

Research on the construction of technology intermediary innovation ecosystem and the growth of small and medium-sized enterprises--taking Wuhu General Aviation Innovation Park as an example

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ABSTRACT

With the in-depth implementation of the "mass entrepreneurship and innovation" strategy in China, scientific and technological innovation has become the main driving force of economic development, and the transformation of scientific and technological achievements is the main channel of scientific and technological innovation, and is the key link of the close combination of science and technology and economy. However, at present, China's science and technology intermediary system is not perfect and the performance of innovation transformation is low, which brings huge problems to the development of small and medium-sized enterprises in the ecosystem. As the carrier of technology diffusion and achievement transformation, the science and technology intermediary and the innovation ecosystem built play a vital role. From the perspective of the construction of the science and technology intermediary innovation ecosystem, Innovative view of science and technology intermediary as the main body, Further study on Wuhu General Aviation Innovation Park through literature analysis method, questionnaire survey method and interview method, The two complementary assets of technology intermediary are selected as the explanatory variables, Introducing resource sharing and knowledge spillover as intermediary variables, To analyze the constructed theoretical framework and mechanism, At the same time, four theoretical frameworks from the perspective of science and technology intermediary innovation ecosystem, For the formation and improvement of the science and technology intermediary innovation ecosystem, the effective promotion of innovation transformation ability and the growth of small and medium-sized enterprises.

KEYWORDS

Technology intermediary; Innovation ecosystem; Small and medium-sized enterprises; Transformation of scientific and technological achievements

1. INTRODUCTION

With the in-depth implementation of China's "mass entrepreneurship and innovation" strategy, scientific and technological innovation has become the main driving force for economic development. In the background of fierce global competition in science and technology, scientific and technological innovation is not only an important support for national development, but also the key to the sustainable competitiveness of enterprises. As an important link of scientific and technological innovation, the transformation of scientific and technological achievements carries the mission of transforming scientific and technological achievements into economic benefits and social values. However, the imperfection of China's science and technology intermediary system and the low performance of innovation transformation have become the bottleneck restricting the development of

science and technology innovation, especially bringing severe challenges to the development of small and medium-sized enterprises in the ecosystem.

As the key link of technology diffusion and achievement transformation, science and technology intermediary plays the role of a bridge connecting scientific and technological innovation and market demand. By introducing, disseminating and applying advanced technologies, science and technology intermediaries promote technological innovation and industrial upgrading of enterprises, and promote the transformation of scientific and technological achievements to the market. The construction of science and technology intermediary innovation ecosystem is helpful to build a bridge of science and technology innovation, promote the effective transformation and promotion of scientific and technological achievements, and provide a broader space for the development of small and medium-sized enterprises.

Most of China's science and technology intermediaries are due by government departments and their own construction. The transformation ability of scientific and technological achievements is relatively weak, the transformation performance is not high, and the construction and contribution to the innovation ecosystem are limited, and more exist as external resources and environment in the innovation ecosystem. Therefore, the early research of domestic scholars mainly focuses on the connotation, structure, function of science and technology intermediary and the correlation with the innovation ecosystem. From the perspective of ecology, Huang Lucheng gave the definition of innovation ecosystem; Gu Shengzu (2017) believed that "innovation and entrepreneurship subject", "innovation elements" and "innovation and entrepreneurship ecological environment" constitute interdependent and synergistic dynamic balance system; Zhang Min and Duan Jinjun (2018) and Kong Wei (2019) also studied the connotation of innovation and entrepreneurship ecosystem from a unique perspective.

In the later stage, domestic scholars conducted empirical analysis based on cases and analyzed technology intermediaries from the perspective of innovation community and innovation performance: Dong Qiang and Tian Xizhou (2018) believe that the construction of regional innovation ecosystem is conducive to the interaction between the resource exchange participants and improve innovation performance; Li Xiaodi and Zhang Xiaoyan (2019) believe that the construction of good innovation ecosystem has spillover effect, which is conducive to the improvement of regional innovation performance, and is an important strategy to promote the development of regional economy.

As can be seen from the research and development path of most foreign scholars, more attention is paid to the transformation ability, innovation performance and contribution rate of science and technology intermediaries. Teece (2018) believes that dynamic capabilities enables enterprises to create and acquire value by building an ecosystem and designing appropriate business models; with a more extensive and comprehensive understanding of technology intermediary operation mechanism, Jacobides, Cennamo and Gawer (2018) indicate that modularity can promote the development of ecosystem.

From the perspective of research content, it mainly focuses on the overall innovation ecosystem, rarely involves the innovation ecosystem and small and medium-sized enterprises, mostly studies the basic operation mechanism, and rarely studies the paths and mechanisms. From the research method, the current research focuses on descriptive research and case analysis, and relatively complete empirical research is still lacking. It is particularly important to build a technology intermediary ecosystem that is conducive to stimulating the innovation momentum of smes and effectively improving the innovation ability of technology-based smes.

