang et al., 2016). After World War II, academics began to pay attention to the changes and transformations of knowledge production models. A number of theories have been proposed to reveal the new features of contemporary scientific knowledge production models. Among them, representative theories include Big Science, Knowledge Production Models 2 and 3, Postacademic science, and Triple and Quadruple Helix Models. These theories provide the theoretical basis and

analytical perspectives for quantifying the knowledge production model.

2.3.3.1 From "Little science" to "Big science"

In his masterpiece "Big Science, Little Science", De Solla Price (1963) pointed out that the transition from "Little Science" to "Big Science" heralded a major shift in the structure of science. "Little science" refers to scientific research activities conducted independently by individual scientists or scientific teams (De Solla Price, 1963), with the primary aim of understanding nature. Knowledge production is mainly driven by scientists' personal interests, and scientific research is based on scientists' own resources. This type of research is oriented towards the pursuit of scientific truth, is characterized by competitiveness, is focused on a single discipline, and is an approach of "science for science's sake" (Li et al., 2014; X. Zhao, 2010). To distinguish from the previous "little science" research model, Price uses the concept of "big science" to characterize the post-World War II paradigm of scientific research. Science has become a vast social systems project and increasingly involved in large government-sponsored development projects to address complex problems that require highly advanced technology and strong theoretical guidance. As a result, the model of individual scientists conducting research alone could no longer be adapted to this need, and scientific research needed to be done by big scientific groups (De Solla Price, 1963).

The shift from "Little science" to "Big science" is an inevitable trend in the development of science. Along with the emergence of interdisciplinary problems, the difficulty of scientific research is increasing, the equipment required is becoming more and more complex, and the research funds required are becoming larger and larger, all of which are beyond the reach of individual scientists. To cope with these problems, the "Little Science" model of knowledge production formed by the academy system has gradually shifted to the "Big Science" model (X. Q. Li et al., 2007).

2.3.3.2 "Academic science" and "Postacademic science"

Ziman (1996) divides the knowledge production models into two types: the academic science and the postacademic science. Among them, the academic science is a purely academic study that focuses on the cognitive function of scientific knowledge and aims to expand accurate knowledge for humanity. In terms of the motivation for knowledge production, academic science is driven by curiosity and imagination to explore the unknown and seek the truth, and is determined by the personal interests and styles of researchers. In terms of organization, academic science is based on highly differentiated disciplinary systems, usually organized

around disciplines, and scientists often belong to the same scientific community, whose research behavior must collectively follow the institutionalized "Mertonian CUDOS norms" of communalism, universalism, disinterestedness, originality, and organized skepticism (Merton, 1941).

The academic science has three characteristics: firstly, scientific knowledge production is mainly based on the internal evolution of knowledge and the progress of knowledge itself as the main criterion, and the interest of scientists is the main driving force of scientific knowledge production; secondly, the specialized division of labor in scientific knowledge production is mainly carried out according to the characteristics of the studied objects, that is, it is mainly manifested in the disciplinary division of labor based on the differences of the studied objects, therefore, scientific knowledge production is mainly reflected in the production of "disciplinary knowledge"; thirdly, academy science is a scientific knowledge production model based on the organizational establishment of "academy" (H. G. Li & Zhang, 2006).

Ziman (1996) identifies the post-academic science as a new system of industrial science that emphasizes the socio-economic function of scientific knowledge with the goal of producing economic benefits from scientific knowledge. Researchers' competition for cash takes precedence over competition for scientific credibility as the driving force of science. So many researchers are totally dependent on research grants or contracts for their personal livelihoods that winning them becomes a goal in itself (Ziman, 2000).

Postacademic science is a revolutionary, irreversible and global revolution in the way science is organized, managed and performed. It is a new mode of scientific knowledge production in which academy science operates in an applied context, an extension of academy science into industry, and a new scientific system organized according to market principles and closely entangled with the network of practice (X. R. Huang, 2003; Lin & Sun, 2005). In the postacademic model, its normative structure has a new twist compared to the academic science, "PLACE norms", i.e., "Proprietary", "Local", "Authoritarian", "Commissioned" and "Expert", are the main operating rules of postacademic science. Postacademic science overturns the monolithic thinking of academic science and considers utility as an important factor in the process of scientific knowledge production, which provides a theoretical basis for science towards socially relevant research, and at the same time provides many useful insights for changing the original view of science and scientific institutions (Li et al., 2014).

2.3.3.3 "Model 1", "Model 2" and "Model 3" of knowledge production

Gibbons et al. (1994) proposed two models of knowledge production, namely, the traditional

Model 1 and the contemporary Model 2. The traditional Model 1 has a "discipline-oriented" logic, in which research questions are formulated and defined from within the discipline, and research results are evaluated by peers within the discipline, with little emphasis on meeting the needs of those outside the discipline. Model 2, on the other hand, has a "problem-oriented" logic, in which the research questions generally do not belong to any single discipline, and the purpose of the research is not only to pursue the accumulation of knowledge within the discipline, but also to emphasize interdisciplinary cooperation, diversified skills, organizational flexibility, and the practical value of knowledge, and it is impossible to evaluate the merits of the results within a single discipline. Not only is science speaking to society, but society is beginning to speak to science (Tuunainen, 2013).

Compared with Model 1, Model 2 has five typical characteristics (D. He & Guo, 2019; Li, 2005). 1) Application-oriented. Model 2 knowledge production is carried out in an applied context, while Model I is carried out in a purely academic context. 2) Interdisciplinary research. The application context determines that Model 2 is naturally interdisciplinary, whereas Model 1 is highly disciplinary. 3) Organizational heterogeneity and organizational diversity. Heterogeneity means that Model 2 is conducted in open "virtual" communities that cross national and cultural boundaries, which allows new actors and organizations, such as think tanks, advisory bodies, and social interest groups, to play an active role in the research process, increasing the diversity of knowledge production agents. As a result, the university is no longer the only place for knowledge production. 4) Social responsibility and self-reflexivity. Model 2 knowledge production is directly related to the public interest, and the whole process has to have a strong sense of social responsibility and needs to deal with the accountability from the society. In contrast, Model 1 has relative autonomy. 5) New quality control. The quality of research results in Model 2 is determined by a broader set of criteria that reflect the increased social nature of the review system, taking into account intellectual, social, economic, and political interests, whereas Model 1 is peer-reviewed (Gibbons et al., 1994).

The Model 2 of knowledge production has gained much attention in reflections on contemporary scientific practices and has had a significant impact on the field of science, technology and innovation policy in particular (Fisher et al., 2001). On the other hand, the characteristics depicted in Model 2 have been questioned by many scholars (Etzkowitz & Leydesdorff, 2000; Hessels & Lente, 2008; Pestre, 2003; Van Rijnsoever & Hessels, 2011). In general, scholars agree more on "applied contexts" and "institutional diversity", with mixed opinions on "interdisciplinary research". "Self-reflexivity" and "social responsibility" are less of a concern, and "new types of quality control" is the most debated.

In the context of global localization, the convergence of various contexts and elements of the new knowledge production phenomenon, economic, technology and culture, in the societies of the world's different geographic groups, has led to a new understanding of the way knowledge is produced. Based on the logical evolution of Model 1 and Model 2, Carayannis and Gonzalez (2003) first talked about the idea of "Model 3" knowledge innovation. Subsequently, Carayannis and Campbell (2006) formally described the phenomenon of knowledge production as "innovation networks" and "knowledge clusters" in terms of the "Model 3" concept. The phenomenon of knowledge production is described by Carayannis and Campbell (2006) with the concept of "Model 3". By Carayannis and Campbell (2009, 2011, 2012), and Carayannis and Ziemnowicz (2007) constructing a well-developed ideological system of the Model 3 knowledge production.

Model 3 knowledge production is the logical result of the development of Model 1 and Model 2 in accordance with the characteristics of the times. Model 1 mainly refers to the "Newtonian model" of university basic research organized in the disciplinary structure system. Model 2 emphasizes knowledge application and knowledge-based problem solving, are interdisciplinarity, application scenarios, diversity and heterogeneity of participants in knowledge production, and agility and flexibility in the organization of knowledge production (Gibbons et al., 1994). Model 3 is dedicated to the formation of multi-level, multi-nodal, multi-modal, and multi-agent knowledge production systems in the Fractal Research Education Innovation Ecosystem (FREIE) (Carayannis & Campbell, 2011). Model 3 reveals the profound change and transformation of knowledge production in the context of global localization and advanced knowledge economy society, which fully expresses the synergistic amplification effect of superior resources such as human capital, intellectual capital, social capital, and cultural capital. It provides a profound theoretical basis and a new theoretical perspective for the construction of multi-level, multi-node, multi-subject and multi-form collaborative innovation model of current knowledge clusters, innovation networks and fractal innovation ecosystems, which opens up a new theoretical living space and ideas for the development of universities in the advanced knowledge economy society (X. C. Wu, 2014).

2.3.3.4 "Triple helix" and "Quadruple helix" theories

Etzkowitz and Leydesdorff (1995) proposed the Triple Helix model to describe the interaction between university-industry-government relations in the knowledge economy, arguing that the synergistic development of the three is the core driver of science and technology innovation. They thus suggested that the synergistic relationship between the three should be strengthened

to promote the production, transformation, application, and upgrading of knowledge and the achievement of innovation goals (Etzkowitz & Leydesdorff, 1995; Etzkowitz & Leydesdorff, 2000; Ivanova et al., 2017; Lawton Smith & Leydesdorff, 2014).

The model of scientific knowledge production depicted by the Triple Helix has the following characteristics (Etzkowitz & Leydesdorff, 1995; Etzkowitz & Leydesdorff, 1998): 1) Academia's involvement in innovation. In the triple helix model, academia is increasingly involved in innovation dynamics, leading to closer cooperation and coordination between them and industry and government departments. 2) Close university-industry-government relationships. The involvement of academic institutions in innovation occurs in the context of increasing institutional interdependence, creating the prerequisites for co-evolution and giving rise to an increasing number of hybrid organizations. 3) Changing status of universities. In the Triple Helix model, in addition to the traditional missions of teaching and research, universities are given a third mission to promote socioeconomic development. 4) Interdisciplinary collaboration. The triple helix model emphasizes the importance of collaborative interdisciplinary research, especially in the most advanced fields of technological research, which are largely based on theories and methods from different disciplinary fields.

The triple helix theory has been widely influential as a mainstream model for analyzing the relationship between universities, industry and governments in scientific research and technological invention. It used to be a guiding opinion of the United Nations to guide science and technology innovation in developing countries (C. Y. Zhou, 2006). Its core value lies in integrating universities, governments and enterprises with different functions and value systems, forming a triad of scientific research, administration and industry (Y. B. Ma & Wang, 2008), thus laying a solid theoretical foundation for regional economic innovation and social development, and promoting the symbiosis and co-growth of universities, governments and enterprises (W. H. Fang, 2003; H. Y. Xu et al., 2015; Y. Ye et al., 2014).

With the rapid development of human society into the advanced knowledge economy, Carayannis and Campbell (2009) proposed the concept of "Quadruple Helix" based on the expansion of the "Triple Helix" innovation model for the development of primary knowledge economy, which adds the "fourth helix" to the "triple helix" innovation system picture. The fourth helix points directly to the civil society and media-based and culture-based public, i.e., non-coercive collective behavior around shared interests, purposes, and values. The concept of "Fourth Helix" requires a broader understanding of contemporary scientific knowledge production: the "public" and "civil society" are the user groups of knowledge innovation, with high relevance for knowledge production and application, which should become the actors of

advanced knowledge production and important elements of the knowledge innovation system. From the organizational perspective, the "Quadruple Helix" ecosystem emphasizes "creative knowledge environments", i.e., environments and situations that positively influence people's creative work in new knowledge production (Resetarits & Resetarits-Tincul, 2012). Public culture, values, lifestyles and media communication styles, which are elements of the "Fourth Helix," influence the multilayered knowledge innovation system. A positive "culture of innovation" can contribute to the development of an advanced knowledge economy. Public discourse and media information interpretation can help civil society to plan priority strategies for knowledge production and innovation (Carayannis & Campbell, 2009).

It should be noted that the power mechanism of Model 1 is a single helix or a double helix. The single helix refers to universities, and the double helix refers to universities and research institutes, while the main knowledge production and dissemination activities are still concentrated in universities. The power mechanism of Model 2 is a "Triple Helix". The "Triple Helix" provides a "social structure model" for knowledge production, in which universities, governments, and industries participate in educational activities according to their own interests and promote changes in disciplines (Y. Huang et al., 2016). The "Fourth Helix" provides the necessary analytical tools for knowledge production and shows the interaction between university-industry-government-media and culture-based publics in collaborative innovation, providing the driving mechanism for Model 3 (X. C. Wu, 2014). The "Quadruple Helix" innovation model empowers the "Triple Helix" civil society environment, which provides an adaptive context for new knowledge production, thus generating an ecosystem map for new knowledge innovation (Carayannis & Campbell, 2010).

2.3.4 Knowledge production and discipline construction

Discipline is a systematic and logical collection of knowledge. The essence of discipline construction is to promote the development of knowledge. The logic of knowledge development is inherent to discipline construction (Z. H. Yin & Zheng, 2019).

Universities are the birthplace of knowledge production. The disciplines are both the basic building blocks of universities and the organizational structure around knowledge production (L. B. Wu et al., 2017). From the perspective of knowledge production, disciplines as the knowledge system of talent cultivation are the process of simple knowledge reproduction; as the knowledge system of scientific research, they are the process of knowledge expansion and reproduction; as the knowledge system of social services, they are the extrapolation process of

university knowledge production. Under the vision of knowledge production, the university is a knowledge production department. All are constant processes of knowledge production, whether it is the simple reproduction of knowledge, the expanded reproduction of knowledge and the extrapolation of knowledge production processes in universities. The construction of academic disciplines is the process of knowledge production (Qu, 2019).

The development of knowledge production models has passed through three stages, namely Model 1, Model 2, and Model 3, in terms of knowledge systems, knowledge production methods, stakeholder groups, and knowledge perspective orientation. The development of disciplines has also gone through four forms: single-disciplinary, multi-disciplinary, interdisciplinary, and transdisciplinary (Xie, 2012), based on the three dimensions of knowledge systems, disciplinary paradigms and methods, and academic communities and value groups of disciplines. The modern transformation of knowledge production paradigm, the complexity, contextuality and diversity of knowledge production have broken through the traditional disciplinary knowledge production framework and expanded the traditional disciplinary connotation, and knowledge production across disciplinary boundaries and disciplinary organization with heterogeneous organizational boundaries have become the main forms.

As the field and carrier of university knowledge production, the knowledge production model is a key factor in determining the quality of the disciplines. The knowledge production model of universities is undergoing a major transformation from Model 1, which pursues academic excellence, to Model 2, which focuses on problem solving, to Model 3, which highlights collaborative innovation. This has given rise to multiple logics of political, public and competitive disciplinary development, and has led to new characteristics of the discipline such as organizational integration, institutional openness, knowledge integration and cultural inclusiveness (Bai, 2020). Discipline construction should focus on two dimensions of discipline knowledge production capacity and discipline organization system, strengthen discipline culture construction, and make discipline construction reach first-class level through demand-led and innovation-driven (L. B. Wu et al., 2017).

In order to innovate discipline construction, organizational innovation is the key. Academic organizations are the planners and executors of knowledge production, and their organizational structure and status directly restrict and even determine the knowledge production capacity of academic organizations. The long-standing hierarchical management model of "university-school-department" and the academic development organization model centering on academic authority, which are formed under the domination of both administrative and academic powers,

have seriously hindered the innovation of knowledge production. The change of knowledge production mode calls for comprehensive innovation of disciplinary organization.

To achieve comprehensive innovation in disciplinary organization, it is crucial to build a three-dimensional, matrix-type disciplinary organization structure, so as to enhance the level of disciplinary organization and promote the interaction of different disciplinary subjects, the sharing of different disciplinary resources and the collaborative innovation of knowledge production. To this end, firstly, universities should dilute the boundaries of disciplinary organizations, build a diversified disciplinary organization based on a common organizational mission, establish a sense of collaborative innovation among multiple subjects, break through the boundary walls of disciplines and open to the society. Based on the common goal of solving major theoretical and practical problems, universities build a diversified disciplinary community that integrates "university, enterprise, government and public", and change the single scholar's community disciplinary organization structure. Secondly, we should reform the linear disciplinary platform system of "university-school-department" and build a matrix disciplinary platform system based on the cross-fertilization and collaborative innovation of disciplines and the corresponding resource input guarantee mechanism to improve the organization level of disciplines and promote the cross-fertilization, penetration and integration of disciplines (Bai, 2020).

2.4 Development of private higher education in China

In recent decades, with the development of private higher education in China, the number of research results related to the development of private colleges in China has been increasing. To address the research questions, we focus on the overall study of private higher education in China, case studies of private colleges, and the study of innovative development of private colleges in China.

2.4.1 Overall study

In the late 1980s, scholars began to pay attention to the issue of private higher education in China, mainly focusing on the study of necessity, i.e., why private education should be developed. Z. Y. Zhang (1987) proposed that private colleges opened up another way for the development of higher education, which had an inestimable effect on rapidly promoting the development of China's education and changing the face of China's education. Pan (1988) clarified the inevitability of developing private higher education in China from the perspective

of governmental decision making, which triggered the research and attention to the field of private higher education in the education sector. Scholars, such as G. Z. Qin (1988), Cheng and Ming (2009), Y. T. Wei (1989), and D. P. Zhou (1989), have also written about the importance of developing private higher education in China from the perspective of historical and international comparison. Y. W. Zhou (1989) pointed out that private higher education has made up for the shortage of state-run education in cultivating practical talents and has produced social benefits that cannot be underestimated. Z. Du (1993) compared private higher education in developed countries such as Europe and the United States and some developing countries, and pointed out the necessity of developing private higher education in China.

In the 21st century, the research results on the overall development of private higher education in China have expanded into more directions.

Overall development. Scholars have explained the importance of developing private higher education from the perspectives of social needs, economic development and historical roles, introduced the overall development status of private higher education, pointed out the problems of private higher education, and made predictions and prospects for the future development of private higher education (W. Hu, 2000; W. Wu, 2002; G. S. Chen, 2001; Liu, 2002; Xu, 2005; Pan, 2005b; Wu & Lu, 2008; J. Fang, 2003; X. T. Fang, 2016; N. Wu, 2013; X. Wang, 2014; H. T. Zhou & B. L. Zhong, 2014; Que et al., 2019).

Regional studies. Scholars focus on the development of local private higher education in China, analyzing the historical, economic, social, and institutional factors that contribute to its development, pointing out its problems and future development directions, and giving policy recommendations (L. J. Du, 2018; Liang, 2002, 2003; J. Zhao, 2007; S. C. Chen & Fu, 2002; J. R. Guo, 2003; Q. R. Wang, 2012; H. F. Wei, 2019).

Orientation. The orientation of private higher education is mainly reflected in the school operation. The orientation of private colleges is mainly focused on the goal, level and talent cultivation. Yuan (2005) proposed that Chinese private colleges should always aim at the latest trend of education reform, seek development by competition, find positioning by characteristics, establish education marketing awareness and market-oriented operation mode, and promote the rapid, stable and healthy development of Chinese private colleges. P. Zhu (2006) made a detailed discussion on the reasons, main subjects and specific practices of private colleges. R. Wen et al. (2008) analyzed the problems in the orientation of private colleges from four aspects, namely, the purpose, scale, level and disciplines of private colleges, and then put forward the strategy of transformation and orientation of private colleges. According to the demand of society for talents and the realistic conditions and advantages of private colleges, L. Y. Hua

(2009) defined private higher education as teaching undergraduate college, teaching application-oriented specialist college and vocational-technical specialist college. X. J. Zhao (2014), starting from the problems in the positioning of private colleges, applied the theory of positioning and concluded that private colleges should find the right positioning from the direction of school development, advantageous disciplines, faculty team and talent cultivation goals, so as to form the core competitiveness, which can stand out among many private colleges and create their own brand of higher education.

According to Ke and Zhang (2013), the development orientation and characteristics of private colleges are strategic issues for development, which play a directional and global role. The market orientation of private colleges in China is very obvious. They try to meet the market demand, allocate resources according to the market mechanism, and set the structure of talent cultivation as "characteristic + popular". It is necessary to further improve the active policy of private higher education development, promote the scientific orientation of private colleges, and promote the overall improvement of the development quality of private colleges.

Property rights. Pan and Hu (2002), Ke (2002), Pan and Hu (2002), Pan (2005a), J. Song (2005), Y. M. Cai and Song (2015), B. Guo (2018), Z. Xiong and Deng (2018), mainly focus on the issue of property rights of private higher education, analyze the reform of property rights system of private higher education and its related issues of cost, profit, and profitability, and put forward persuasive policy motions on this basis.

Comparative Studies. M. Han (1995), Wu (2003), X. J. Zeng (2004), S. H. Liang and Zheng (2013), Jia (2013), L. Hong (2013), H. Y. Yang (2014), Xia (2018), W. T. Tan (2021), focus on the comparison between private higher education in China and public higher education in China and private education in foreign countries. The scholars try to analyze the differences in the development of private higher education, and find out the experiences that can be learned from the development of private higher education in China and the corresponding countermeasures.

Internal management. Y. Q. Liu and Sun (2004), Y. L. Wang (2014), L. Z. Zhao (2005), Kong (2004), Xu and Zhou (2005a), J. X. Chen (2014), discussed the internal management issues of private higher education institutions, including leadership, operation mechanism, faculty construction, student learning and management, curriculum and specialization, teaching management and quality assessment.

Laws and policies. In reality, the support and protection of private colleges by Chinese policies and regulations still need to be improved. D. H. Xu et al. (1993) suggested that it is important to implement the Provisional Regulations on the Establishment of Private Higher

Education Institutions to promote the healthy development of private higher education institutions. L. M. Wang (2000) suggested that the Law on Private Higher Education should be enacted to regulate the healthy development of private higher education in China through legal support. Wu (2001), through empirical analysis, pointed out that many operational mechanisms of private higher education in China still lack the guarantee of relevant laws and policies, and its development is still subject to a certain degree of discrimination, and the policy environment for the development of private higher education should be further improved.

From the perspective of economics, F. Q. Yan (2005) pointed out that the government should make comprehensive and reasonable use of various policies to manage and control private education, and make a distinction between profit-making and non-profit-making private education institutions and treat them differently. Z. Y. Li and Tang (2005) pointed out that since the Reform and Opening up in China, the construction of private higher education policies and regulations in China has gradually been on the right track, and has basically established the legal status of private higher education, set up the legal system of private higher education, and clarified some major policies such as property rights ownership.

As the organizer of private colleges, J. B. Zhang (2006) researched on the issue of government policy funding. He believes that government funding for private colleges is not only helpful to strengthen the government's management responsibilities, but also beneficial to the development of private colleges in the direction of public welfare, and proposes the main initiatives that our government can learn from international development experience to support the development of private education. Lan and Zeng (2014) analyzed the problems of the private higher education system from the necessity of improving the system of regulations, and made some suggestions to improve the construction of the private higher education system.

Z. Wang (2014) pointed out that the development of private higher education depends on the support of relevant national policies and regulations, and the standardization of private higher education, education level, education quality, and construction standards all need the restraint of relevant national policies and regulations, and from the spirit of education development, based on the understanding of private higher education and the development of relevant policies and regulations, the development of policies and regulations of private higher education is discussed. Ding (2018) points out that many laws and regulations or policies on financial support for private colleges have been introduced from the central to local levels, but a more complete framework of financial support system has not been formed, and there are still many gaps and deficiencies in the financial support system for private colleges in China, both in terms of substantive and procedural laws. C. L. Zhang (2019) analyzes the contribution of

private colleges to society from the perspective of "public interest" and draws on feasible public financial support systems or policies at home and abroad to study the construction of a public financial support system and financial policies that are conducive to the sustainable development of private colleges.

Development strategies. Private higher education, as a product of China's higher education system reform, has become an indispensable part of China's higher education development. Y. M. Han (1999) suggests that the development of private higher education in China involves not only the optimization of structure and scale of development, but also the management system and mode of operation. In terms of the mode of operation or the trend, in addition to encouraging and supporting the establishment of private colleges in general, several new modes of operation should be explored. Liu (1999, 2002), through the macro background of private higher education development, theoretically analyzed and empirically described the development modes of private higher education in China from both theoretical and practical levels. According to the different modes of capital investment and school operation, the founding and development of private colleges in China are divided into six main models. Although different models have different advantages and limitations, they all show the active adaptation to the market and effectively use the market mechanism to promote the diversified development of private colleges. Xu and Zhou (2005b) reviewed the development of science and technology majors in private colleges in China, analyzed the characteristics of their settings and the reasons for their formation, discussed the significance of developing science and technology majors, especially engineering majors, in private colleges to expand the development space, discussed the background, problems and challenges of the transformation of science and technology majors in private colleges, and made suggestions and countermeasures on how to develop science and technology majors in private colleges to further expand the development space. M. H. Zha (2014) adopts a new classification standard to classify the development model of private higher education, proposes the dominant development model of private higher education, the market-oriented development model, formed under the basic and special mechanisms of private higher education recovery and development, discusses the main challenges it faces, explains the problems it faces from a theoretical perspective, and looks forward to its future.

X. Q. Liu (2021) proposed that after higher education has entered the mass stage, private colleges must change to internal development with internal factors as the driving force and resources, and put more emphasis on school quality, school characteristics and reform and innovation, which has become an important way for their sustainable development. Y. M. Xiong and Huang (2015) proposed that the sustainable development of private colleges reflects the

interpenetration, influence, and reference of various development models. The practical impetus mainly comes from the continuous improvement of governance structure, comprehensive improvement of teaching quality, continuous improvement of development ability and gradual emergence of school characteristics of private colleges.

Discipline construction. The talents needed by society come from the cultivation of colleges and universities, so the majors set up by colleges and universities are the bridge between colleges and society. The rationality of school majors directly determines whether the cultivation of talents meets the needs of society. According to S. J. Xu (2010), China's universities do not take into account the development of regional economy in the setting of majors, which results in the imbalance between the establishment of majors and local economic development. At the same time, the exit mechanism of majors is not perfect or even non-existent in some universities. According to W. M. Li (2011), private colleges do not highlight their own characteristics in setting majors but blindly converge with public colleges and universities, and only pursue economic benefits of setting majors without paying attention to long-term development. A few of colleges and universities are eager to establish majors with low investment and quick results. The competition among private colleges intensifies the unreasonable setting of majors; the lack of autonomy in adjusting majors and the low ability to adapt to the market.

P. Yu (2013) analyzed the construction of specialties in private colleges in China from the new situation and found that there are the following problems: fewer majors are set up by themselves. The scattered and rapid setting of majors affects the construction of specialization. There is no distinctive faculty in ad hoc majors, and there is no training program for distinctive talents, moreover, there is no leader of professional construction. The construction of majors is not a loft in the air, and it needs to be based on the foundation of the university, the faculty and the economic development of the region. According to Z. F. Zhang and Li (2005), in private colleges, majors with long-term development should be the main majors, and only on this basis should popular majors be added appropriately. The specialties of the university should be the focus of the construction of majors, and the construction efforts should be increased. The setting of disciplines should be synchronized with the market demand in the same period to ensure its stability and prevent the phenomenon of roller coaster.

L. Chen and Guo (2013) pointed out that the construction of majors should be based on continuous research and constant attention to the current development of disciplines and the market demand of the current era. We should plan the construction of majors, adjust the existing majors appropriately, develop new majors with the times, and dare to innovate and develop

special majors; introduce leading majors, cultivate famous teachers, and build a stable teaching team; focus on the development of applied scientific research to improve the level of teachers' scientific research; strengthen the cultivation of practical skills and the construction of practical teaching system; improve the management level and create a good environment for the construction of majors. G. Y. Wang and Wang (2016) proposed that the strategies for discipline construction in private colleges under the perspective of the differentiation strategy should be: staggered definition of training objectives, implementation of differentiated training modes, construction of characteristic "skills + humanities" curriculum system and strengthening of a differentiated practical teaching mode.

2.4.2 Case studies

One of the more comprehensive works dealing with case studies of private colleges is *The Global Education Industry: Lessons from Private Education in Developing Countries* (Tooley, 1999), which describes the state of private education in a dozen developing countries, discusses why, how, and where private education is developing, and what issues are impeding its development; and offers suggestions and advice on how to manage and nurture the private education sector so that it can develop appropriately. *The World Famous Universities Series* published by Hunan Education Publishing House introduces in depth the history, current situation, characteristics, achievements and experiences of 60 Chinese and foreign universities, especially the reforms, innovations and explorations made by each university in the areas of university system, faculties and departments, subject contents, teaching methods, school management, internal and external connections, according to the specific conditions of their countries and in order to meet the needs of the emergence of the new technological revolution and the future information society (Shang, 1987). Among them are many well-known private colleges and universities, such as Harvard University, Cambridge University, Waseda University, Katholieke Universiteit Leuven.

Regarding the development of private colleges in China before 1950, S. Tan (1995) conducted a case study of Yanjing University, Lingnan University, and Xiangya Medical College among Chinese church universities, providing a more in-depth account of the development of these universities, their distinguished presidents, and their policies and characteristics, as well as a brief overview of the beginnings of 21 church universities. Pan and Liu (1993) compiled historical data on China University, Fudan University, Nankai University, and Xiamen University, including school histories written by some contemporaries, documents

issued by the Ministry of Education, and speeches by the president. Z. Du (1993) selects West China Concordia University (before 1950) and Fudan University (before 1942) as case studies, focusing on the development of these schools, their achievements, and characteristics. Q. R. Song (2002) studied Xiamen University, Peking Concordia University, Nankai University, and Yanjing University as prominent private universities founded by the state and the church in different periods. In addition, several other works have been conducted on individual private universities, such as L. H. Zhang (2005), K. Zhang et al. (2003), Nankai University History Writing Group (1989), Y. Hong (1990). D. Y. Zheng (1994) briefly introduced several private colleges and universities other than church universities, namely, the private Sino-French University, the private Daxia University, the private Guangzhou College, the private Jiaozuo College, and the Shanghai Lixin College.

Regarding the development of private colleges in contemporary China, Q. Zhu (2004) conducted a case study of Beijing City College, focusing on its profile, enrollment, fees and teaching management. B. H. Wang (2006) suggested that Xi'an Eurasian University is one of the representatives of the "Xi'an model" of private higher education institutions, which is a typical example of independent innovation of private colleges and university. It has implemented a series of tactics to overcome the unfavorable institutional and policy environment and provide a "leading service" that is better than the general public higher education institutions. S. Z. Dong (2006) analyzed the construction of corporate governance system of the Shanghai Jianqiao College from a practical point of view, gave rational consideration to the key aspects and main problems of the construction of corporate governance system of private colleges, and put forward some countermeasures and suggestions to improve the corporate governance structure of private colleges in the light of the actual situation. Xu (2012) conducted a case study on the internal management system of private colleges, such as Zhejiang Shuren University, Heilongjiang Dongfang College and Jiangsu Sanjiang College.

Y. Wang et al. (2013) analyzed the innovation and entrepreneurship education of Heilongjiang Dongfang College in terms of promoting curriculum construction, optimizing teachers' resources, carrying out practical activities, and creating an educational atmosphere. K. B. Hua (2019) analyzed Wuxi Taihu College in several dimensions, such as market orientation, teaching linkage arrangement, and students' mentality, and made suggestions for the employment of private college graduates.

2.4.3 Innovative development

G. T. Yu (1999) proposed that the mechanism innovation is the source of vitality for the development of private colleges. Y. B. Zhou (2003) proposed that in order to achieve leapfrog development, private colleges must improve the quality of teaching and learning in innovation and make the characteristics in innovation. Innovation is not only the soul of national progress, but also the soul of survival and development of private colleges. X. Gao (2004) points out that in the process of developing private higher education, efforts should be made to ensure quality, create characteristics, and achieve innovation. Only in this way can the sustainable development of private higher education be ensured. Jin and Qin (2010) suggest that institutional innovation is the inevitable choice for the long-term development of private colleges in view of the severe challenges they face. X. Guo (2012) pointed out that for private colleges, to seize the major strategic opportunity of national economic and social transformation and innovation to develop and strengthen themselves, and to come out with a development mode with distinctive features and relative advantages is the only way and the most urgent task for private colleges. Establishing brand awareness, speeding up the pace of brand construction, creating and owning famous college brands with core competitiveness has become a strategic choice for the sustainable and healthy development of private colleges in China (Z. J. Yin & Lou, 2014). Lou (2015) emphasizes that under the new situation, strengthening internal improvement and focusing on innovation are the inevitable choices for the sustainable and healthy development of private colleges from the perspective of price control. X. T. Fang (2016) proposed the concept of "learning field" for innovative development of private colleges, focusing on the components and mechanisms of learning field in private colleges, thus providing a basic paradigm for analyzing and solving the innovative development of private colleges, local colleges and universities and even "first-mover" colleges and universities.

Private colleges should seize the opportunity and break through the bottleneck, integrate the Internet into the school's internal construction, talent training, school-enterprise cooperation, professional construction, teacher training and scientific research mechanism, improve the effectiveness and quality of innovation and entrepreneurship education, and explore the innovation-driven development path of private colleges in the Internet era (R. J. Zhang, 2018). Z. Luo and Jiang (2018) proposed that the supply-side reform of higher education is an inevitable trend of economic restructuring and industrial transformation and upgrading under the new normal. It should take advantage of national policy support, give full play to its own flexible operation mechanism, position itself scientifically, highlight its characteristics,

optimize its structure; consolidate its foundation, enhance its connotation, and focus on improving the quality of application-oriented talents cultivation; implement classification management, strengthen its investment, and standardize and guide private colleges to improve their operational efficiency. In the internationalization perspective, private colleges in China should focus on exploring the path of internationalization and innovative development, and carry out international cooperation and exchange in multiple forms and channels (S. S. Sui et al., 2019). Z. H. Sun (2021) puts forward some important points and suggestions for reform and innovation to meet the requirements of establishing modern university system and further demonstrate the vitality and strong vitality of private colleges.

2.5 Summary

In summary, we have comprehensively reviewed and sorted out relevant studies on open innovation, resource bricolage, knowledge production, and the development of private colleges in China around the research questions, summarizes and concludes the conceptual connotation, dimensional division, measurement methods, and research progress of each research variable. At the same time, we have summarized the shortcomings in previous studies and proposed further research ideas.

Open Innovation. Scholars have divided different types of open innovation according to the organizational subject, knowledge flow direction and time in the open innovation paradigm. In general, both inward-oriented open innovation and outward-oriented open innovation are important types of innovation, which reveal the knowledge flow in different directions in the process of collaborative cooperation between enterprises and external partners, and have been widely studied by academics. Meanwhile, the research on the connotation of open innovation, the relationship between open innovation and knowledge, technology and capability, and the impact of open innovation on performance, i.e., how open innovation affects the cultivation of knowledge, capability and technology within the enterprise and how to realize the mechanism of innovation performance is more in-depth, but the research on what characteristics of open innovation subjects, how open innovation subjects affect innovation performance, and the mechanism of their impact There is room for further research and exploration. From the research results, scholars' assessment of the implementation process of open innovation is mainly qualitative. Among the organizational subjects of open innovation, more attention is paid to enterprises, and case studies of open innovation in non-enterprise organizations are rare.

Resource bricolage. The research methods of resource bricolage have gradually expanded

from theoretical analysis and case studies to empirical studies and case studies in parallel. At present, there are relatively more studies on the effect of resource bricolage, but they are mostly limited to the research on the positive effect of resource bricolage, and the research on the negative effect of resource bricolage and the dynamic research on the effect of resource bricolage are yet to be strengthened. Among the antecedent influencing factors of resource bricolage, scholars can strengthen the research on team, network, and system, in addition to continuing the research from both individual and organizational aspects. The existing literature on the drivers of resource bricolage mainly focuses on organizational factors and individual factors, and future research can continue to strengthen the study of these two drivers and also expand to team, network, and system aspects. The research on the situational factors of resource bricolage is mainly carried out from three aspects: organizational, team, and environmental factors, and future research can also be extended to individual influence factors. At the same time, the research on resource bricolage can be extended to other types of entities, besides the resource bricolage behavior of state-owned enterprises, large and medium-sized enterprises, and family enterprises, for example, few case studies have been seen in private colleges in China. In addition, there is relatively little literature on the mechanism of resource bricolage, and there is still much room for future research, for example, on business model innovation, opportunity identification, entrepreneurial orientation, knowledge management, social capital, and many other aspects to expand the research on the mechanism of resource bricolage. In particular, it should be noted that China, as the world's most populous country, has been relatively scarce in terms of resources per capita. Therefore, in the Chinese context, there is still much room for research on resource bricolage behavior.

Knowledge production. From a global perspective, scholars have tested, extended and expanded the theoretical framework of knowledge production models by applying case or empirical methods in their research methods. In terms of research contents, they have covered both theoretical and practical research, and the scope of research involves colleges and universities, society, and institutional arrangements, forming a relatively complete research system of knowledge production. In contrast, the current research on knowledge production models in China is mainly in applied research, i.e., it mainly applies the theoretical framework of Model 2 and Model 3 to study the impact and changes of the new model of knowledge production on Chinese universities, especially public universities, in various aspects such as teaching, research and management. The research questions will be further investigated in the following areas:

The knowledge production subjects in Model 2 and Model 3 include not only universities

but also more and more new types of knowledge production institutions. Therefore, the research subjects should be extended to all links in the knowledge production chain, especially focusing on some new types of knowledge production institutions oriented to application contexts, such as private colleges in China. On the one hand, their roles, functions, organizations and impacts in the new model of knowledge production are studied. On the other hand, comparative studies can be conducted on the knowledge production activities of these new institutions with those of traditional institutions such as universities.

The new mode of knowledge production is closely related to the transformation and development of Chinese universities, the reform and development of Chinese higher education, and the construction of China's innovative country. How to produce more new knowledge to meet the urgent needs of national and social development and make up for the shortage of the current knowledge production activities is the value of the research on the new mode of knowledge production. The research should not be limited to the university itself, but should be combined with the innovative development of the country in order to reach the corresponding height and help the development of Chinese higher education and the early realization of an innovative country.

The development of private higher education in China. The research is no longer confined to the field of education, but has integrated the multidisciplinary perspectives of management, economics and ecology. The number and scale of researchers involved in the study of private higher education are large, including the leading experts and scholars in the field of higher education, investors in private higher education, founders and managers of private higher education institutions, and a group of young and middle-aged researchers trained by higher education institutions. The research base has been continuously improved and the research results have been enriched.

However, there are still shortcomings in the existing research. Firstly, the development strategies and countermeasures of private colleges based on static development environment are questionable whether they can comfortably cope with the dynamic and complex competitive environment. Secondly, from the viewpoint of research themes, policy and theoretical researches are the majority, while practical and empirical researches are less, and the existing research results mostly propose specific countermeasures for the problems, lacking overall, three-dimensional and comprehensive in-depth researches. Thirdly, there is a lack of scientific investigation and research in case studies, a lack of in-depth analysis of private colleges, and a lot of knowledge about private colleges still remain at the perceptual level, which easily causes "unclear problems and unknown situations" and affects the judgment on the development status

and problems of private colleges.

Therefore, under the research premise of the dynamic environment that Chinese higher education is moving from the mass stage to the universal stage, it is necessary to increase the empirical research on private colleges. Through in-depth research on private colleges, scientific sampling and preparation of research tools, scientific data and real cases are used to enhance the scientific nature of research on the development of private colleges, and discover and refine the achievements and experiences of the development of private colleges. This is not only of great theoretical significance for the research of innovative development of private colleges, but also of great practical reference value for guiding the further reform and development of private colleges in China.

Based on the above discussion, we propose a theoretical conceptual framework for the subsequent study based on the literature review.

1) In the context of resource constraints, private colleges in China can achieve developmental performance in knowledge production based on the knowledge production Model 3 through open innovation.

2) Resource bricolage is an important mediating variable for the open innovation performance of knowledge production achieved by private colleges in China.

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Chapter 3: Research Methods

This study focuses on how a private college in China break through internal and external resource constraints and achieve innovative development, as well as its growth mechanism, key elements of innovation structure and interaction mechanism under the real situation of the development of Chinese higher education from mass to universalization. Since the related research is still in the early descriptive and non-standardized stage, and we focus on the question about “how was it done”, we adopt a case study design and an inductive construction method based on grounded theory.

3.1 Case study

Case study is a much used research strategy. Eisenhardt (1989) argues the case study as a way to discuss why and how questions, mainly through deep descriptions of situations to state and explain phenomena in reality, and thick descriptions to build a holistic picture. Yin (1994) argues that a case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Researchers need to draw lessons from a large body of evidence and data sources, and then discover the underlying patterns. Siggelkow (2007) describes the case study as a talking pig, requiring the researcher to describe the case in depth and to express it vividly and graphically as a story, so that the particular phenomenon can stimulate the reader's excitement and discernment.

Based on the research task, Scapens (1990) categorized case studies into five types: descriptive case studies, illustrative case studies, experimental case studies, exploratory case studies, and interpretive case studies. Distinguished by the different ways of use, Yin (1994) argues that quantitative analysis of large samples uses statistical imputation to process the data, while case studies use analytical imputation. C. H. Chen and Liu (2010), on the other hand, emphasize the adaptability of the case study method, pointing out that case study, as a systematic and holistic research strategy, should be judged scientifically not on the basis of qualitative or quantitative analysis, but whether it is suitable for in-depth research. In response to the challenge of insufficient process, conclusion validity and reliability of the case study, Q. Tang and L. H. Yang (2016) gave the case study method to construct theories and develop

theories as the goal, using both empirical and non-empirical methods to analyze the relationship and conclude that validity and reliability coexist.

As can be seen, case studies are closely related to and integrated with reality, and the theories generated on this basis are often novel and special, and empirically valid. Through typical cases, we can discover or explore the general laws and particularities of things, and then derive conclusions or new research propositions. The case study not only allows for the description, explanation and in-depth exploration of complex management phenomena and problems, but also place particular emphasis on the contextual element, which gives a whole picture by highlighting processes, explaining relationships and telling stories through the context (Dyer & Wilkins, 1991). We focus on the revelatory rather than the representative nature of cases because unique cases often provide researchers with new, critical, and valuable insights that suggest directions for deeper research (Eisenhardt & Graebner, 2007). By uncovering revelatory cases, the findings can also inspire other organizations if new concepts are developed and process mechanisms are abstracted and condensed (Siggelkow, 2007).

3.2 Grounded theory

Despite its richness and potential for discovery, qualitative research has been criticized for its frequent lack of academic rigor. Glaser and Strauss (1967) proposed the grounded theory, arguing that new theories could be based on careful observation of everyday real life and the observer's own understanding of events, i.e., the object of study could be interpretive realities. Interpretive realities may not be completely objective, but they are also important for understanding human behavior and forming new theories (Glaser & Strauss, 1967). The introduction of grounded theory bridged the awkward gap between theoretical and empirical research (Glaser et al., 1968), allowing for a breakthrough in qualitative research methods.

Grounded theory offers a compromise between extreme empiricism and complete relativism, proposing a set of systematic data collection methods to aid theory construction (Suddaby, 2006), and emphasizing the importance of constant comparison and theoretical sampling. The term "constant comparison" here refers to the synchronization of data collection and analysis, and the continuous refinement and revision of theory. In contrast to positivists who separate data collection and analysis, grounded theory suggests that data collection and theory formation should be an interactive process. It is a continuous cycle of "collecting data - forming theory - collecting data again - refining theory". The idea of constant comparison requires that when a researcher discovers new issues while collecting data, he or she should

seek new data from other sources of information to verify them, and constantly compare the newly collected data with the categories that have been formed based on existing data. When new categories emerge that are different from the existing ones, the theory is revised and the new categories are incorporated into the theory. This process is repeated until the theory reaches saturation. Theoretical saturation means that the newly collected data can be generalized by existing categories and no new categories are created. Theoretical sampling is the process of determining the next step in data collection based on the currently constructed theory. Grounded theory does not require rigid adherence to a priori assumptions, but rather assumes that new data may generate new theories (Glaser & Strauss, 1967).

As an important and scientific methodological approach to qualitative research, grounded theory has been sought after by many scholars for its scientific rigor, validity, and legitimacy and has been applied to different disciplines (Glaser & Holton, 2007). The reasons for this are twofold: first, quantitative research is mainly applicable to examine the relationship between identified variables, but it lacks identification and explanatory power for phenomena that are not clearly defined or cannot be derived from established theories, which requires qualitative research to first define or give a theoretical framework for the phenomenon to be studied. Second, since its inception, grounded theory has been valued for its more scientific process and practice-oriented methodological features (Suddaby, 2006).

The differences between scholars in different fields due to their disciplinary backgrounds, research paradigms, and research questions have led to many differences and evolutions in the practical application of rooting theory. The differences between scholars in different fields due to their disciplinary backgrounds, research paradigms, and research questions have led to many differences and evolutions in the practical application of grounded theory.

Based on the "value neutrality" principle of classical positivism, Glaser (1978) emphasized that the theory should come from data independency of the researcher. Therefore, the researcher should not have any theoretical preconceptions or value judgments prior to the study and should keep his or her "pure mind" to discover the theory from the raw data through layers of coding, which is known as the classical grounded theory. However, other scholars, such as Strauss (1987), argue that the researcher is bound to have pre-existing preconceptions before embarking on any research and it is right to try to avoid "preconceptions", but it is too idealistic to consider the researcher's mind as a "blank slate" in reality. Instead, we should emphasize the rational use of personal experience and the introduction of new concepts and methods, such as "Dimensionalization", "Axial coding" and "Paradigm modeling", to program the grounded theory (Corbin & Strauss, 1990), leading to the creation of the programmatic grounded theory

(Corbin & Strauss, 2008). Further, Charmaz (2006) argues that neither data nor theory are discovered and that the researcher is part of the world of study and the data collected. Through the researcher's engagement with the past and present, and interaction with people, perspectives, and research practices, the researcher constructs his or her own grounded theory. It is known as the constructive grounded theory.

In general, in its basic manifestation, grounded theory is a set of systematic methods and guidelines for data collection and analysis. In its basic logic, grounded theory emphasizes the theory construction from empirical data (Strauss, 1987). In its basic methodology, grounded theory uses a generative inductive approach to continuously extract core concepts and categories from raw data. In its basic characteristics, grounded theory emphasizes that theory is grounded in empirical data. However, the final theory constructed should not be limited to its empirical nature only (Y. Wu et al., 2016).

3.3 Case selection

Qualitative research often uses purposive sampling to select cases that more optimally collect information to answer the research questions (Saunders et al., 2019). The sample case selected for this study followed the principles of theoretical sampling (Eisenhardt & Graebner, 2007). Since our research question is mainly concerned with how to achieve innovative development in a private college in China under resource-constrained conditions, we choose Tianfu College (hereinafter referred to as TFC), one of the private colleges in China, as our research case based on the following case selection criteria.

Firstly, the sample case must be homologous to the target object of the study. TFC was established in 2006, located in Sichuan Province, and is a private college developed in the context of the development of Chinese higher education from mass to universalization.

Secondly, the sample case should have typical empirical development performance. After more than ten years of development since its establishment in 2006, TFC now has three campuses in Chengdu, Mianyang and Deyang in Sichuan Province, covering a total area of more than 127 hectares; as of December 2021, there are more than 28,000 students enrolled and more than 1,200 faculty members.

TFC adheres to the ideas of internationalization, informationization and integration of industry and education, based on the advantages of economics and management disciplines, makes full use of information technology to transform traditional majors, actively opens majors urgently needed for regional economic development and people's livelihood, and continuously

promotes crossover, integration and innovation of majors, forming a development pattern of disciplines and majors that are mutually supportive, cross-penetrating and coordinated.

TFC vigorously promotes the process of internationalization of curriculum and course system to cultivate first-class applied talents with solid professional knowledge and humanities, proficient in information technology, international vision and innovative thinking, and suitable for the needs of modern social development and economic construction.

The goal of TFC is to build a university with strong talents and academic excellence, based in Sichuan, facing the west and radiating the whole country, and striving to build TFC into a national first-class applied undergraduate institution with characteristics and influence.

In February 2017, TFC passed the ISO9001:2008 certification audit. In the 2021 China Alumni Association (www.cuaa.net) university rankings, TFC is ranked 20th among more than 730 private colleges nationwide. TFC has successfully ranked among the first-class private colleges in China.

Thirdly, the sample case should provide detailed evidence of innovative development and meet the requirements of data availability and research convenience (Eisenhardt, 1989). All is data (Glaser & Hon, 2007). All can be used as the raw data for grounded theory, including interviews, reflections, texts, literature, observations, questionnaires, memos. Through the systematic analysis and step-by-step induction of the raw data, we eventually have to abstract the theory based on empirical facts. The data and information related to TFC's development over the past ten years, including official publications, media reports, official website, WeChat public website, school yearbook, and annual summaries of departments, are available from several public sources, which also provide data support for this study.

3.4 Research subjects

Universities and colleges are the birthplace of knowledge production (Bai, 2020). Disciplines are both the basic building blocks of universities and colleges and the organizational structure around knowledge production (L. Wu et al., 2017). Discipline construction is the active behavior to promote the development and enhance the discipline according to certain value goals (D. X. Zhang, 2016). The construction of disciplines is the process of knowledge production (Qu, 2019).

The fundamental purpose of running a university is to cultivate high-quality talents, and at the same time, produce high-level scientific research results. Disciplines are the basis and reliance of talent cultivation and scientific research. In this respect, they are the foundation and

condition of running a university. The results of discipline construction are reflected in the promotion of high-quality talent cultivation and high-level scientific research output (D. X. Zhang, 2016). Therefore, the development pattern of discipline construction will also map the development characteristics of its college or university. Therefore, the development pattern and details of the discipline construction will also map out the development characteristics of the university or college itself.

Since its establishment, TFC has achieved significant development performance in discipline construction. By 2020, TFC have a total of 38 undergraduate majors and 29 junior college majors (Figure 3.1).

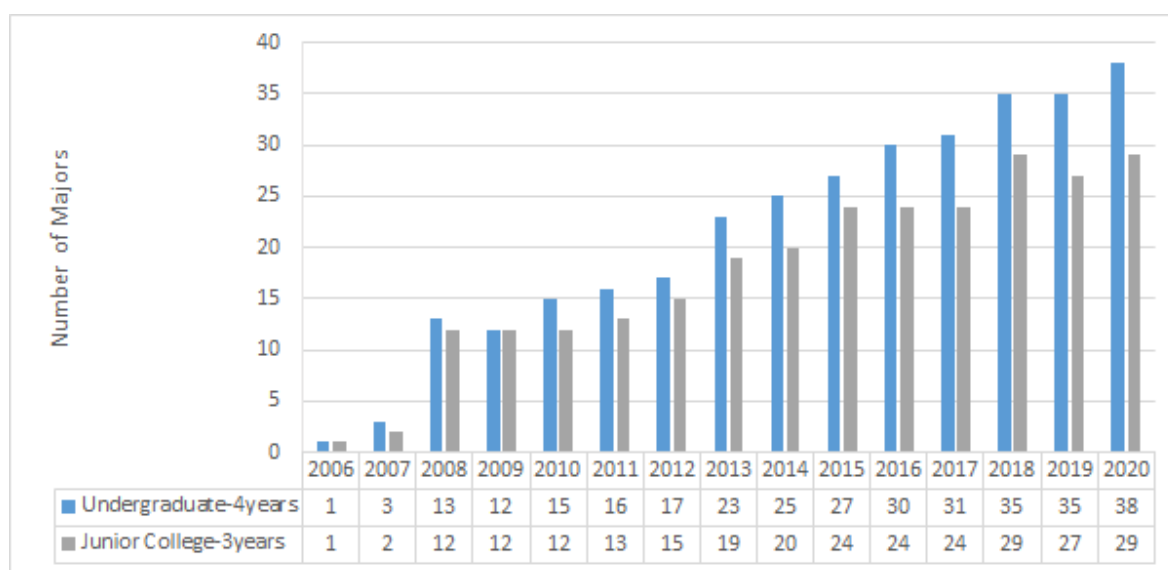


Figure 3.1 Statistics on the number of majors in TFC (2006-2020)

Source: TFC’s Annual Basic Information Statement of Higher Education Institutions from MOE

Besides the overall scale, TFC has also achieved more outstanding innovative development performance in different levels and contents of discipline construction, including curriculum development, new major creation and major cluster building. We selected three of these specific examples to form the set of research subjects for this study: the Oracle Club (OC) courses, the major of Private Banking (PB) and the major cluster of Health and Nursing (HN). From the perspective of a TFC discipline builder, we compiled the important events and activities in the discipline construction of the above three examples to form a conceptual map of the TFC discipline construction process (Figure 3.2).

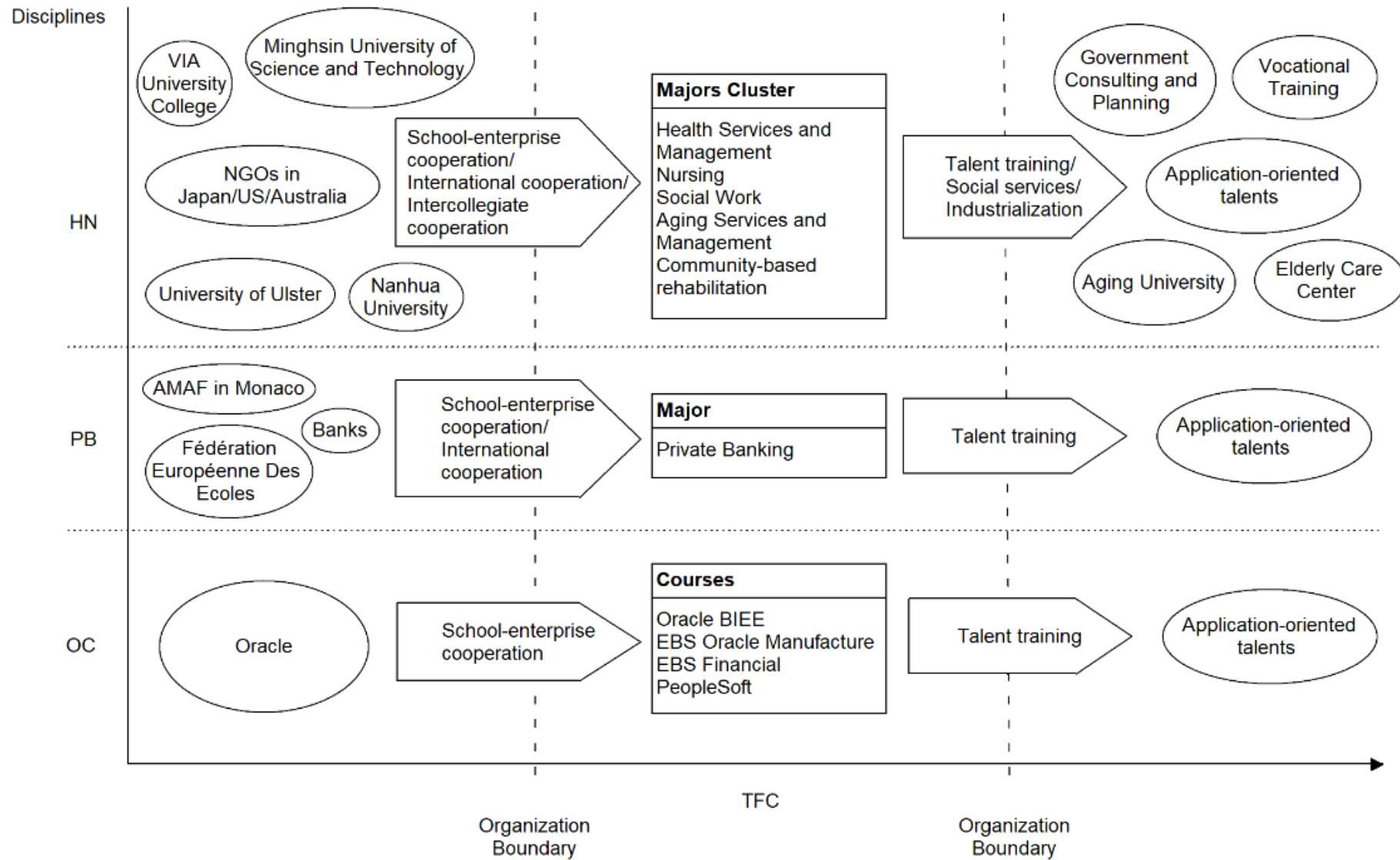


Figure 3.2 TFC disciplines construction process

3.4.1 Courses of Oracle Club (OC)

In the 21st century, China's management consulting industry, especially the IT consulting industry, is on a fast track of development. There is a growing shortage of talents with cross-disciplinary backgrounds who understand both management and IT technology, which seriously lags behind the development of the industry (W. J. Luo & Sun, 2020).

In response to the huge market demand for management consulting talent development, Yang Dayou (YDY), then Vice President of TFC, and Yao Jin (YJ), then Director of the Center for Economics and Management, took the lead and joined forces with Oracle to establish the Oracle Learning Group at TFC in 2006 with the strong support of TFC. Oracle is responsible for providing support worth 23 million RMB (about \$2.7 million), including software licenses, product support, Oracle database upgrades, Oracle Application Server, Oracle development tools, and Oracle E-Business Suite. TFC faculty, led by YDY and YJ, are developing the courses at TFC based on their professional interests and with the support of Oracle Academic Initiative (OAI).

In 2007, with the strong support and promotion of OAI, TFC and Oracle officially established the Oracle Club in TFC (TFC-OC), which is modeled on the Oracle Learning Group model, with Oracle providing Oracle products and technology platforms for research and learning. The club being highly autonomous by students for a combination of independent research and team support with the off-site support of instructors. Teachers and students learn, grow and develop together, forming the OC spirit of openness, innovation and sharing.

From 2011 to 2021, TFC-OC and OAI have successfully cooperated to hold eleven Enterprise Management IT Solution Competitions with the vision of discovering applied talents and sending useful talents to the society. Through the competition, faculty and students in TFC-OC not only tested the results of their learning in the operation cycle, but also discovered outstanding talents who became the core team members of TFC-OC.

TFC-OC now offers courses in Oracle BIEE, EBS Oracle Manufacture, EBS Financial, PeopleSoft, PeopleSoft Secondary Development, Machine Learning, etc. for all TFC students and faculty.

At present, among nearly 20 colleges and universities in China that have OC, TFC is the only private college. TFC-OC has become a model for the operation of OCs in colleges and universities nationwide (Pu, 2012).

3.4.2 Major of Private Banking (PB)

The first private banking institution in mainland China was established in March 2007. In order to fill the gap in the training of private banking talents in Chinese colleges and universities, TFC signed a cooperation agreement with Association Monégasque des Activités Financières (AMAF) in January 2012, based on the framework of Fédération Européenne Des Ecoles (FEDE) to create the first private banking major in Chinese colleges and universities.

The PB major introduces the Monaco private banking talent training system, and seamlessly integrates the 550-hour private banking professional courses of AMAF into TFC's existing talent training architecture. The professional courses include banking, securities, insurance, trust, fund, financial calculation, anti-money laundering, risk control compliance, private banking account management, etc., covering all areas of the high-end wealth management industry in all dimensions.

In addition to financial expertise, in response to the life preferences of the future target customers - high net worth individuals, the PB major focuses on strengthening students' workplace-specific quality training in addition to professional courses, offering fine arts courses such as wine tasting, golf advancement, luxury culture and styling design to help students cope with future workplace competition needs with ease.

Based on the international standard training model of full English teaching, the entire professional faculty of the Private Banking program is mainly composed of five European bankers selected by AMAF and executives from Chengdu's financial industry with overseas study experience selected by TFC.

At the same time, PB major builds a first-class real-world training environment through the construction of domestic and international school-enterprise cooperation networks, and strengthens the seamless integration of teaching and practice. Unlike general majors who require students to start their internship from the fourth academic year, PB major are required to start their internship at domestic and international cooperative financial benchmark entities from the winter break of their junior year, thus ensuring the achievement of high-quality employment goals.

In October 2012, TFC successfully held the "2012 Chengdu High-end Wealth Management Forum".

In November 2014, TFC established the Private Banking Institute, which is responsible for coordinating the construction of the PB major.

Starting from 2016, all PB students can apply for a one-year exchange program in Geneva,

Switzerland in their fourth year of study.

Since 2012, PB major has trained more than 100 professionals who are active in various branches of high-end wealth management. As the first education program in Chinese colleges and universities to train international talents in the field of high-end wealth management represented by private banking, the major has gained strong industry reputation and recognition, becoming a model of academy for private banking talents training in China (Xue & Yin, 2015).

3.4.3 Majors cluster of Health and Nursing (HN)

In November 2000, according to China's fifth census, there were 130 million people over 60 years old in China, accounting for 10.2% of the total population. China has entered an aging society. The development of China's aging career is relatively lagging behind, and there is a strong need for the training of health and nursing professionals.

Since 2010, TFC has started the study and research work on senior care and senior care education, and has visited Chinese Taiwan, Japan, the United States, the United Kingdom, Denmark, Australia, Thailand, France and Germany to study the senior care industry and senior care education and training. Since 2012, TFC has established teaching cooperation and academic exchange with Ming-Hsin University of Science and Technology in Taiwan, South China University in Taiwan, VIA University in Denmark and ULSTER University in U.K. TFC has visited 76 different types of senior care institutions and service organizations with typical representatives from Japan, U.S., Australia, Chinese Taiwan and China mainland.

In September 2012, TFC established the Institute of Aging Services and Management, and set up the major of Aging Services and Management (junior college level, 3 year).

In September 2013, TFC established the Institute of Social Work and set up the major of Social Work (undergraduate level, 4 year).

In September 2015, TFC set up the major of Community Rehabilitation (junior college level, 3 year).

In September 2018, TFC set up the major of Health Services and Management (undergraduate level, 4 year) and the major of Nursing (junior college level, 3 year).

In September 2019, TFC set up the major of Nursing (undergraduate level, 4 year).

Among the majors cluster of HN in TFC, the major of Aging Service and Management major has entered the project of "Quality Improvement Plan for Key Majors of Private Colleges in Sichuan Province", and the major of Social Work has been listed in the second batch of "Application Demonstration Majors in Sichuan Province", as well as the construction point of

first-class undergraduate majors in Sichuan Province. As of 2021, the majors cluster of HN in TFC has own over 4,000 students.

In addition to academic education, the majors cluster of HN in TFC also actively plays a social service function.

In November 2013, TFC initiated and hosted the first Western Senior Care Services Industry-University-Research International Cooperation Forum.

Starting from September 2016, TFC has been conducting vocational education and training related to health and nursing. As of 2020, 23 trainings have been offered, with a total of 1,140 participants.

TFC presided over the preparation of aging caregiver level standards in Sichuan Province.

TFC presided over the preparation of 5 local standards for aging care services in Mianyang.

TFC prepared the implementation plan and action plan for the reform and development of the aging service industry for Guizhou Province.

At the same time, the majors cluster of HN in TFC actively explores the path of industrialization to implements the integration of industry and education.

In March 2018, TFC established Tianfu Aged University, the only full-time university for the elderly in Sichuan Province, providing a diversified platform for aging education.

In June 2020, TFC established Tianfu Zhonghe Senior Care Center to provide healthcare one-stop senior care services.

In September 2018, TFC was selected as a leading higher education institution in Sichuan's health and nursing industry by *Huaxi Metropolis Daily* and *Huaxi Community Media*. Currently, TFC is one of the most influential colleges and universities in Sichuan Province in the fields of talent training, academic research and industrial cooperation in the senior care business.

3.5 Data collection

Data collection strategies need to match the research questions. Data sources for case studies include literature, archival records, interviews, direct observation, participant observation, and physical evidence (Yin, 2009). K. T. Ye (2006) categorized them into four types: interviews, observations, questionnaires, and archives. According to the originality of the data source, it can be divided into primary data and secondary data. Primary data refers to data collected and processed by the researcher in person for the first time, including interviews, direct observations, and indirect observations. Secondary data are data derived from surveys and scientific experiments conducted by others (commercial and government agencies, marketing research

firms, computer databases, etc.) and include documents, archival records, and physical evidence (Hox & Boeije, 2005)

For this study, we focus on the development practices of TFC in the field of knowledge production. To achieve this, we collected a wide range of primary and secondary data related to TFC based on a multi-source data collection approach (Eisenhardt, 1989) with multiple subjects and multiple pathways in order to form an evidence triangle (Yin, 2009) and reduce the bias of information sources.

First, we conducted semi structured interviews with key project leaders and project members involved in the aforementioned TFC discipline construction sample project (Table 3.1). Prior to the interviews, an interview outline was sent to the interviewees, and an online preparatory interview of no more than 10 minutes was conducted with each interviewee in advance to enhance familiarity and to confirm the formal interview time. During the interviews, one-on-one interviews were conducted with the interviewees to ensure that the interviewees did not influence each other. Each interview lasted about one hour. During the interview process, we asked the interviewees to provide detailed contact information for additional verification in case of missing or conflicting information. All interviews were tape-recorded. After each interview, the research team compiled and completed the interview transcripts within 36 hours based on the interview recordings. The interview transcripts were submitted to the interviewees for confirmation of their authenticity and completeness. After mutually confirmed by multiple research team members, they were coded for archiving.

Table 3.1 Basic information of interviewees

Name	Roles	Age	Job Title	Number of words recorded in the interview	Material Codes
YDY	Founder of TFC-OC, Former Vice President of TFC Co-founder of PB major,	56	Professor	9211	S1
TL	Former Director of the Institute of Private Banking, Dean of the School of Finance in TFC	37	Associate Professor	6478	S2
WZ	Head of the PB major	36	Associate Professor	3696	S3
CST	One of founders of HN major cluster, Former Director of the Institute of Aging Services Management, Vice Dean of the School of Health and Nursing in TFC	35	Associate Professor	5044	S4

The main open-ended questions from the interviews are presented in Appendix A, which focus on the origins of the discipline in question, important time points in the discipline, organizational factors in the achievement of the discipline's performance as observed from the

interviewer's perspective, and recommendations for next steps. The interviewers and informants were guided by the prepared questions rather than being rigidly constrained by them. Since this was an inductive study, some unexpected but interesting topics were also pursued.

Secondly, field observation is also an important source of data. The researcher himself started to work at TFC in July 2006, and he could observe the basic operation information of each secondary unit of TFC at close range, and understand the strategic decision of the knowledge production case, the theme of knowledge production activities and the related implementation process.

In addition to the primary data developed from semi structured interviews and field observations, secondary data obtained from multiple sources can also support scientific case study needs with greater objectivity and traceability (J. Q. Su & Liu, 2013). The researcher also valued secondary data collection by gathering information from internal sources including official publications, newspapers, journals, websites, social media, and internal sources such as school plans, internal meeting speeches, departmental annual summaries, and project submission materials related to the research questions, which were transcribed, coded, and archived. These sources contain data on TFC's development performance and descriptions of the research objects related to knowledge production from a third-party perspective (Table 3.2).

Table 3.2 Secondary data information

Category	Name	Source (Year)	Material Codes	
External information	Book	Education Informal Essay	Southwestern University of Finance and Economics Press (2012)	M1
		Education Perspective: A Preliminary Study on Education Reform of Tianfu College	Southwestern University of Finance and Economics Press (2012)	M2
	Reports	Make efforts to supply-side reform, crack the integration of education and industry	China Education Daily (2018)	M3
		Private Banking class, specializing in helping multi-millionaires to manage money	Chengdu Economic Daily (2012)	M4
	Papers	Exploration and practice of ERP practical teaching course system design	Out-of-School Education in China (2009)	M5
		Exploration of integrated talent training mode of industry-academia-research in ageing service	Scientific Research on Aging (2015)	M6
		Exploration and Research on Practical Teaching System Based on ORACLE ERP	Information Technology and Informatization (2017)	M7
		Research on Innovative	Education Modernization	M8

Category	Name	Source (Year)	Material Codes	
Internal information		Information Management Talent Cultivation Model (2017)		
		Discussion on Oracle Club Applied Talent Training Model under CDIO Mode	Teaching Method Innovation and Practice (2019)	
		Research on the cracking mechanism of the dilemma of university-industry-education integration in the context of application-oriented transformation	Heilongjiang Researches on Higher Education (2019)	
		Construction and Practice of Quality Assurance System of Talent Cultivation in Applied Universities under the Background of Integration of Industry and Education	TEACHER (2020)	
	Website	Oracle Club	Baidu	M12
		Tianfu College	TFC Official website	M13
	OC	Declaration Materials of Teaching Achievement Award of Private Colleges in Sichuan Province	2020	M14
	PB	Documents on the establishment of campus organizations and appointment of personnel	2014	M15
		Annual Summary	2014-2019	M16
		Introduced teaching materials in English	2012	M17
		Registration Form of Key Bases of Social Science Research in Mianyang City	2016	M18
	HN	Annual Summary	2016-2020	M19
		Documents on the establishment of campus organizations and appointment of personnel	2017	M20
		Official website		M21
	TFC	Video of the president's speech at the whole school assembly	2014-2019	M22
		School Development Plan (2016-2020)	2016-2020	M23
		Tianfu Spirit	2012	M24

3.6 Validity and reliability

In order to ensure the rigor and trustworthiness of the case study, both the validity and reliability of the study were examined.

Validity

This study collated and summarized the disciplinary building behaviors of TFC based on

the chronological order, and analyzed whether the open innovation theory, resource bricolage theory, and knowledge production theory matched the actual development data of disciplinary building, to ensure the internal validity of the study.

In response to the common needs of Chinese private colleges to break through the resource constraints and seek their own development, we use open innovation theory, resource bricolage theory and knowledge production theory to guide this case study, with the aim of exploring innovative development models that can be applied by other Chinese private colleges, to improve the external validity of this study.

Reliability

The interviewees in this study were all the persons in charge of discipline building instances in TFC. The information they provided is quite representative for discipline building work.

At the end of the In-depth Individual Interviews (IDI), we used participant testing to ensure that the information recorded was not misinterpreted by the interviewer by having the interviewees check that the interview notes were consistent with their statements. Three of the four interviewees felt that they did, while one (YDY) felt that some details needed to be added and added them accordingly.

In addition to the reliability enhancement measures regarding interview data collection, we adopted the triangulation (Patton, 1999) to further enhance the reliability of the study.

Methods triangulation: We used interviews, observations, and literature review simultaneously to collect data. Among them, the literature collected in this study was based on public publications, journals, authoritative media, official accounts, and official archived internal materials to improve the accuracy and authority of the data.

Data source triangulation: In this study, three different discipline building examples of TFC were selected for data collection, which is in line with the requirement that nested multiple case studies within the same case can improve the generalizability of research results (Yin, 2009).

Theory triangulation: For the collection of examples of discipline building in TFC, we explain multi-dimensionally through theories such as open innovation and resource bricolage.

Investigator triangulation: It is important to note in particular that since the researcher himself started working at TFC, in July 2006. This may have the advantage of long engagement for qualitative research and has facilitated the access to the internal literature of the research subjects. However, the identity of the researcher itself poses a serious risk of bias in this study. Therefore, this study minimizes the bias impact by investigator triangulation. We formed the research team. Other members of the research team, rather than the researcher himself,

conducted the interviews and compiled the initial data. Then, the two groups of research team members independently conducted data analysis and took the common results for the study.

In addition, we invited academic colleagues with extensive research experience to conduct peer review of the data collection and data analysis through the check by others method in order to further improve the overall reliability of this study.

3.7 Data analysis

In qualitative research, "it takes a creative leap of faith for any data to yield a theory, no matter how small" (Langley, 1999). The single case study should not only "tell a good story", but also strictly follow the data processing ideas and procedures to advance.

This study adopts a structured data analysis approach (Gioia et al., 2012) based on grounded theory to demonstrate the connection between data and new inductive concepts, and to form aggregated dimensions.

First, we summarized the raw data and performed initial data coding. We took the perspective and position of the TFC discipline builders and named the 1st-order concepts with the interviewees' terms (Gioia et al., 2012) to maintain the integrity of the 1st-order (information-centered) terms.

Second, in contrast to the theoretical foundation and literature review, we look at 1st-order concepts from a theoretical perspective, consider the deeper connotations under them, and abstract them into 2nd-order (theory-centered) themes with theoretical connotations.

Next, we classify and summarize 2nd-order themes and further aggregate and distill them into overarching theoretical aggregate dimensions. After that, we assemble the terms, themes and dimensions into a "data structure".

Based on the aforementioned work, we conduct a systematic and focused theoretical exploration and integration of the relationships between different concepts and themes of the same time sequence in order to form a theoretical structure. In the process of exploration, we first continuously update the case data and deepen the study of existing relevant research results. Secondly, we compare case data, existing literature and theoretical results, deepen our understanding, and iterate through the cycle until the theory and data are highly matched and robust results are presented.

Specifically for the coding work in question, we established case study groups. The members of the two groups each classified the raw material. Multiple key sentences were obtained through clustering of similar content. Then, the key sentences were analyzed and

repeatedly compared to the reference theory to form codes. The two groups reviewed each other's codes to ensure reliability between the codes. In the event of disagreement between the two coding groups, the disputed codes were presented to a non-coding faculty member of the case study team who made the final decision. Each coding step was repeated and refined until a consensus was reached.

3.8 Summary

This chapter first proposes a case study strategy and an inductive theoretical construct based on grounded theory based on the “Why” and "How" attribute of the research questions. Then, the strategic value of the case study for the research is further clarified by reviewing and discussing the definition, the classification of the research task, and the applicable research scope about the case study strategy. We further deepen the understanding of the scope of application of the methodology through the origins of the grounded theory, solving the target problem, the main points of the applicable steps, and the similarities and differences of the main theoretical schools. At the same time, the review based on the case study and grounded theory provides a benchmark for the criteria and operational specifications for case selection, data collection, and data analysis for this study.

Based on the research questions and according to the requirements of homology, typicality, data availability, and research convenience for case selection in case study, we selected TFC, one of the private colleges in China, as the research case. After more than 10 years of development since its establishment in 2006, TFC has achieved an impressive development performance and has been ranked among the top private colleges in China. In all aspects of TFC's development, TFC's discipline building is not only reflected in the growth of the number of majors, but also in better examples of innovative development performance at different contents and levels, including courses development, new major creation and majors cluster construction. We selected the courses development of Oracle Club, the major creation of private banking, and the majors cluster construction of health and nursing to constitute the set of research subjects for this study based on our research needs.

After clarifying the study case, we collected first-hand data through semi-structured interviews with relevant discipline building leaders and key teachers and field observations. Secondary data was formed by collecting publicly released books, newspaper reports, discipline construction papers, official websites and archived conference videos, development plans, declaration materials, annual work summaries and publicity materials related to the research

questions. Primary and secondary data together constitute the collection of raw materials for this study.

It was followed by a discussion of the validity and reliability of the study design. Firstly, we analyzed whether the relevant literature matched the data on the actual development of disciplinary building by organizing and summarizing the disciplinary building behaviors of the cases based on chronological order, thus ensuring the internal validity of the study. Secondly, by sorting and summarizing the existing literature, we initially explored the innovative development models that can be applied to other private colleges in China, so as to improve the external validity of this study.

Regarding the reliability issue, the reliability of the interview data collection was first enhanced by the representativeness of the interviewees and the elimination of misinterpretation of the interview data. The reliability of the study was then further enhanced by employing triangulation (Patton, 1999). Among them, the requirement of method triangulation was met by using interviews, observations and literature review simultaneously. By selecting three different research examples of TFC, the requirement of data source triangulation was achieved to enhance the generalizability of the research results. For the collection of discipline building examples, theory triangulation is used for multi-dimensional interpretation. In particular, the risk of bias in this study due to the identity of the researcher was minimized by Investigator triangulation. Moreover, the overall reliability of this study was further improved by the check by others method.

Finally, the raw material was coded around the research question, following the structured data analysis method (Gioia et al., 2012) to form 1st-order concepts, 2nd-order themes and aggregate dimensions, which were assembled into the data structure for subsequent research.

Chapter 4: Results and Discussion

4.1 Introduction

Based on the research methods discussion in Chapter 3, combined with the case study strategy and the structured data analysis method (Gioia et al., 2012), we obtain a data structure (Figure 4.1) consisting of three aggregate dimensions: knowledge production, resource bricolage, and TFC model, by analyzing the TFC raw material, which serves as the basis for the subsequent discussions in this chapter.

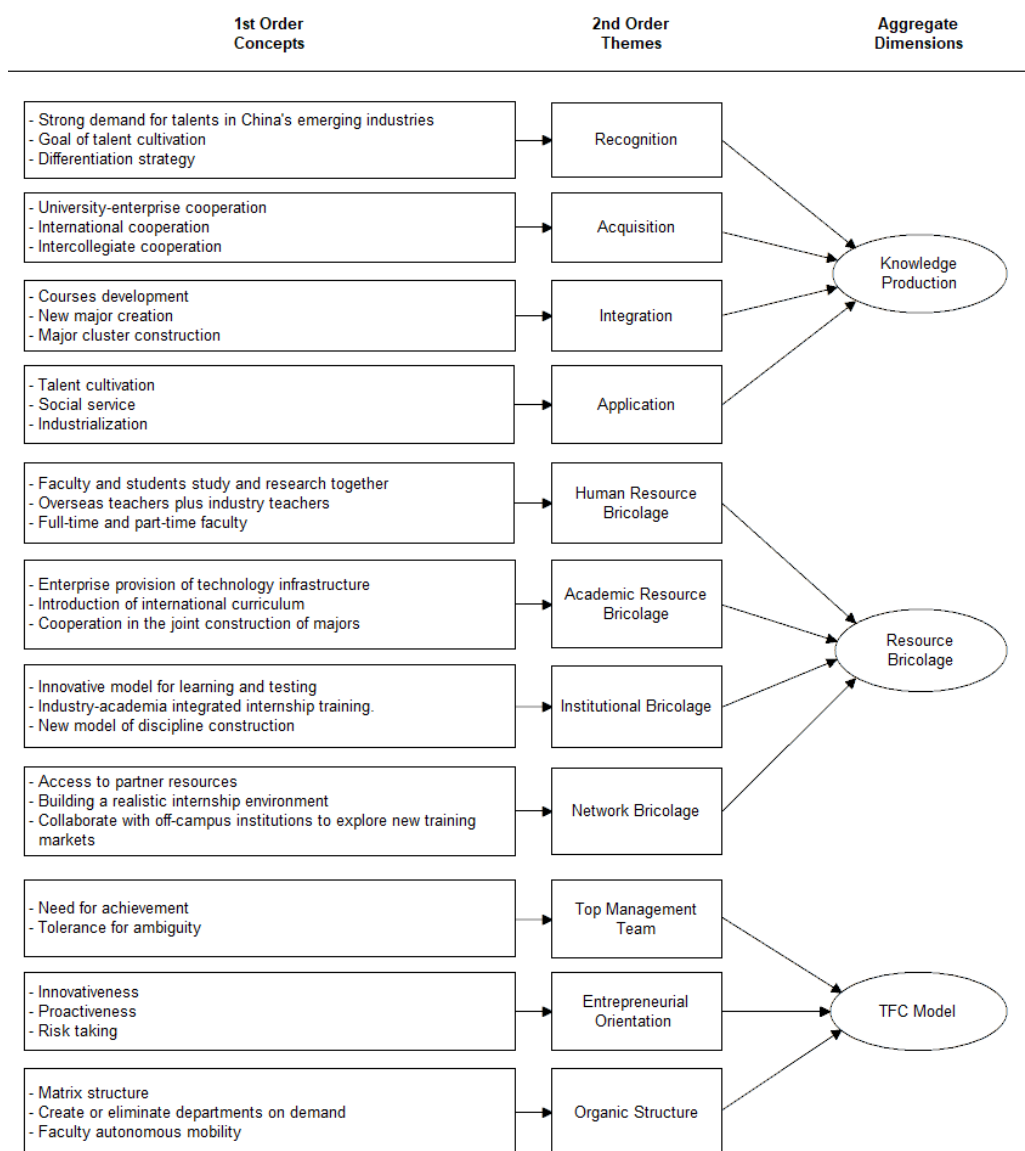


Figure 4.1 Data structure

In Section 4.2 we present the knowledge production process of TFC which is divided into four phases of knowledge recognition, knowledge acquisition, knowledge integration and knowledge application. Section 4.3 discusses the resource bricolage behavior in the process of TFC knowledge production. In Section 4.4 we further discuss what combination of organizational elements TFC uses to support its own open innovation development of knowledge production. Finally, Section 4.5 summarizes the main results found in the previous sections.

4.2 The Innovative model of knowledge production in TFC

Phase division is the basis for longitudinal case studies (Yin, 2009). By combining the process of different levels of discipline construction examples from courses development (OC), new major creation (PB) and majors cluster construction (HN) in TFC, we find that the innovative development performance of TFC in knowledge production increases step by step. Among its process elements, there are both similar inheritance of basic elements and differential development of individualized elements.

Based on the grounded theory analysis of data related to discipline construction examples in TFC, we find that the knowledge production process of TFC mainly includes four stages: knowledge recognition, knowledge acquisition, knowledge integration and knowledge application.

4.2.1 Knowledge recognition

The main task of the knowledge recognition phase is to search, discover or confirm the external knowledge that meets its own knowledge production needs among the external knowledge resources, which is the concrete manifestation of TFC's opportunity recognition ability.

In the era of knowledge economy, knowledge is no longer an obscure academic term, but more regarded as a resource (C. H. Wu, 2018). With the evolution of knowledge production models from Model 1 to Models 2 and 3, colleges and universities are no longer the only sites of knowledge production. Knowledge production can take place in open virtual communities that cross national and cultural boundaries, and new participants and organizations that can play an active role in the research process have increased the diversity of knowledge production subjects (D. He & Guo, 2019).

Meanwhile, knowledge management is considered as a key factor for organizations to

achieve competitive advantage (Ferraresi et al., 2012). Knowledge management enhances organizations to effectively use existing and new knowledge to create new products and processes by recognizing and leveraging knowledge (Chen & Huang, 2019).

TFC, similar to other Chinese private colleges, has massive disadvantage compared to public universities in terms of funding, faculty level and student quality. All three of these are important resource bases for discipline building. It also determines that the discipline building of TFC cannot fully replicate the practices and paths of academic research-oriented public universities, but needs to seek help from external resources according to the needs of the external environment and its own positioning.

From the external environment, the market demand for talents is changing with the development of the social economy. With the rapid development of China's economy in recent decades, especially in the era of knowledge-based economy, various new industrial forms have emerged. There is a gap in the supply of talents for new industries. It poses new challenges and opportunities for the talent cultivation and discipline construction of private colleges.

From its own positioning, TFC aims to cultivate highly qualified talents of applied and complex types who are proficient in foreign languages and information technology tools, have solid professional knowledge, humanities, and an international perspective. This determines that TFC takes service industry-oriented as the logical starting point of development, deepens the interaction with industry as the fundamental path of development, and closely follows the development situation of industry as the basic direction of development. Its discipline building should be set according to the market demand, development trend, technical requirements, job settings and talent needs of relevant industries (D. Cao, 2015).

Whether it is responding to the external environment of industry talent needs or implementing internal talent training goals, it is the embodiment of TFC's application-oriented positioning. The implementation standard that organically unifies the two is the differentiation strategy.

Differentiation strategy is a strategy adopted to differentiate a company's products, services, and corporate image from its competitors in order to gain a competitive advantage (Gan, 2006). In a market with strong players, the only strategy available to a latecomer is the differentiation strategy, which is achieved by finding a gap in the market, a weak point in the market, that is, to develop a product (or labor service) for which the market has a demand but not a supply; or a product for which the market already has this form but offers a product with a different connotation (Pu, 2012).

In the era of knowledge economy, among the massive knowledge sources and contents in

the external environment, only the external knowledge that truly meets our own development orientation and needs can or should be used for us to trigger and improve the innovative development performance of our own knowledge production. The differentiation strategy provides the main value judgment reference standard for TFC in the search and identification of external resources (knowledge).

Through knowledge identification, TFC identifies or discovers available external knowledge resources that meet its knowledge production requirements and needs to improve its resource constraints (Table 4.1). Knowledge identification phase can be regarded as the starting point of TFC's subsequent knowledge production process.

Table 4.1 Knowledge recognition

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Recognition	Strong demand for talents in China's emerging industries	China's management consulting industry, especially the IT consulting industry, is on the track of rapid development, and there is a growing shortage of talents with cross-disciplinary backgrounds who understand both management and IT technology, which seriously lags behind the development of the industry. (S1) In 2010, there was a gap in the training of private banking talents in Chinese colleges and universities. (S2) In 2000, China has entered an elderly-oriented society. The development of China's aging career is relatively lagging behind, and there is a strong need for the training of elderly nursing professionals. (M6)
	Goal of talent cultivation	Cultivate applied and complex high-quality talents who are proficient in foreign languages and information technology tools, own solid professional knowledge and humanities, and have an international perspective (M24)
	Differentiation strategy	"TFC's strategic positioning is summarized in two phrases: seeking differences and highlighting characteristics." <i>President, 2012 (M1)</i> "So how to differentiate? It is to find the gap in the market, the weak point of the market. That is: where there is demand in the market, but no supply, or where there is a large demand but little supply." <i>President, 2012 (M1)</i>

4.2.2 Knowledge acquisition

The knowledge acquisition phase is the process of introducing the external knowledge resources identified in the knowledge recognition phase into the organization internally, and is the concrete manifestation of the absorption and connectivity capability of TFC.

Based on market entry, market expansion, technology absorption and other purposes,

enterprises usually adopt such methods as cooperative innovation, technology mergers and acquisitions, and strategic alliances to achieve rapid entry into new product markets, access to external technology resources and brand channels, and reduce R&D costs.

Unlike enterprises, TFC, as a private college in China, introduces available external resources in order to improve the dilemma of its own resource constraints and enhance the innovation performance of its own knowledge production. In this context, considering the "make/purchase/partner" decision-making protocol used to acquire external resources, TFC prefers the partner model due to the consideration of the full cost of development and likely challenges to the investment. From the discipline building practice of TFC, TFC mainly builds partnerships to obtain external resources through university-enterprise cooperation, international cooperation and intercollegiate cooperation (Table 4.2).

Table 4.2 Knowledge acquisition

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Acquisition	University-enterprise cooperation	In 2006, TFC joined hands with Oracle to establish the TFC-Oracle Learning Group. In 2007, TFC and Oracle formally established the Oracle Club (TFC-OC), which is based on the Oracle Learning Group model, to develop Oracle technology courses and train management consulting talents.
	International cooperation	In 2012, TFC signed a cooperation agreement with AMAF in Monaco to offer the first private banking major in Chinese colleges and universities.
	Intercollegiate cooperation	In May 2013, TFC established a long-term academic and talent exchange relationship with Ming Shin University in Chinese Taiwan (the first university in Chinese Taiwan to establish an ageing services and management program).

University-enterprise cooperation

University-enterprise cooperation is a social project in which two core organizations, a university and an enterprise, cooperate loosely or closely to promote overall benefit maximization through the transfer of knowledge or technology, funding, personnel, and equipment (Y. M. Wen et al., 2015). It is an effective mechanism for higher education to actively adapt to social development, which reflects an internal law between education development and social requirements (F. M. Zheng, 1991). The university-enterprise cooperation model realizes resource sharing, complementary advantages and common development through the cooperation between universities and enterprises (Yi, 2016), which is a concrete manifestation of the increasingly close connection between higher education and society.

In the university-enterprise cooperation relationship, we usually emphasize more on the services provided by higher education institutions for enterprises. However, at the same time,

university-enterprise cooperation is also an effective means to solve a series of problems in the internal development of higher education. The importance of university-enterprise cooperation lies in its ability to promote scientific and technological innovation, transformation of scientific and technological achievements, economic development, improvement of talent training quality and college or university development.

Oracle, as a world-renowned IT industry leader, has a complete consulting product solution and a strong desire to expand its emerging market share. TFC cooperated with Oracle to build a partnership in the form of Oracle Club, and obtained Oracle products and technology platform for research and learning from Oracle, which largely compensated for the lack of investment in hardware and software due to its own financial constraints in courses development.

At the same time, TFC's training of management consulting talents based on Oracle technology platform not only meets the demand for talents in the development of emerging industries, but also further enhances the direction and relevance of TFC's own discipline construction, highlighting the application-oriented training of TFC talents.

International cooperation

The international cooperation of higher education we are talking about here mainly refers to cross-border, cross-national and cross-cultural higher education exchange and cooperation (X. D. Zhao et al., 2008), which mainly includes faculty and student exchange, degree equivalence, scholars visiting each other, international joint education, international cooperative research, participation in and holding of international academic conferences, complementary and assistance of international educational resources. International cooperation is a new requirement for higher education institutions in terms of socio-economic, technological and cultural development, and it is also a role that higher education institutions should and can play in the historical trend of internationalization of economy and technology in the world (C. G. Chen, 1998).

At the same time, the positive effect of international cooperation in higher education for developing countries cannot be underestimated. First, it enables the advanced technology and experience of developed countries to spread rapidly in developing countries in a synchronized manner through international exchange, which is conducive to shortening the gap between the two in education and science and technology and greatly accelerating the improvement of education and science and technology levels in developing countries. Secondly, it helps to provide a cultural paradigm for developing countries to promote cultural integration among the international community. Third, internationalization of education is also conducive to increasing the openness of society and broadening the cultural horizons of its members. The

role of internationalization of higher education in the reform and development of higher education in China cannot be underestimated (Cui & Chen, 1998).

The high-end wealth management industry, represented by private banking, has emerged in China in just over a decade, while in Europe there is indeed more than 500 years of industrial development. Through the partnership with AMAF and the cooperation under the framework of FEDE, TFC has been able to introduced the system of professional training, international teaching materials, and high-level industry teachers from Monaco, one of the central regions of the global wealth management industry. The introduction of these resources has greatly compensated for the lack of educational resources in TFC, promoted the establishment and development of emerging major and cross-disciplines in TFC, filled the gap in the cultivation of talents in the field of private banking in Chinese colleges and universities, brought about changes in educational concepts and thinking patterns, and accelerated the process of scientific and modernization of discipline construction.

Intercollegiate cooperation

Besides university-enterprise cooperation and international cooperation, intercollegiate cooperation is also an important way to obtain external resources.

Intercollegiate cooperation refers to the cooperation relationship established between colleges or universities through signing agreements, and the main purpose is to achieve resource sharing and common development through cooperation in scientific research and teaching (E. L. Liu, 2010).

The limited educational resources are an important motivation for universities to cooperate initially. Intercollegiate cooperation not only eases the pressure of colleges and universities' demand for resources in the development process of mass higher education, but more importantly, it connects different educational environments through cooperation and forms an open educational field, which provides a broader space for discipline construction and talent cultivation.

Compared with joint education and university mergers, intercollegiate cooperation is a more concise relationship. Through inter-university cooperation, colleges and universities seek to develop more initiative, operative and flexible, which embody the concept of cooperative development and provide a better way to solve the limited educational resources.

The senior care industry in Chinese Taiwan is more mature than that in mainland China. In response to the huge demand for talents in the aging industry in mainland China, TFC has built a solid foundation of knowledge resources for the construction of its own majors clusters by establishing partnerships with universities in Chinese Taiwan to learn teaching experience,

introduce professional courses, draw on discipline systems, and refer to talent training models.

In summary, through university-enterprise cooperation, international cooperation and intercollegiate cooperation models (Table 4.2), TFC builds cross-organizational networks to acquire the required external resources through partnerships, rather than purchase, to achieve heterogeneous external resource acquisition.

4.2.3 Knowledge integration

The knowledge integration phase occurs when external knowledge resources are brought within the TFC through partnerships and cross-organizational networks. The purpose of knowledge integration is to enhance the value of knowledge by continuously seeking new ways to combine external knowledge with knowledge already existing within the organization (Kogut & Zander, 1992). The knowledge integration phase is the concrete implementation stage of TFC's discipline building by combining external resources with its own resources, and is the concrete manifestation of TFC's transformation and innovation capabilities.

According to the different contents and levels demonstrated by the research subjects of OC, PB and HN, TFC mainly has three different scales of knowledge integration and innovation efforts in the knowledge integration phase: development of courses, creation of new major and construction of major cluster (Table 4.3).

Table 4.3 Knowledge integration

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Integration	Courses development	TFC-OC offers several courses such as EBS Financial, Oracle BIEE, EBS Oracle Manufacture and PeopleSoft for TFC students of all majors.
	New major creation	Starting in 2012, TFC was the first college to offer a private banking major in China.
	Major cluster construction	From 2012 to the present, TFC has been building a major cluster of health and nursing, including geriatric services and management (junior-college), community rehabilitation (junior-college), nursing (junior-college), social work (undergraduate), health services and management (undergraduate), and nursing (undergraduate).

Development of Courses

The course, as the implementation module in the process of discipline and major construction, is both the foundation of discipline and major development and undertakes the mission to realize the interoperability and coordinated development of disciplines and majors, which is an important guarantee for the sustainable development of the university or college (Mu, 2014). The course is not only an effective carrier and practical way to accomplish the

knowledge, ability and quality of talents, but also the feedback of teaching reform generated in the curriculum will further stimulate the exploration and development of the discipline and the major (Z. M. Ye et al., 2010).

Courses development is a core aspect of major construction and is divided into four main phases: objectives, content, organization, and evaluation (Tyler, 2008). The knowledge explosion and the changing times have brought great challenges to the field of education (Johnson, 1991). Volatility, Uncertainty, Complexity, and Ambiguity have become typical of this era (Bennett & Lemoine, 2014). This places higher demands on the ability of course development to respond to dynamically changing needs: 1) the need to sensitively perceive learner needs to accurately grasp changes in learning needs; 2) the need to quickly deliver usable courses to ensure that learners can quickly learn and gain value; and 3) the need to flexibly and easily adjust and optimize to ensure course quality and flexibility to respond to changes (X. Y. Li et al., 2021).

In the previous knowledge acquisition phase, TFC formed a cooperative knowledge production partnership with Oracle through the university-enterprise cooperation model. Through the industry-leading IT technology platform and the latest IT application technology provided by Oracle, TFC's courses development has a solid foundation of content resources.

TFC has built a learner-based course development community (Schwab, 1969) through the Oracle Club with Oracle, which includes not only learners, but also other stakeholders directly or indirectly related to the courses, such as teachers, curriculum experts, and corporate experts, as important members of the curriculum development team. The OC is a learner-oriented team that responds efficiently to the individual, differentiated, and evolving needs of learners by focusing on the needs of learners and improving the value of the course to learners.

At the same time, the inclusion of learners makes it possible to manage learning needs in a precise and dynamic way. Because of the practical orientation of the course, learners' experiences become an important source of course content. The learners' process feedback is the compass for the course development community's action adjustment, which helps the course to be optimized and improved in time and enhances the team's flexibility and responsiveness. Dynamic and precise management of needs helps keep pace with learners' needs and is an important guarantee for the usefulness, rationality and competitiveness of TFC course development.

In addition, OC has formed a group deliberation mechanism in the process of OC course development, including the collection of learner needs, the development of course content, and the evaluation of the development process and results. All members of OC, as well as

stakeholders related to the course development, such as teachers, learners, course experts, and corporate project managers, repeatedly weigh and make joint decisions on issues in the development process through a consultative and democratic approach, allowing a wider range of opinions to participate in the process of problem identification and response, and reaching a consensus solution on how to deal with the problem (Hamlett, 2003).

In particular, learners, as the target audience of the course, are an essential and important member of the course deliberations. This multi-subject and pluralistic form of curriculum development promotes interactive communication, negotiation and dialogue, and reflection and improvement in the process of courses development, and achieves collective wisdom and co-creation through the collision and feedback of multiple opinions to enhance the rationality and effectiveness of the courses.

Creation of new major

The majors of higher education institutions are the basic units of talents training based on related disciplines according to the needs of specific occupational division of labor in society (B. S. Zhang & Wang, 2012), which is an important vehicle to realize the functions of higher education. Major is both a mediator linking knowledge development (disciplines) and knowledge transfer (curriculum, teaching), and a link between the school's talent training program and the needs of society (Z. M. Ye et al., 2010).

So, majors of higher education institutions are at the intersection of disciplines and their classifications and specific social and vocational needs, and have both academic and vocational characteristics. From the perspective of academic nature, majors are based on disciplines and mainly undertake the function of talent training of disciplines. In view of the vocational nature, the construction of major should meet the demand of high-level professionals for social and economic development, which requires higher education institutions to continuously improve the running conditions, innovate the mechanism of talent cultivation, and accumulate professional advantages to ensure the quality of talent cultivation. Therefore, the construction of major mainly includes the construction of faculty, the development of talent training program and courses, the building of experimental and internship bases.

The setting of major is an important combination of social demand and higher education institutions operation, and is a key link for colleges and universities to realize the function of talent cultivation, which determines the scale and quality of higher education to a certain extent (He et al., 2021). The relationship between major setting and industrial development is an interdependent and synergistic one, as majors are established because of industrial demand and industries flourish because of professionals (Y. Y. Pan, 2021).

The market demand for talents is changing with the development of social economy. Chinese public colleges and universities generally lack market awareness, have insufficient initiative and pressure to create new majors according to the market demand, and their major settings and curriculums development are not in line with international standards and cannot keep up with the demands of economic development, with outdated teaching contents. On the contrary, the application-oriented orientation of Chinese private colleges determines the principle of their majors setting according to what kind of vocational and technical talents are in shortage in the society.

TFC has formed a new talent training program by introducing the Monaco private banking talent training system; incorporating the 550 hours of professional courses from the AMAF into the professional curriculum system; forming a professional teaching team of five European bankers selected by AMAF and financial executives practicing in Chengdu; and building a real-world practice training environment through domestic and international university-enterprise cooperation network. Based on the above major construction work, TFC created the first private banking major in Chinese domestic colleges and universities, filling the gap of industry talent training.

Construction of majors cluster

Majors cluster is a major collection with orderly structure, complementary advantages and shared resources, and the inner composition of professional cluster determines the external service form or service direction of the profession. The structure of major clusters should be designed scientifically and reasonably by combining industrial development, school characteristics and student development (H. Zhang, 2019).

The current major division in China is too fine, and the students trained from a certain major can hardly adapt to the industry talent demand. While majors cluster is a collection formed by multiple majors involved in an industry, so the docking of major cluster with industry can better meet the talents required for industry development (B. Jiang et al., 2016).

At the same time, for colleges and universities, the majors cluster construction is more conducive to integrating resources, improving the efficiency of school operation, forming the characteristics of school operation, dynamically adjusting the curriculum, teachers and bases with the development of industry, incubating new majors and utilizing the resources of old majors, so as to improve the overall ability and level of the school to serve national strategies, industries and regional economic development.

Majors cluster construction can more flexibly adapt to the objective requirements of industrial changes. Majors clusters can make use of a wide range of resources within the cluster

according to industrial changes, and the resources of the cluster's majors and courses can be flexibly combined and adjusted in a timely manner during the cultivation process.

The construction of major cluster can also better adapt to the objective requirements of industrial integration development. We can better grasp the overall industrial development trend, improve the adaptability of talent training to industrial changes, and cultivate composite talents through the construction of major cluster.

The construction of major cluster is more conducive to students' all-round development. Using majors cluster as the carrier of education can better implement the concept of selective education, allowing students to choose from a wider range of career fields, more professional directions and richer curriculum modules according to their own development and the needs of the external environment, meeting the diversified and diverse needs of students.

Majors cluster construction is a resource integration activity based on major development, and its focus is the same as major development, but it is also very different from individual major development. According to different major characteristics, different conditions and resources, and different industrial and social needs, there are four main construction modes of major clusters, including relying on a common foundation, centering around core majors, facing occupational clusters, and facing industrial chains (H. Zhang, 2019).

Facing the reality of the accelerated aging of Chinese society, TFC builds industry-oriented major clusters by analyzing the demand for talents in the senior care industry chain, so as to better enhance the ability of the majors to serve the economic development, and more conducive to the formation and development of TFC's advantages and characteristics of schooling.

TFC started from the setting of the geriatric service and management major in 2012, and construct the health and nursing majors cluster with the health, aging care and nursing as the core. By 2021, TFC's HN majors cluster has included three undergraduate majors in nursing, social work and health service and management, and three junior college majors in nursing, geriatric service and management and community rehabilitation.

Through an in-depth understanding of the senior care industry chain, TFC has summarized its common and individual knowledge system and technical skills framework, based on academic and vocational education, relying on the industrial operation of nursing centers, senior care institutions and Tianfu University for the Aged, to build an industry-oriented majors cluster operation mode.

4.2.4 Knowledge application

The application of knowledge is a reflection of the development performance of the knowledge integration phase. In modern society, talent cultivation, scientific research and social services are still the main functions of colleges and universities. The disciplines in colleges or universities are the specific bearers of various functions. Only by continuously improving the level of disciplines can universities better assume their responsibilities (X. D. Feng, 2002).

The knowledge application phase is a concrete demonstration of the level of TFC discipline construction. The knowledge production process of TFC is bound to reflect the functional attributes of TFC as a higher education institution.

By coding and analyzing the three research subjects of OC, PB and HN, the application of knowledge embodied in the discipline construction of TFC is mainly manifested in talent cultivation, social service and industrialization (Table 4.4).

Table 4.4 Knowledge application

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Application	Talent cultivation	Oracle club provides courses based on Oracle technology platform for TFC students and faculty. All TFC students and faculty can voluntarily apply to join Oracle club for learning. Since 2012, over a hundred talents who are active in various branches of high-end wealth management have been trained and delivered from the major of private banking. At present, there are more than 4,000 professional students training in majors cluster of health and nursing in TFC
	Social service	In October 2012, TFC successfully held the "2012 Chengdu High-end Wealth Management Forum". In November 2013, TFC initiated and hosted the first Western Senior Care Services Industry-University-Research International Cooperation Forum. TFC is actively involved in health and nursing vocational training. By 2020, a total of 23 trainings were offered, with a total of 1,140 people participating in relevant trainings. TFC presided over the preparation of the grading standards for geriatric caregivers in Sichuan Province. TFC presided over the preparation of 5 local standards for elderly services in Mianyang city. TFC prepared an implementation plan and action plan for the reform and development of the elderly service industry for Guizhou Province.
	Industrialization	In March 2018, TFC established Tianfu Elderly University, the only full-time university for the elderly in Sichuan Province, providing a diversified platform for ageing education.

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
		In June 2020, TFC established Tianfu Zonghe Ageing Care Center to provide medical care one-stop elderly care services.

Talent cultivation

Article 31 of the Higher Education Law of the People's Republic of China stipulates that "higher education institutions shall focus on cultivating talents, carrying out teaching, scientific research and social services, and ensuring that the quality of education and teaching meets the standards set by the state". This regulation clearly indicates that Chinese higher education institutions focus on cultivating talents, which is a concrete expression of the essential characteristics of Chinese higher education.

In 2017, the Ministry of Education of China stated in its "Opinions on the Establishment of Higher Education Institutions in the Thirteenth Five-Year Plan" that higher education in China can be generally classified into three types: research-oriented, application-oriented and vocational-skill-oriented, based on the orientation of talent cultivation. Among them, research-oriented higher education institutions mainly cultivate innovative talents for academic research, while application-oriented higher education institutions mainly cultivate application-oriented talents for economic and social development (C. Y. Yue & Xu, 2020).

China's application-oriented talents are the talent training objectives proposed by some new undergraduate colleges and universities in the process of mass higher education in the late 1990s from the perspective of misalignment competition. As a new type of talents, applied talents have a distinct career-oriented and competence-based orientation, and are significantly different from traditional knowledge-based academic talents in terms of cultivation requirements, process contents, methods and approaches.

After more than 20 years of practice, a group of applied colleges and universities insist on taking social development as the guide, dynamically adjusting education content and cultivation methods, forming a close connection between applied talents training chain, discipline professional chain and social innovation chain and industrial chain, which is better adapted to the direction of China's higher education reform and the needs of China's economic and social development. It has become one of the main goals recognized by most local general undergraduate institutions, private undergraduate institutions and higher vocational institutions in China (J. F. Shi et al., 2020).

We can see that whether it is through the university-enterprise cooperation, curriculum construction, developing a series of OC courses with outstanding professionalism and application, serving the skill cultivation of management consulting talents; or through

international cooperation, creating a new major to fill the gap of private banking industry talent cultivation; or through intercollegiate cooperation, launching the construction of majors cluster, promoting the cross-fertilization of health and nursing, expanding professional knowledge and capability, and form a model of integrating education and industry to train talents. In the discipline construction practice of TFC, the application of knowledge is first of all closely focused on the central task of colleges and universities, which is the cultivation of application-oriented talents.

Social service

Social service is an important function of colleges and universities, which is the externalization and embodiment of the essence of higher education (W. H. Zhang, 2009).

Regarding the connotation of social service of colleges and universities, in a broad sense, it covers all the activities of talent cultivation, scientific research, social service and cultural inheritance and innovation carried out by colleges and universities around the needs of economic and social development (Sheng, 2012). In a narrow sense, social services of colleges and universities mainly refer to the services provided by colleges and universities to directly meet the needs of economic and social development based on their teaching, scientific research, talents and knowledge (Y. F. Sui & Tang, 2008), which is an effective way for colleges and universities to make direct contributions to the society with their intellectual resources.

The social services provided by colleges and universities are important for promoting economic and social development, upgrading their own construction and improving the quality and efficiency of education. Making good social service is the starting and ending point for colleges and universities to cultivate talents (Z. M. Xu & Yan, 2003).

As an application-oriented college, TFC mainly serves economic and social development by cultivating application-oriented talents, which also requires TFC to strengthen its social service function and highlight its application attributes through social services (J. Luo & Yang, 2020). In addition to the cultivation and delivery of applied talents to meet the requirements of social services in the broad sense, we find that TFC's social service performance based on the narrow category is also more prominent. TFC helps industry development and promotes the transformation of achievements by organizing industry forums; carries out continuing education through social-oriented vocational training; leads local governments in setting industry standards and compiling development plans, and provides think-tank consultation.

Industrialization

With the advent of the knowledge economy, colleges and universities, as high-density knowledge reserves and knowledge creators, are no longer just spiritual homes away from

society, but are increasingly expected to serve society directly by pushing and spreading their knowledge and technological advantages to society, and by participating in local social practices and social shaping. Colleges and universities are gradually moving to the center of society, realizing various forms of integration with communities, economies and societies (Y. Li & Liu, 2012).

University-run enterprises are a way to participate in the main battlefield of economic construction and an important form of promoting the combination of science and technology with economy and the industrialization of scientific and technological achievements (B. J. Sun, 2007). Unlike the Western university spin-off (USO), Chinese universities directly invest in technology enterprises. It is a very special form of knowledge industrialization and enterprise organization, which is a unique phenomenon in the history of higher education and knowledge technology industrialization in the world (Chang & Yuan, 2003).

The university-run enterprises of Chinese colleges and universities have two major functions. One is to promote the transformation of scientific and technological achievements into real productivity through the combination of industry, university and research. The second is to build a corresponding organizational system and diversified development mode for the integration of industry, university and research, to promote the commercialization and industrialization of scientific research results, to create income to feed their own schooling and research funds.

TFC creates an industry-education group via running its own university-run enterprises, such as Tianfu University for the Aged and Tianfu Nursing and Rehabilitation Center, to integrate industry and education, completely solving the mismatch between the supply side of talent training and the demand side of industry.

TFC builds knowledge education system, technical skills training system and experimental practical training internship system based on real industrial environment; drives talent training reform, faculty construction and scientific research innovation based on industrial development; enhances industrial competition based on talent training and scientific research advantages. From the supply-side elements of talent and innovation to drive the upgrade of industrial quality and efficiency, the mutual support and deep integration of education and industry are formed, which realizes TFC's functions: talent cultivation, social service, and industrialization.

Here, we found that not all research subjects exhibited the same knowledge application performance besides talent cultivation. This may reflect the differentiated characteristics of current social needs of different discipline or major, which can be further analyzed in future studies.

4.2.5 Model of knowledge production process in TFC

The essence of discipline building is the process of knowledge production (Qu, 2019), which is a sequence of events formed by using knowledge as the driving element. In summary, the knowledge production process of TFC mainly includes four phases: recognition, acquisition, integration and application. We ignore the different professional contexts caused by involving different majors or disciplines, and the different practical details involved in courses development, new major creation and majors cluster construction, and get the model of knowledge production process in TFC as follows (Figure 4.2).

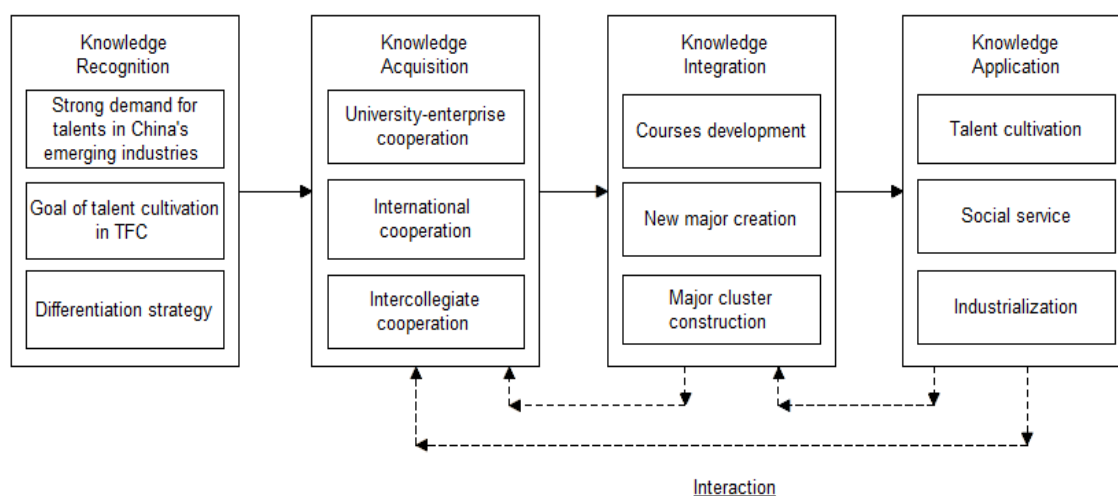


Figure 4.2 Model of knowledge production process in TFC

In particular, the dotted line in Figure 4.3 indicates that interactions can also occur at different phases of the TFC knowledge production process, rather than just a simple linear one-way model. For example, in the knowledge integration phase, TFC conducts OC course development, and its content and the technology platform of the course implementation environment need to be consistent with the technology product versions of Oracle, the university-enterprise partner of TFC. As we all know, the iteration of information technology products is very fast, which requires TFC to pay close attention to the upgrade of the partner company's technology products. When a new Oracle technology product is released, it means that new knowledge acquisition is needed for the upgrading of courses.

Similarly, in the knowledge application phase, TFC can test the effect of its own application-oriented talents training in the process of serving the society and industrialization. TFC also can test the rationality and applicability of the talents training program, curriculum system and practical training arrangement in the knowledge integration phase through the real industrial environment, and feed back to the iterative work of the existing discipline construction. At the same time, in the knowledge application phase, the new social knowledge

needs and industrial talent gaps discovered by TFC based on the industry-education integration model can be used as the origin for the construction of new disciplines, or to open up external knowledge acquisition again.

4.2.6 Open innovation in TFC knowledge production

Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (Chesbrough, 2006b). It basically means that innovation is generated by accessing, harnessing, and absorbing flows of knowledge across the firm's boundaries (Chesbrough, 2017).

Although different in the specific contents and levels of knowledge production, TFC focuses on the acquisition and development of external knowledge in the process of knowledge production, the essence of which is the integrated use of knowledge flow across the internal and external boundaries of the organization to accelerate internal knowledge innovation.

In the courses development, TFC builds a learning community based on Oracle's technology platform by constructing Oracle club, a brand new organizational platform, to introduce, digest, integrate and harness Oracle technology, develop an application-oriented course pool for management consulting talent training, and become a national model for OC operation.

In terms of major creation or setting, through international cooperation, TFC introduced the talent training system in the core regions of the wealth management industry, integrated international professional teaching content, formed a new professional talent training program, organized a professional and international faculty team, and attached an innovative internship arrangement with industry-education integration to create the first private banking major in China.

In the construction of major clusters, TFC builds a majors cluster based on industrial chains by drawing on the experience of discipline construction in universities in the pioneering regions of recreation industry, further explores the integration of industry and education, tests the quality of talent training and improves the ability to serve society through an industrialization approach, and constructs builds a regional first-class application-oriented professional cluster.

Zhang et al. (2019) argue that by integrating external knowledge sources, the R&D knowledge of universities can be enriched and the innovation of universities can be improved. TFC has achieved good innovative development performance at different levels of discipline construction by integrating external resources, compensating for the disadvantages of internal

and external development resources, building applied characteristic disciplines, majors and courses, and creating its own core competitiveness.

Chesbrough and Bogers (2015) further defined open innovation as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries. TFC realizes the innovation work of its own knowledge production through the 4-phase application life cycle of recognition, acquisition, integration, and application, and promotes the accumulation and systematic integration of various innovation elements with disciplines as the core, and promotes various research elements to achieve collaborative innovation across disciplines, colleges, universities, regions, departments, borders, and countries (He, 2018).

In summary, we believe that TFC's knowledge production process model is a typical open innovation model. The open innovation strategy is suitable and effective for TFC's knowledge production. Therefore, we propose the following:

Proposition 1. Private colleges in China can achieve good innovation development performance in knowledge production through open innovation strategies.

4.3 Resource bricolage on knowledge production in TFC

Resource bricolage is a resource-creating activity in organizations that takes immediate action to respond to opportunities and threats by reorganizing the resources at hand to achieve resource construction (Baker & Nelson, 2005). Resource bricolage emphasizes the action orientation of the bricolage in the face of challenges, the rejection of inherent limitations, the reliance on resources at hand, and the reorganization of resources to achieve new purposes. Resource bricolage is an important way to solve the challenges of resource constraints such as technology, human resource, and physical resources, and to help enterprises innovate products, services, technologies, and business models (H. Guo et al., 2016; Salunke et al., 2013; Senyard et al., 2014; X. M. Wu et al., 2017).

By coding the data related to TFC discipline construction, we found evidence of bricolage in the development of open innovation in TFC knowledge production, mainly in the areas of human resource, academic resource, institutional and network (Figure 4.1), which has both similarities and certain differences with the factor-based resource bricolage behavior in the Western context, reflecting the unique connotation of resource bricolage in the Chinese context.

In terms of the analytical framework, resource object, bricolage method, and bricolage result are important units of analysis in the logic of resource bricolage (B. B. Dong & Luo, 2018). This section focuses on the specific performance of resource bricolage in the TFC

knowledge production process and the possible positive and negative bricolage impacts from these three dimensions.

4.3.1 Human resource bricolage

Drucker (2007) argues that the company have only one real resource - human and management is to fully develop human resources to do a good job. For Chinese private colleges, human resources are the key element to promote the development of the school, improve the quality of teaching and learning, and increase the effectiveness of school operation (Que, 2021).

The main body of implementation of discipline building, major construction, course development and talent training are teachers. Teachers are the creators, discoverers, users and transmitters of disciplinary knowledge. Teachers are dual in nature: they are the main body of academic work and activities of a certain discipline under academic affiliation, participating in academic research and discipline building. While they are also the main body of teaching work and teaching activities under teaching administrative affiliation, being the lecturer of a certain specialty or a certain course. Because of this, for higher education institutions, high level of faculty is very significant for discipline building, major construction, course development and talent cultivation (Z. M. Ye et al., 2010).

As a private college, TFC also faces the dilemma of insufficient high-level faculty in the process of knowledge production. Through human resource bricolage, TFC is able to ensure the faculty requirements for high quality disciplines building (Table 4.5).

Table 4.5 Human resource bricolage

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Human Resource Bricolage	Faculty and students study and research together	TFC students and faculty can apply to join TFC-OC to conduct research according to their interests.
	Overseas teachers plus industry teachers	The faculty of Private Banking major is composed mainly of European bankers selected by AMAF + executives from the financial industry in Chengdu. There are 154 full-time and part-time faculty members, including 63 full-time teachers/teaching assistants, 31 visiting professors/associate professors, and 12 expert teams organized by industry experts in School of Health and nursing in TFC
	Full-time and part-time faculty	

In OC course development, TFC faculty and students voluntarily joined OC according to their own interests and formed a learning community to carry out learning as well as course development, thus constituting the original team of knowledge producers for the OC project.

In creation of the new major in private banking, in addition to the selected full-time faculty of its own finance, TFC combined five bankers from Europe selected by AMAF and industry

experts with overseas educational backgrounds selected in the financial industry in Chengdu to create a professional and internationalized professional faculty team, effectively meeting the demand for internationalized professional teaching faculty for the PB major, thus strongly supporting the construction of the first high-quality private banking major in China.

In the process of professional cluster construction, the demand for human resources is obviously greater. In addition to its own full-time faculty, HN recruits part-time teachers, establishes visiting professorships, and introduces industry experts to jointly form applied faculty team. TFC realizes a human resource bricolage model that does not seek all but uses all, thus ensuring the quality of HN's professional cluster construction and meeting the high standard of human resources required for the knowledge production activities that strive to be first-class.

The actual results of the three research cases of knowledge production in OC, PB and HN show that TFC has achieved relatively good innovative performance in all the above-mentioned dimensions of discipline building. It can be seen that human resource bricolage is a good solution to the lack of high-level faculty in TFC.

4.3.2 Academic resource bricolage

The discipline building is not a pavilion in the air. It needs corresponding academic resources as the foundation support in addition to human resource factors. High-quality academic resources are the most direct and important representation of high-level private colleges. The accumulation of academic resources increases the thickness of discipline and major construction and feeds the talent cultivation of the college.

In the knowledge production process of TFC, the following types of academic resource bricolage are mainly reflected: technology resource, curriculum resource, and major resource (Table 4.6).

Table 4.6 Academic resource bricolage

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Academic Resource Bricolage	Enterprise provision of information infrastructure	Oracle provides TFC-OC with Oracle products and platform for research and learning to develop courses.
	Introduction of international curriculum	Private Banking major seamlessly integrates the AMAF 550 hours of specialized courses into the third academic year of the TFC talent development program.
	Cooperation in the joint construction of majors	The Aging Services and Management program is jointly constructed by Sichuan Open University (SOU), TFC and Sichuan Association of Elderly Services (SAES). TFC and SAES are jointly

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
		<p>responsible for curriculum construction, TFC is mainly responsible for talent training, SAES provides practical training units, and SOU is responsible for assessment and issuance of academic certificates.</p> <p>The Health Management program and Nursing program are built by Sichuan Open University (SOU) and TFC in cooperation and joint training of students. TFC is responsible for curriculum development, talent training, and practical training units. SOU is responsible for assessment and issuance of academic certificates.</p>

Technology resource

In the era of knowledge economy, information technology tools and platforms have become more and more indispensable technical infrastructure for discipline building. First-class technical resources undoubtedly have a great supporting role for high-quality application course development and major construction.

Through a partnership with Oracle, TFC established the Oracle Club on campus, with Oracle providing technical products and platform support worth RMB 23 million (approximately \$2.7 million), including software licenses, product support, Oracle database upgrades, Oracle Application Server, Oracle development tools, and Oracle E-Business Suite. By fully exploring the resources of industry enterprises, TFC has made a bricolage of information infrastructure, effectively alleviating the dilemma of lack of financial resources in the initial stage of TFC, resulting in the lack of basic resources for discipline building, and laying a solid foundation of resources for subsequent OC course development.

Curriculum resource

Due to certain limitations in the construction of faculty and blind spots in the recognition of the key points of professional talents' ability in emerging industries, private colleges have limited ability to develop courses in emerging majors.

Through international cooperation, TFC introduced AMAF's 550-hour professional curriculum based on Monaco's private banking talent training system, and constructed the talent training program and professional curriculum system of the new private banking major on this basis. Through the bricolage of curriculum resources, TFC solves the problem of shortage of mature curriculum resources, promotes the localized and deep integration of international teaching resources, and facilitates the application and sharing of high-quality educational resources, thus being the first among universities in China to open a private banking major.

Major resource

Due to the external policy environment, including the approval of new majors and the scope

of enrollment qualifications, Chinese private colleges have many restrictions and cannot enjoy the same rights and benefits as public universities.

TFC cooperates with Sichuan Open University and Sichuan Association of Elderly Services, fully exploits the resources of public universities and industry associations, jointly sets up the major, jointly draws up the training program, jointly organizes teaching, assessment and issues certificates. Through the above initiatives, TFC has broken through the shackles of the mechanism, improved the reputation of the industry, built its own brand of major cluster, and become an important support point to pry the innovation of applied talent training.

From the knowledge production empirical results of OC, PB and HN, TFC has been more effective in addressing the knowledge constraints caused by the lack of accumulation of its own academic resources through the bricolage of academic resources. This is further corroborated by the fact that bricolage was found to act as the mechanism that translates knowledge constraints into innovation outcomes (Shen, 2018).

4.3.3 Institutional bricolage

The institutional bricolage is by refusing to enact limitation with regard to many standard and regulations, to venture into unclear or restricted areas, to break the rules, and to actively try to find solutions or opportunities to problems (Baker & Nelson, 2005). The essence of institutional bricolage is the process of using resources at hand to form new institutions, norms, processes, and practices that provide an innovative solution to an unknown or obstructed area (Zhao et al., 2016).

The current situation of limited resources makes it impossible for private colleges to exactly replicate the established working standards and rules of public universities. Instead, they can only find seemingly impermissible solutions by finding alternative ways to actively experiment. TFC serves its own discipline building by abandoning the traditional model of curriculum development, major and major cluster construction, and combining its own needs and characteristics through institutional bricolage (Table 4.7).

Table 4.7 Institutional bricolage

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Institutional Bricolage	Innovative model for learning and testing	The Oracle Club adopts an innovative model in the form of learning and research, departing from the traditional teaching model, which is mainly teaching, and advocating a double-way learning approach of independent and team-based support. Faculty and students learn, grow, and develop together. TFC-OC cooperated with OAI to hold the 11 enterprise management information technology solution

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
	Industry-academia integrated internship training.	competitions. Through the competition, the best works of OC will be decided. Unlike the traditional arrangement of professional internship system in China, where students start their internship in the last semester, PB's student internship arrangement runs through the whole process of professional course study.
	New model of discipline construction	TFC implements the idea of integration of industry-academia-research, and creates a six-in-one operation mode of "industry-academia-research-medical-care-nursing" for HN major cluster.

In the OC course development example, TFC-OC adopts an innovative model in the form of learning and research, departing the traditional teaching model which is mainly teaching, and advocating a double-way learning approach of independent learning and team support. Teachers and students learn, grow and develop together, creating a learning community. At the same time, TFC-OC cooperates with enterprises to hold professional competitions to replace the traditional classroom assessment method and test the learning results, in order to practice the competition purpose of discovering applied talents and sending useful talents to the society. TFC-OC has become a model for the operation of for nearly 20 Chinese universities that set up Oracle Club.

In the example of PB's new major construction, PB strengthens the seamless connection between teaching and practice, and builds a first-class practical training and internship environment through domestic and international school-enterprise cooperation network. Unlike the traditional arrangement of professional internship system, where students start their internship in the last semester, PB's student internship arrangement runs through the whole process of professional course study, thus ensuring that PB students' training objectives of industry-academia integration are achieved.

In the example of HN major cluster construction, TFC implements the idea of integrated schooling of industry-university-research, based on academic education + vocational education, relying on the industrial operation of the nursing center, medical rehabilitation center, elderly institutions, and Tianfu University for the Aged, and supported by Sichuan Tianfu Aging Industry Development Center, to build a six-in-one operation mode of "industry-university-research-medical-care-nursing".

In summary, TFC strongly supports the innovation performance achievement of the aforementioned knowledge production projects through institutional bricolage. Institutional bricolage is one of the most valuable parts of the TFC knowledge production process in terms of innovation value. This also confirms the positive relationship between resource bricolage and process innovation (Senyard et al., 2014).

4.3.4 Network bricolage

Network bricolage is the use of its own external network relationships to bridge partner resources to meet its own individual resource needs. Unlike the institutional bricolage discussed previously, which is an intra-organizational behavior, the network bricolage is a bricolage behavior between organizations. Network bricolage usually does not change the ownership of resources, but only has shared and specific access to some resources of external organizations (J. Lu et al., 2020).

The change of knowledge production mode makes knowledge production has long been not a task that universities can accomplish independently by relying on closed doors.

By discussing the research subjects of OC, PB, and HN, we find that the essence of TFC's discipline construction is a knowledge production process based on the open innovation strategy. At the front end of TFC's knowledge production process, TFC introduces technical resources, knowledge resources, and human resources of partners through network bricolage. At the back end of TFC knowledge production process, TFC integrates the industrial resources and market resources of partners through network bricolage to serve the cultivation of applied talents, build internship training environment and help develop industrialized market channels.

The change of knowledge production model makes knowledge production has long been not a task that universities can accomplish independently by relying on closed doors. At the front end of TFC's knowledge production process, TFC introduces physical resources, knowledge resources and human resources of partners through network bricolage. At the back end of TFC knowledge production process, TFC integrates the industrial and market resources of partners through network bricolage, serves the cultivation of applied talents, builds internship training environment, and helps develop industrialized market channels (Table 4.8).

Table 4.8 Network bricolage

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
	Access to partner resources	Oracle provides software platform for TFC-OC TFC introduces 550 hours of courses from AMAF The private banking major strengthens the seamless integration of teaching and practice, and builds a first-class practical training environment through domestic and international school-enterprise cooperation network.
Network Bricolage	Building a realistic internship environment	TFC has established clinical teaching bases in cooperation with 76 secondary and above hospitals covering major cities in Sichuan province, and has established off-campus practical training and practice bases in cooperation with 73 most representative

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
	Collaborate with off-campus institutions to explore new training markets	elderly institutions and social service centers covering Chengdu and Mianyang. In January 2018, TFC cooperated with Sichuan University for the Aged to promote the training of elderly caregivers and elderly social workers and to promote the re-employment of the elderly. In December 2018, TFC and Sichuan Civil Affairs Cadre School jointly launched a training program for senior citizens' assessors under the "Hundred Million Senior Citizens' Talents Backbone Construction Project".

4.3.5 The role of resource bricolage on TFC knowledge production

In addition to the horizontal discussion according to the types of resources bricolage together and the vertical analysis according to the process of TFC knowledge production, we find that at each phase of knowledge acquisition, knowledge integration and knowledge application, TFC breaks through resource constraints through resource bricolage, thus specifically realizing the innovative development performance of knowledge production.

In the knowledge acquisition phase, TFC accesses technology resources, curriculum resources, major resources and human resources from external partners through network bricolage, which is a concrete expression of TFC's absorption ability.

The connotation of major construction can usually be summarized into two parts: structural and functional elements (B. S. Zhang & Wang, 2012). In the knowledge integration phase, TFC optimizes the faculty through human resource bricolage; builds a curriculum plan in line with international standards through curriculum resource bricolage; and creates a learning and experimental environment in line with mainstream industry standards through technology resource bricolage. Through the above input (academic resource, human resource) bricolage, TFC meets the requirements of structural elements in the connotation of major construction based on its ability to integrate resources, which is a concrete demonstration of its transformation and innovation ability. At the same time, through the institutional bricolage, TFC promotes the construction of learning community, innovative talent training model, and creates a six-in-one major cluster construction and operation model, which ensure the realization of internal process innovation and effectively echoing the aforementioned input bricolage.

In the knowledge application phase, TFC serves the functional elements in the connotation of major construction through network bricolage to create an integrated industry-academia internship training environment and serve the cultivation of applied talents; cooperates with off-campus institutions to develop new markets and provide a broader space for the deepening

of the industrialization of major clusters and the demonstration of TFC's parsing ability.

It can be seen that resource bricolage plays an active role in stages of knowledge production in TFC, and is a concrete manifestation of the various capabilities in the TFC open innovation model. We further modified and extended the knowledge production model diagram of TFC (Figure 4.2) to include the impact of resource bricolage.

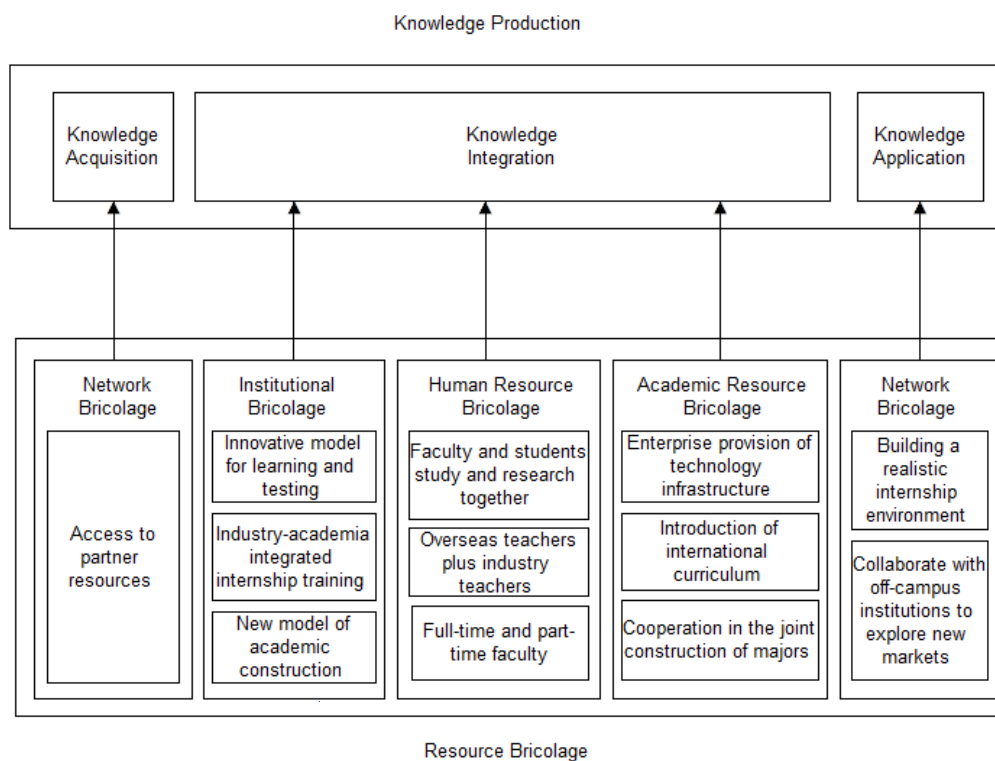


Figure 4.3 Resource bricolage in knowledge production in TFC

As seen from Figure 4.3, the knowledge integration phase in the TFC knowledge production process is a concentrated phase of input (human resource, academic resource) bricolage and institutional bricolage, which shows that the resource integration ability of TFC has a crucial role in the innovation performance of TFC. This also confirms that Input bricolage affects start-up performance through resource integration capacity, and institutional bricolage also affects start-up performance through resource integration capacity (Zhao et al., 2016). The innovation performance of TFC's discipline building sample relies on the strategic choice of open innovation. The resource bricolage can be seen as a concrete way for TFC to achieve and obtain innovative development performance by making full use of the resources at hand to build organizational capacity in a resource-constrained situation.

In summary, TFC strongly supports the development of open innovation in knowledge production through resource bricolage. Therefore, we propose the following:

Proposition 2. Resource bricolage has an important positive contribution to the development of open innovation in the TFC knowledge production process.

It is important to note that studies have shown that resource bricolage is not harmless and may lead to negative outcomes such as opportunity traps and over-dependence. Based on the dynamic nature of organizational entrepreneurship, resource bricolage is a transitional strategic arrangement for TFC. In the long run, excessive use of "bricolage" may prevent the organization from searching for the "right resources" and updating the organization's strategy, which may lead to negative effects such as closedness, exclusivity, and low performance (W. Deng et al., 2018).

The above conclusions drawn in this study are the results of exploring the positive effects of resource bricolage on knowledge production in TFC based on case-history data in a specific time window. This does not exclude the possible obstruction of resource bricolage on the long-term development of TFC and the possible negative impact on social perceptions, which can be analyzed in future studies.

4.4 TFC Model

In the interviews with the relevant persons in charge of the discipline building of TFC, all of them coincidentally mentioned that they received strong support from the college. This also provides a path for our study to continue to look deeper into the kind of organizational model, i.e., the combination of organizational elements, through which TFC supports the achievement of the aforementioned open innovation development performance of knowledge production.

By coding and analyzing TFC's organizational management materials related to knowledge production, we found that the leadership from the top, an entrepreneurial-oriented organizational culture, and an organic organizational structure are the main components that constitute the TFC model to support TFC's knowledge production based on the open innovation model.

4.4.1 Top management team

In order to develop innovation in an organization, we must first solve the "Why" problem, that is, where is the motivation for development? Top management team (TMT) leadership behavior is an important antecedent variable of team performance (Y. F. Cao, 2011). Leadership behavior from top managers in organizational change is an important support for improving organizational innovation (Jung et al., 2008).

For public universities, the president is the soul of the university, and a good university cannot be separated from a good president. For private colleges in China, the organizer is the

soul of them. An excellent private college cannot be separated from an organizer who is committed to education, forward-looking and daring to start a business (Que, 2021).

The biggest dilemma faced by entrepreneurs is how to acquire the required resources and develop them. Organizers of high-level private colleges need creativity, improvisation, integration, and the ability to deal with the risks associated with market uncertainty (Baker & Nelson, 2005). The core entrepreneurs, such as the chairman and president of high-level private colleges, are good at capturing market opportunities, have high entrepreneurial alertness, integrate resources flexibly and skillfully, and have outstanding entrepreneurial spirit. This is the biggest difference between a high-level private college team and a mediocre private college team.

From the analysis of TFC's organizational management materials, TFC's TMT characteristics highlight the need for achievement and ambiguity tolerance (Table 4.9).

Table 4.9 Top management team

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Top Management Team	Need for achievement	<p>“Take the low grade as the starting point for the time being and vow to make the top university our goal.” <i>President, 2012(M1)</i></p> <p>“Create a hundred-year foundation and running a first-class famous university.” <i>President, 2012(M13)</i></p> <p>“In about thirty years, the college will become a first-class undergraduate college with distinctive domestic characteristics, outstanding disciplinary advantages and high social recognition.” <i>Vice President, 2012(M24)</i></p> <p>2020-2040, to become a distinctive undergraduate college with outstanding disciplinary advantages and domestic first-class. <i>(M23)</i></p>
	Tolerance for ambiguity	<p>“The only thing without changing in the world is change.” <i>President, 2012(M1)</i></p>

Need for achievement

The need for achievement is what motivates a person to accomplish difficult tasks and achieve success (McClelland, 1961). Entrepreneurs with a strong need to achieve tend to explore more advanced ways of entrepreneurship, which leads to success and outstanding organizational performance. At the same time, entrepreneurs with a high need for achievement have high goals, a strong desire for self-fulfillment, and a desire to succeed. Entrepreneurs with a strong desire for success are more likely to find multiple values in the resources at hand, put them into immediate action with great enthusiasm, innovate to create viable solutions, and take the initiative to gain satisfaction and fulfillment. Therefore, the need for achievement positively influences entrepreneurial performance and resource bricolage (Xiao & Chen, 2019).

From the very beginning of TFC, PGQ, the president and one of principal organizer of TFC,

set out the vision of building TFC into a first-class university. His ambition of building the school is characterized by the need for high achievement, such as "Take the low grade as the starting point for the time being and vow to make the top university our goal" (2006-2012) and "Create a hundred-year foundation and running a first-class famous university"(2012-present).

Based on the goals proposed by PGQ, TMT has proposed to build TFC into a first-class undergraduate institution with distinctive features, outstanding disciplinary advantages and high social recognition in China in about thirty years by formulating the medium and long-term plan of the college. The development and promulgation of TFC's development plan enables the members of the organization to understand the prospects and goals of the organization's development. TFC keeps organization members motivated via goal motivation to for a long time.

It can be seen that the need for achievement coming in TMT is the endogenous source power of TFC's innovation development, and is the fulcrum that drives the innovation development of all work including knowledge production.

Tolerance for ambiguity

Ambiguity tolerance is a positive mental ability required to perceive and process complex information, mainly in response to uncertainty and risk in the innovation process (Hou et al., 2013).

Usually, the entrepreneurial environment and market demands are highly variable, and high ambiguity tolerance contributes to innovative thinking and behavior (Zenasni et al., 2008), which facilitates the survival of entrepreneurs in an uncertain environment. At the same time, high ambiguity tolerance entrepreneurs are able to accept ambiguous situations, are good at finding favorable factors in the uncertainty of entrepreneurial resources, take in a wide range of resources, and find what they need for organization development based on the diversity and possibilities of resource utilization. Therefore, high ambiguity tolerance positively affects entrepreneurial performance and resource bricolage (Xiao & Chen, 2019).

TFC's TMT is fully aware of the uncertainty of the internal and external development environment and has a tendency to view ambiguous situations as desirable (Stanley Budner, 2010). PGQ, the president of TFC, proposed that "the only thing without changing in the world is change" to describe the fickleness and instability of the external environment, demonstrating the high degree of ambiguity tolerance in TFC's TMT characteristics. It creates positive conditions for encouraging members to innovate through trial and error.

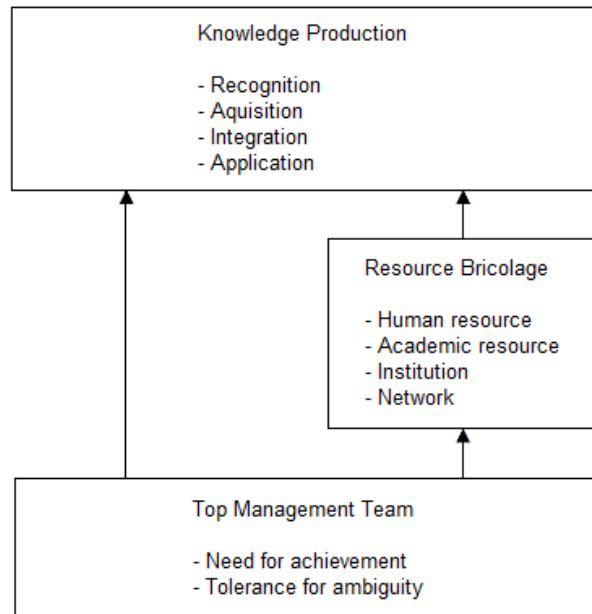


Figure 4.4 TFC model I

Leadership from the top is the foundation of leadership behaviors in TFC's open innovation development and resource bricolage. The high need for achievement and high tolerance for ambiguity that characterize TMT provides motivation and direction for the organization's members to perceive a positive innovation culture, creating a strong vision of innovation and helping to improve the quality of innovation in the organization.

As a result, we obtain TFC Model I (Figure 4.4).

4.4.2 Entrepreneurial orientation

After addressing the dynamics of development, the creation of an organizational culture is a direct contributor to the organization's innovative development. Ghoshal et al. (1997) study shows that entrepreneurial enthusiasm of the top management team or the general employees is not enough; it is necessary to create an entrepreneurial-oriented culture in the whole organization and work together to bring about improved organizational performance.

Entrepreneurial Orientation (EO) is a strategic decision-making concept and model adopted by firms to enter new business areas with innovation, proactiveness, and risk taking (Miller, 1993), and is considered to be a facilitator of firm performance (Anderson & Eshima, 2013; Barringer & Bluedorn, 1999; Covin & Lumpkin, 2011; Covin & Miller, 2014; Rauch et al., 2009). EO helps firms to remain sensitive to new things, knowledge, and opportunities (Z. F. Zhu, 2015), which has a positive impact on knowledge discovery and thus has a direct impact on the developmental performance of knowledge production. G. Chen (2017) also found that entrepreneurial climate with innovation incentives, organizational support, and external

orientation plays a positive moderating role between entrepreneurial bricolage and entrepreneurial performance.

Analysis of the coding of TFC-related information showed that the EO of TFC focused on innovativeness, proactiveness, and risk taking (Table 4.10).

Table 4.10 Entrepreneurial orientation

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Entrepreneurial Orientation	Innovativeness	"How to do well in private colleges? Pioneering and innovation is the only way out." <i>President, 2012(M1)</i> "From the first day of operation in 2002, the college has incorporated "innovation" into all its work." <i>Vice President, 2012(M24)</i> In 2007, TFC became one of the first few universities to establish an Oracle Club in China. In 2012, TFC was the first college in China to offer a private banking major.
	Proactiveness	Since 2010, TFC has started the research of the elderly industry and education, and started the construction of the major cluster of health and nursing in September 2012. "The college encourages innovation for everyone, and the cost of innovation is paid for by the college." <i>Vice President, 2012(M24)</i>
	Risk taking	"Doing something is not always successful, but in the process of doing something, there may be new opportunities." <i>President, 2015(M22)</i>

Innovativeness

Innovativeness reflects a firm's tendency to engage in and support new ideas, novelty, experimentation, and creative processes (Lumpkin & Dess, 1996), and is the product of a combination of a firm's innovation culture, innovation climate, innovation strategy, and innovation platform. Innovativeness is at the core of EO, which helps companies to create a strong innovation climate and encourage employees to come up with new ideas, thus contributing to the innovative development of the organization.

From the beginning of the school's establishment, TFC has made innovation as its own development gene. PGQ, the president of TFC, sees innovation as the only way to achieve its goal of being a top university. By implementing the concept of innovation in all the work of the organization, TFC has created a strong internal atmosphere of innovation. This lays the foundation of the organizational environment for the development of innovation in TFC, and side-by-side answers why the cases of knowledge production innovation in OC, PB, and HN are concentrated in TFC.

Proactiveness

Proactiveness is the willingness and foresight of a company to quickly identify and grasp

market opportunities, which helps the company to stand in a favorable competitive position and gain the first entrant advantage, thus helping the company to gain and maintain a competitive advantage. With limited capabilities and resources, latecomers need to gain first-mover advantage and seize valuable market potential to achieve organization development (Lumpkin & Dess, 1996; Miller & Friesen, 1983).

TFC's application-oriented positioning and differentiated strategy development ideas make TFC pay close attention to the changes in the industry. Once the industry opportunity is confirmed, TFC quickly enters the implementation stage. The cases of knowledge production innovation of OC, PB, and HN are themselves the manifestation of proactiveness in the development of knowledge production in TFC.

Risk taking

Risk taking is the degree to which enterprises are willing to take corresponding risks when pursuing and seizing potential market opportunities and conducting new product development activities (Lumpkin & Dess, 1996; Miller & Friesen, 1983).

Innovations are events with high uncertainty, high difficulty, high reward and low success rate (Hou et al., 2013). The willingness and ability of enterprises to take risks is conducive to promoting enterprises to invest resources in R&D.

TFC calls for full innovation and the cost of innovation is covered by the college. This relieves innovators of their worries and greatly motivates organizational members to innovate, thus building an open, failure-tolerant organizational environment and facilitating the development of organizational entrepreneurial bricolage activities (Z. F. Zhu, 2015).

At the same time, the low success rate of innovation, PGQ, the president of TFC, is not considered as an unacceptable result, but may be the beginning of a new innovation. Risk taking can also be seen as a projection of the ambiguity tolerance from TMT characteristics in EO. As the proverb says that for a military commander, winning or losing a battle is a common occurrence. Maintaining a positive attitude toward the uncertain outcome of innovation is also a manifestation of risk taking.

The more risk-taking entrepreneurs are willing to take, the more they desire high achievement, the more they can tolerate uncertain conditions and information in the innovation process, and the more they can create a strong innovation climate among organizational members (B. H. Peng et al., 2020).

Hung and Chiang (2010) found that EO positively moderates the relationship between the propensity to open innovation and enterprise performance. The innovativeness, proactiveness, and risk taking of EO facilitate enterprises and employees to effectively cope with high

environmental turbulence and uncertainty, which in turn helps enterprises to improve their innovation performance (X. M. Wu et al., 2017).

At the same time, EO has shaped enterprise's decision-making style of being committed to innovation, acting in advance, and risk taking, which is considered to be one of the important factors influencing resource bricolage (Yao et al., 2018).

Proactiveness highlights the characteristic of "action now" and emphasizes that entrepreneurs can quickly deploy and reconfigure resources after identifying social problems, which increases the efficiency of resource bricolage (Baker & Nelson, 2005). Risk taking can reduce the psychological pressure of social entrepreneurs in trial and error, promote the bold use of resources and different combinations, and enhance members' motivation to resource bricolage (Hooi et al., 2016).

TFC bears the cost of innovation by itself, which greatly increases the risk tolerance threshold of individual in the innovation process. TFC employees repeatedly explore through trial and error, iterative innovation, to break the original system and resource constraints in order to obtain new development performance. This is also in line with the requirement of the "a refusal to enact limitations" dimension of the resource bricolage (Di Domenico et al., 2010).

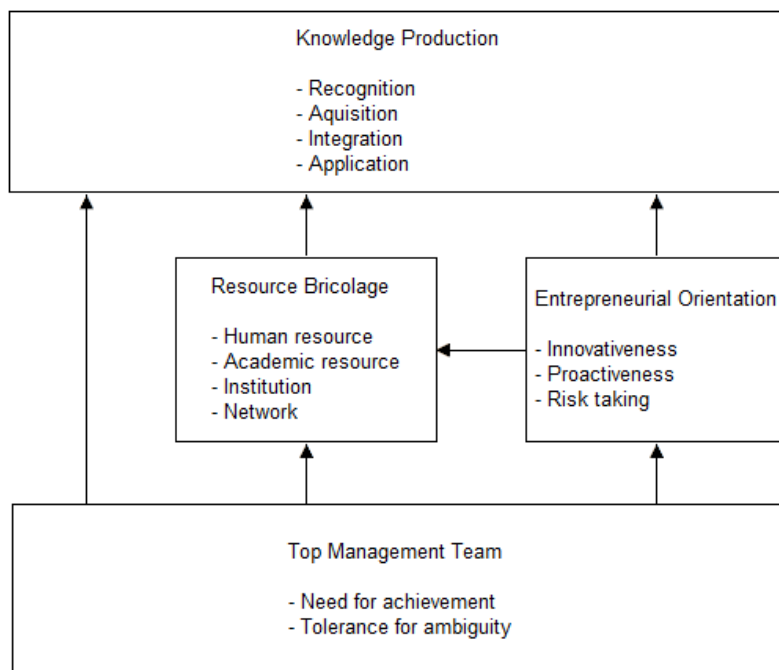


Figure 4.5 TFC model II

Furthermore, EO helps enterprises to remain sensitive to new things, knowledge and opportunities (Z. F. Zhu, 2015). Three innovative cases of knowledge production, OC, PB and HN, also corroborate from another side that EO has a positive impact on knowledge recognition and thus has a direct impact on the innovative performance of knowledge production.

In summary, we take the effect of EO into account in the model and obtain TFC Model II (Figure 4.5).

4.4.3 Organic structure

Organizational structure is at the service of organizational strategy. Knowledge production based on open innovation models requires a corresponding organizational structure to support the achievement of innovation performance. Effective OI requires a flexible and dynamic organizational structure based on collaboration (Chesbrough, 2012). Based on the analysis of the coding of organizational structure materials, we found that TFC mainly met the requirements of open innovation for organizational flexibility by constructing an organic organization, thus ensuring the successful achievement of innovation development performance (Table 4.11).

Table 4.11 Organic structure

2nd Order Themes	1st Order Concepts	Representative Quotations & Evidence
Organic structure	Matrix structure	Faculty Matrix in TFC (M1) In September 2012, TFC established the Institute of Aging Services and Management and opened an Aging Services and Management major at the junior college level. (M21) In September 2013, TFC established the Institute of Social Work and opened a social work major at the undergraduate level. (M21)
	Create or eliminate departments as needed	In November 2014, TFC established the Private Banking Institute, which is responsible for the expansion of the private banking major. (M15) In June 2017, TFC abolished the Institute of Social Work and the Institute of Aging Services and Management, and newly established the Institute of Aging Services and Social Work. (M20)
	Faculty autonomous mobility	"Teachers are assigned to various institutes according to their own choice" (M2)

The organizational structure of Chinese public universities originates from the Soviet university model, which has typical characteristics of a hierarchical system. The organizational structure of faculty management is rigid, or inflexible. Universities are grouped into several professional colleges according to majors or disciplines, and the colleges are further divided into departments or teaching and research groups according to majors or courses, forming a professional tree-like organizational structure based on the principle of academic proximity. In this structure, faculty members are bound to organizational units of teaching and research with more defined specializations, creating mobility hindrances and inflexibility (Figure 4.6).

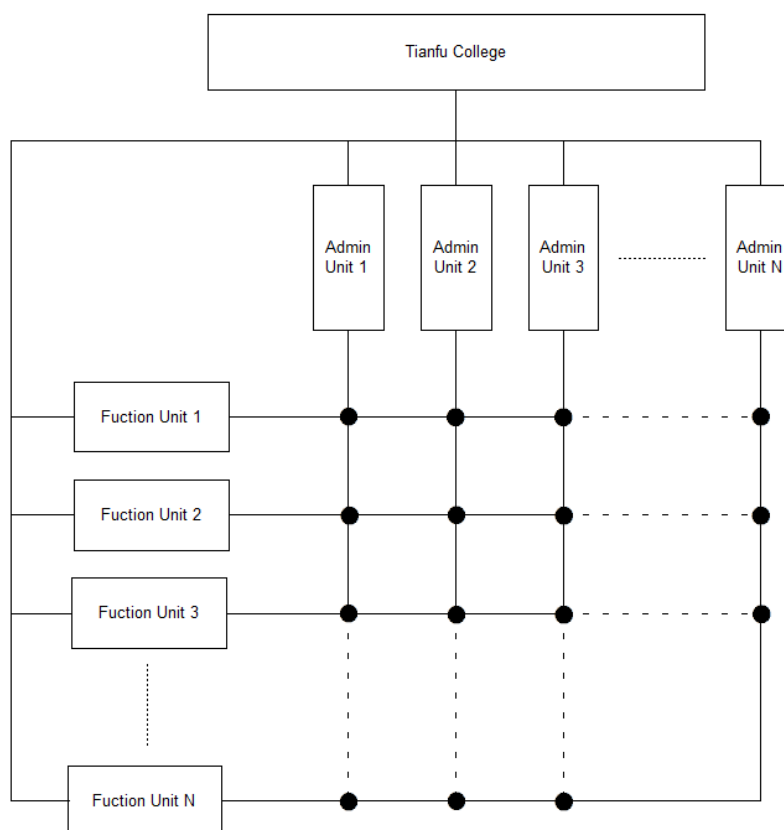


Figure 4.6 Faculty matrix in TFC

Source: Pu (2012)

TFC, on the other hand, constructs the Faculty Matrix (Figure 4.7) for faculty management. Each teacher is at a different node of the matrix depending on the content and nature of his or her work in TFC.

The Faculty Matrix is divided into an administrative dimension and a functional dimension. The administrative dimension is implemented through the faculty centers. Instead of organizing the secondary school by majors (like accounting school or engineering management school), TFC forms faculty centers by discipline categories, such as Economics and Management Faculty Center, Information Technology Faculty Center, Mathematics Faculty Center. The Faculty centers is mainly responsible for the daily management of personnel, teaching of public knowledge, supervision and adjustment of standardized implementation processes and other universal work.

Each faculty member at TFC is assigned to a faculty center based on his or her subject category background. If a faculty center has too many teachers and is too large, TFC again splits it into several to maintain an appropriate management margin, like Economics and Management Faculty Center I, Economics and Management Faculty Center II.

The functional dimension of the faculty matrix is then realized according to the functional units that undertake different specific functions and constitute different matrix combinations

with the administrative units.

Taking discipline building as an example, TFC accomplishes the specific work of major construction by establishing the institute. The Institute is not an administrative organization, but a project organization responsible for knowledge production. The faculty center and the Institute form the Faculty Matrix for the purpose of disciplinary building (Figure 4.7). Each faculty member can register to a specific institute to clarify his or her functional attributes and participate in specific major construction work, taking into account his or her professional background, interests or career development plans.

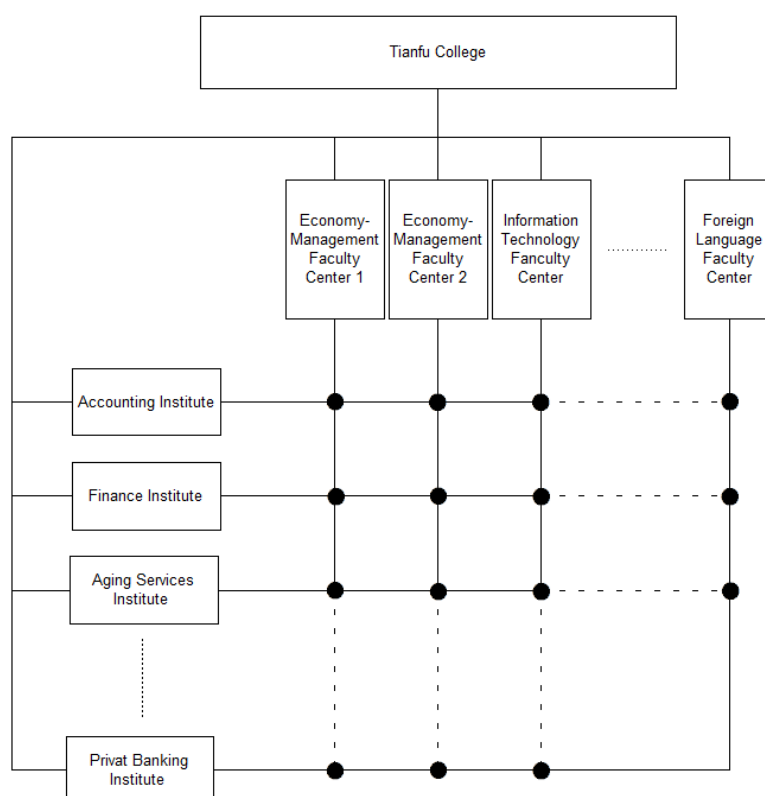


Figure 4.7 Faculty matrix (Center – Institute) in TFC

Source: Pu (2012)

Similarly, in addition to the institute as a functional unit for discipline building, the course group (as a functional unit for teaching) and the project group (as a functional unit for research) can be used as functional unit modules in different matrix combinations with the administrative functional units. Each faculty can exist as a node in different matrix combinations according to his or her own choice.

Through the Faculty Matrix, TFC breaks down the barriers to faculty mobility, encourages faculty to break through their own professional limitations, and stimulates the initiative of personnel, thus facilitating the implementation of human resource bricolage and meeting the requirements of disciplinary building integration and innovation.

At the same time, based on the faculty matrix management model, TFC establishes or abolishes institutes on an as-needed basis, instead of establishing institutions by people, thus ensuring a lean and efficient institution with a high degree of adaptability and innovation, which facilitates the occurrence of bricolage.

From the perspective of organizational management style, a flexible management style can stimulate employees to take ownership of resource bricolage and creativity and facilitate resource bricolage activities (Ferneley & Bell, 2006). Also, the relationship between EO and firm performance will be moderated by the use of an organic structure. Firms with an EO that use an organic structure will have higher performance relative to those that do not use an organic structure (Lumpkin & Dess, 1996).

TFC constructs an organic organization through a matrix faculty organization structure and an on-demand institutional management style, which not only meets the need for organizational stability and professionalism in knowledge production, but also ensures the requirement of establishing a flexible teaching production line, effectively supports the internal resource bricolage including personnel and knowledge, and provides a strong organizational structure for innovation and development.

In summary, we obtained the complete TFC Model (Figure 4.8) after considering the effect of organic structure.

Open Innovation Development of Private Colleges in China

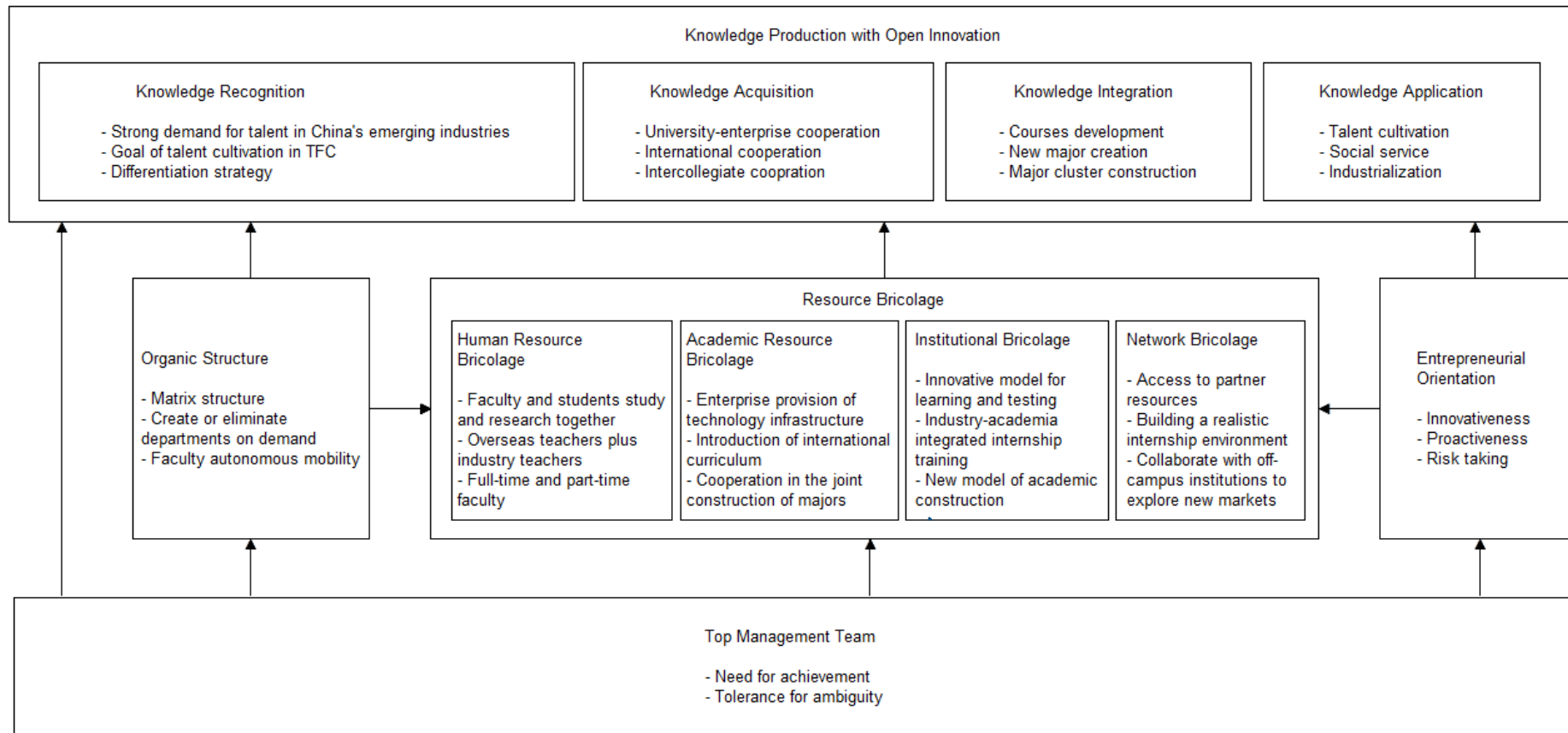


Figure 4.8 TFC model

Meanwhile, based on the previous discussion, we can find that top leadership, organizational culture, and structure are three key organizational elements that support open innovation in the knowledge production process and help to implement resource bricolage at the path level. Based on the innovation development performance achieved in the three studied subjects of OC, PB and HN, we propose the following:

Proposition 3. TMT with high need for achievement and high ambiguity tolerance, entrepreneurial oriented organizational culture and organic structure help knowledge production in private colleges to achieve open innovation development performance.

4.5 Summary

In this chapter, firstly, using the research methods presented, combined with the case study strategy and the inductive analysis method of grounded theory, we obtain the three aggregated dimensions of knowledge production, resource bricolage and TFC model, through the analysis of the raw materials related to TFC research subjects around the research question.

Secondly, according to the content of data structure, we divide the knowledge production process of TFC into four phases of knowledge recognition, knowledge acquisition, knowledge integration and knowledge application. The main task of the knowledge recognition phase is to search, discover or confirm the external knowledge that meets its own knowledge production needs among the massive external knowledge resources based on the external industrial talent demand, internal talent cultivation goal and differentiation strategy, which is the concrete embodiment of TFC's opportunity identification ability. In the knowledge identification phase, TFC builds a partner network through university-enterprise cooperation, international cooperation and intercollegiate cooperation to introduce external resources for its own knowledge production work, which is the embodiment of TFC's absorption ability. In the knowledge integration phase, it specifically accomplishes different levels of discipline construction through course development, major creation and major cluster construction, which is the concrete embodiment of TFC's innovation and transformation ability. In the knowledge application phase, the functional elements of TFC's knowledge production are completed through talent cultivation, social service and industrialization. TFC realizes the innovation work of its own knowledge production through the application life cycle of four phases: recognition, acquisition, integration and application, which is a typical open innovation model. The open innovation strategy is suitable and effective for TFC's knowledge production.

In the third section, we discuss the resource bricolage behavior in the process of TFC

knowledge production. According to the analytical framework of resource objects, bricolage methods and bricolage results, we find that resource bricolage in TFC knowledge production mainly focuses on human resource, academic resource, institution and network through horizontal analysis. Subsequently, we conducted vertical analysis according to different phases of the TFC knowledge production process and found that the knowledge integration phase is where input (human resource, academic resource) bricolage and institutional bricolage are most concentrated. Through human resource bricolage and academic resource bricolage, the work of course development, new major creation and major cluster construction is strongly supported. Through a variety of institutional bricolage, the abandonment of the traditional model of discipline building is realized, thus effectively implementing the innovation of internal processes. At both ends of the knowledge production process, it is the network bricolage that performs obviously. At the phase of knowledge acquisition, the access of partner resources is completed through network bricolage; at the phase of knowledge application, the docking of industry-academia network and market network is completed through network collocation to serve the cultivation of talents and industrialization work. Through resource bricolage, TFC breaks through the dilemma of its own resource constraints and strongly supports the achievement of open innovation performance of knowledge production.

In the fourth section, we further discuss what combination of organizational elements TFC uses to support its own open innovation development of knowledge production. The results find that TMT with high achievement needs, high ambiguity tolerance, entrepreneurial-oriented organizational culture and organic organizational structure together constitute the TFC model that helps TFC achieve open innovation development performance in knowledge production.

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Chapter 5: Conclusion

5.1 Summary

In the past 20 years or so, against the background of China's higher education moving from elite stage to universal stage, private colleges in China have made great progress in their overall development. In terms of scale, private higher education in China has become an important piece of the puzzle of Chinese higher education. However, due to policies deficiency and resources constrain, Chinese private colleges are completely unable to match Chinese public universities in the areas of institutional environment, financial resource, faculty, quality of students and other important resources. Given the limited resources, private colleges in China need to find different development models and paths from public universities in order to survive and develop in the increasingly competitive higher education environment. Therefore, this study addresses the aforementioned dilemmas of the development of Chinese private colleges and poses two research questions: 1) How can a private college in China achieve innovative development under the constrained resources and 2) What are the structural elements of innovative development of the private college in China and their interaction mechanisms?

Through reviewing and combing the literature, we find that under the vision of knowledge production, school is a knowledge production department, and discipline construction is the process of knowledge production (Qu, 2019). The featured disciplines and majors are often the lifeline and core competitiveness of universities, and they are also the features that are most easily and widely recognized by the outside world. In the era of knowledge economy, the development of knowledge production mode has gone through three stages: Model 1, Model 2 and Model 3. Knowledge production across disciplinary boundaries and disciplinary organization of heterogeneous organizational boundaries have become the main forms. The application orientation of Chinese private colleges, which inherently requires active contact with industry and interaction with industry (H. W. Huang et al., 2011), which provides external environment support for knowledge production in private colleges in line with Model 2 and Model 3.

Open innovation, through the acquisition and utilization of external resources, opens new ways for organizational innovation. Chesbrough (2006a) states that open innovation is the use

of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation. It may provide a practical reference model and development path for Chinese private colleges to make up for the disadvantages of internal and external development resources, integrate external knowledge sources to enrich the knowledge production and improve the innovation of colleges, build applied characteristic disciplines and majors, and construct their own core competitiveness.

At the same time, resource bricolage, as an important way for new start-ups to resolve institutional and resource constraints, can effectively break the dilemma of resource constraints in social entrepreneurial enterprises (W. Peng et al., 2018). It may provide a feasible breakthrough method for Chinese private colleges suffering from resource constraints, that is, through the bricolage and integration of internal and external resources and innovative use, to maximize the effectiveness of resources and thus form a unique competitive advantage.

Therefore, we propose the theoretical hypothesis that 1) Chinese private colleges can improve their own knowledge production development performance through open innovation; 2) Chinese private colleges can break through resource constrain and achieve open innovation development performance through resource bricolage.

Based on the research question focusing on the "How", we adopted an exploratory case study of a Chinese private college with high development performance, Tianfu College (TFC), as a case. We selected a collection of innovative practices in discipline construction at TFC, including Oracle Club (OC) courses, Private Banking (PB) major, and Health and Nursing (HN) major cluster, as the research subjects. The raw data set was formed through semi-structured interviews, on-site observations, and the collection of secondary data. The research team used an inductive analysis method (Miles & Huberman, 1994) based on grounded theory to analyze the data. Primary codes were formed by iterative combination of raw materials. The primary codes were then combined to form secondary codes. Based on this, the concept of aggregation dimensions was further refined through cross-analysis of raw data, secondary codes, and existing literature: knowledge, resource bricolage, and the TFC model.

By distilling the knowledge production model of TFC, we confirmed the effectiveness of the open innovation model in the field of knowledge production at TFC. Based on the different resource bricolage behaviors distilled at different stages of the knowledge production process, we found that resource bricolage strongly supports the open innovation development performance of knowledge production at TFC. The analysis of the material shows that the unique faculty matrix organization of TFC strongly maintain organizational flexibility to support the implementation of resource bricolage. The entrepreneurial orientation is not only

conducive to resource bricolage behavior, but also has a positive effect on open innovation development. The top management team is the foundation of the entire organizational structure, and in addition to building an organic organization, creating an entrepreneurial orientation, and supporting resource bricolage, it is the direction and driving force behind the development of open innovation at TFC.

In summary, we have drawn the following conclusions from the case study based on the research question of "how to achieve innovation development in a Chinese private college under the background of resource constraints".

(1) *Private colleges in China can achieve good innovation development performance in knowledge production through open innovation strategies.*

(2) *Resource bricolage has an important positive contribution to the development of open innovation in the TFC knowledge production process.*

(3) *TMT with high need for achievement and high ambiguity tolerance, entrepreneurial oriented organizational culture and organic structure help knowledge production in private colleges to achieve open innovation development performance.*

5.2 Theoretical contributions

This study expands and deepens the literature and research related to open innovation, resource bricolage, and the development of private colleges in China from the following points.

Firstly, this study develops a theoretical collection model of TFC concerning the open innovation development of knowledge production through case studies. Through the model, the mechanism of achieving open innovation development in the field of knowledge production in a private college in China and the interaction of organizational structure elements are clarified, which provides a reference for further theoretical research.

Secondly, open innovation research began with the analysis of large enterprise samples (L. M. Gao & Ma, 2014), and in previous open innovation studies, the research objects mainly focused on the enterprise context, from the initial technology multinationals to SMEs, and then to the construction of open innovation ecology. By grounded analyzing TFC, we fill the gap in the existing research on open innovation regarding a Chinese private college as the research object. It is proposed that a Chinese private college can develop through the open innovation development model under the resource constraint.

Thirdly, this study reveals the bridging role of resource bricolage in the development of knowledge-producing innovation in TFC and expands the breadth of examples of resource

bricolage in open innovation development research.

Fourthly, it provides new ideas from practical analysis for the study of innovation development of a private college in China. While most of the existing studies have discussed the innovation development of Chinese private colleges by environmental slices, this study reveals the key institutional elements and their interactions that support the innovation development of a Chinese private college from the organizational dimension through the data of a time window of nearly 15 years of the case, bridging the gap that previous studies have not considered enough the internal dynamics and complexity of the organization.

5.3 Practical reference

In addition to theoretical contributions, this study provides a practical reference for the innovative development of a private college in China.

Chinese public colleges and universities are allocated resources through the administrative power of the government and enjoy various resources given by administrative priority, while most Chinese private colleges can only obtain marginalized resources through the market mechanism, which is a concrete manifestation of the poorly ordered pattern of resource allocation in Chinese society due to the strong public administrative orientation in the field of higher education (Que, 2021).

Through this study, we show from more than a decade of open innovation development in knowledge production at TFC that open innovation may also be a sustainable trend that may provide the basis for achieving competitive advantage (Huston & Sakkab, 2006). This provides a realistic and feasible idea for Chinese private colleges, seeking individual development paths in the context of resource constraints. It requires Chinese private colleges to grasp the dividend of applied talents' demand brought by China's rapid economic development and drastic industrial changes, adhere to open schooling, increase openness to actively expand and absorb external resources, enhance external resources transformation and integration ability, form comparative advantages through differentiated competition in emerging applied disciplines, highlight applied talents cultivation and better serve social and economic development.

Meanwhile, through this study, we found that in addition to the strategic level of open innovation choice, at the execution level, resource bricolage is a proven tactical choice for Chinese private colleges to break through resource constraints and achieve open innovation achievement. For private colleges, which have relative disadvantages in terms of funding, faculty and student sources, resource bricolage has shown strong applicability in all aspects of

the knowledge production process. The input bricolage can effectively alleviate the lack of resources for the private college in terms of lack of investment, high level of faculty and quality of student population. At the same time, through institution bricolage, it also reflects the institutional advantages of private colleges are be flexible and innovative to adapt to the changing external environment, actively seek changes, and not yield to constraints. It also requires private colleges to further exert the resource bricolage, actively expand the cooperation network, enhance the integration of industry and education, explore their own potential to improve their own resource utilization, and strengthen their own process optimization and mechanism innovation. All of the above promote the resource gathering and utilization of high-level private colleges, and lay the foundation for their development (W. M. Gao, 2004).

In addition, through this study, we can see that at the organizational level, the leadership at the top, organizational culture climate and organizational structure have an important role in supporting the development of open innovation in the private college. It is a positive suggestion for administrators who aspire to build a high level of private colleges in China regarding organizational capacity building. Managers of Chinese private colleges need to first of all have the boldness and goal to pursue excellence and implement high-level leadership through consistent high achievement orientation to provide organizational momentum for the development of private colleges. By actively creating an entrepreneurial-oriented organizational culture to encourage innovation, engage innovate, and dare to innovate, we are able to achieve innovative development of the organization through an effective way of breaking through resource constraints with demand. At the same time, private colleges need to give full play to the advantages of mechanism and create a flexible organic organization, so as to provide flexible and powerful organizational structure guarantee for the integration and utilization of resources and open innovation development, and realize the development performance of school operation.

5.4 Research limitations and further research

This study corroborates the effectiveness of the open innovation development model for innovation development in a private college through a case study of knowledge production practices in TFC. The study demonstrates that a Chinese private college can break through resource constraints and gain innovative development performance through resource bricolage. Meanwhile, the top management team, entrepreneurial orientation and organic organization of TFC play a positive moderating role on its resource bricolage and the effect of resource

bricolage on open innovation performance. This study further expands the theoretical context of open innovation and resource bricolage research, enriches the relevant research objects, and provides some guiding references for the innovation development of Chinese private colleges. But there are still many shortcomings based on the study itself.

Firstly, the development of college and university involves many public management and educational management categories such as talent cultivation quality, teacher education mechanism, logistics supply assurance, social service level, and organization construction at all levels (A. J. Wei, 2009). This study focuses on the innovative development of TFC from the perspective of knowledge production. The limitations of research perspectives determine the lack of comprehensive representation of research on innovative development of private colleges.

Secondly, this study is an exploratory case study based on the knowledge production practice of TFC. The conclusions drawn by the research are applicable to TFC. However, the differences in attributes such as geographic location, historical endowment, and professional categories in other private colleges have resulted in inadequate generalization of research conclusions. More case comparisons or more practices are needed for follow-up improvement and verification.

Furthermore, this study involves the analysis and identification of knowledge production practices in TFC, and the process of research interviews, case data analysis and generalization may be limited by the researcher's knowledge and experience, subjective bias and objective error, and other factors, and there is a need to further test the reliability of the findings.

In summary, in the future research, we can further develop research from the perspectives of talent cultivation and social services to enrich the demand of multidimensional perspectives of innovation development of private colleges. For the data of private colleges from different regions, types and levels to expand multi-type and multi-context case studies and comparative studies to improve the generality of research findings.

At the same time, based on the theoretical model derived from this study, the development of relevant scales will be enhanced, thus supporting further empirical studies to be conducted.

Also, for the realistic scenario that organizations in all industries are experiencing dynamic environments marked by strong competitive pressure (Y. Su & Li, 2020), so we can further strengthen our focus on dynamic environments as well as explore the mechanisms of dynamic environments' influence on the innovation development performance of private colleges in China.

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Appendix A: Outline of the Interview

No.	Interviewee	Interview Questions
1	YDY	<p>How did the Oracle Club program get started?</p> <p>What are the main ways or elements of the Oracle Club program?</p> <p>From your point of view, which formal or informal elements or channels important for the development of the Oracle Club program?</p> <p>Could you please talk further from the Oracle Club program about the comparative advantages of TFC's disciplines construction and the areas that needed to be strengthened?</p>
2	TL	<p>The first question, what is the origin of the creation of the private banking major?</p> <p>What are the main ways or elements of the private banking major?</p> <p>From your point of view, which formal or informal elements or channels important for the development of the private banking major?</p> <p>Could you please talk further from the private banking major about the comparative advantages of TFC's disciplines construction and the areas that needed to be strengthened?</p>
3	WZ	<p>As the director of the private banking major, what are your main responsibilities?</p> <p>The private banking major was originally introduced from abroad, so perhaps due to cultural differences, there are some differences in the teaching. You also mentioned the integration and standardization of teaching resources in your work. How did you localize the teaching resources you introduced?</p> <p>How do you approach this aspect of student management in your work?</p> <p>How to improve in new major creation?</p> <p>Which formal or informal elements or channels do you think are important for the development of the private banking major?</p> <p>From the perspective of the private banking major, what are the comparative advantages and the areas that need to be complemented in TFC's discipline construction?</p>
4	CST	<p>Can you tell us about the origins of the construction of major cluster about the health and nursing, which started from research in social work and aging services?</p> <p>Can you review some of the important points in the construction of major cluster about health and nursing?</p> <p>The health and nursing major cluster in TFC is a first of in our west, which has made brilliant achievements in academics or in the industry. So as the core of your team, which formal or informal elements do you think are more important to the construction of health and nursing major cluster?</p> <p>Can you tell us about the comparative advantages and the areas that need to be complemented of TFC's discipline construction, from the perspective of the major cluster of health and nursing?</p>