From the perspective of the construction of science and technology intermediary innovation ecosystem, this paper takes the science and technology intermediary as the main body, through the in-depth study of Wuhu General Aviation Innovation Park, selects the two complementary assets of science and technology intermediary as the explanatory variables, introduces resource sharing and

knowledge spillover as the intermediary variables, and constructs the theoretical framework and mechanism. Through literature analysis, questionnaire survey and interview methods, this paper discusses the role of science and technology intermediary in the innovation ecosystem and influencing factors, puts forward the four mechanism theoretical framework, for the formation and improvement, the ability of innovation and the growth of small and medium-sized enterprises to provide theoretical support and practical guidance.

2. THEORETICAL BASIS

2.1. Technology Intermediaries and Their Complementary Assets

In today's society, science and technology intermediary plays an important role in promoting scientific and technological innovation and promoting industrial development. Science and technology intermediary refers to the organization or institution that promotes technological innovation and industrial development by introducing and disseminating advanced technology and knowledge. Science and technology intermediaries can be scientific research institutions, technology consulting companies, incubators, etc. They help enterprises and individuals to acquire advanced technology, improve technology level and promote industrial development through technology transfer, technical consultation, technical training and other ways.

Technology intermediaries play an important role in technology transfer. Through technology transfer, advanced technology can quickly spread to various fields and promote technological innovation and industrial upgrading. Technology intermediaries can also provide technical consulting services for enterprises to help them solve technical problems and improve their technical level. In addition, technology intermediaries can also provide technical training and support for researchers to improve their technical capabilities and innovation capabilities.

Technology intermediary are in the intermediate link of technological innovation, and the continuous innovation of technology supply and demand also promotes the reform of technology intermediary themselves. This change constantly generates complementary assets. Teece divides them into universal complementary assets (General Complementary Asset), professional complementary assets (Specialized Complementary Asset), and common specialized complementary assets (Co-specialized Complementary Asset). Teece The concept of complementary assets is mainly based on small and medium-sized innovative enterprises. If these enterprises want to industrialization new technologies, they must allocate operating assets that complement new technologies in different ways, such as marketing network, brand, management, manufacturing, after-sales service, etc.

Science and technology intermediary is cooperate with science and technology enterprises, universities, scientific research institutes, the middle of technology industrialization when intermediary technology patents with a university professor with a technology enterprise technology trading, it must have familiar with the patent of technical experts or can invite to such technical experts, but also must have familiar with the technology application of business experts or invited to such experts. When it wants to help a technology enterprise transfer technology property rights, it must maintain close business ties with intellectual property evaluation agencies, technology exchanges, banks, guarantees and other technology financial service departments. These independent experts, knowledge system, service qualification, customer relationship, and the experts, knowledge system, service qualification and customer relationship of other units indirectly owned through strategic agreements are the complementary assets of science and technology intermediaries.

Teece Complementary assets are divided into three categories. When introducing the concept of complementary assets into science and technology service industry, it is difficult to divide them into three categories, because such complementary assets are "soft", reflecting the differences between service industry and manufacturing industry, so this study divides them into two categories: universal complementary assets and professional complementary assets. Universal complementary assets

mainly include: service hardware facilities (such as business sites, computer network equipment, etc.), total assets, low-level human resources (ordinary business personnel, technical personnel and management personnel), technology source channels, technology demand channels, etc. Professional complementary assets mainly include software facilities (such as databases, professional knowledge system, etc.), high-level human resources (directly or indirectly owned technical experts, operation and management experts), and cooperative relations with various subjects in the innovation system, etc.

2.2. Innovation Ecosystem

Innovation ecosystem refers to an interactive and interdependent system composed of various organizations, institutions and individuals, aiming to promote innovation and promote industrial development. The concept of an innovation ecosystem originates from ecology, emphasizing the interaction and reciprocity among various elements to achieve innovation and growth.

The innovation ecosystem includes innovators, scientific research institutions, enterprises, investors, governments and other participants, who cooperate with each other, share resources, and jointly promote innovation in the innovation ecosystem. At the core of the innovation ecosystem are innovators, who promote scientific and technological progress and industrial development through innovation activities and practices. Scientific research institutions provide technical support and research results, enterprises provide market demand and commercialization opportunities, investors provide financial support, and the government provides policy support and environmental guarantee, so as to jointly build an ecosystem conducive to innovation and development.

In recent years, innovation ecosystems have received wide attention and application worldwide. Many countries and regions are actively building innovation ecosystems to promote scientific and technological innovation and promote economic growth. The construction of innovation ecosystem can not only promote scientific and technological innovation and industrial development, but also enhance national competitiveness and innovation ability.

Overall, the innovation ecosystem is a complex system consisting of multiple players and elements that jointly drive innovation and development through various forms of cooperation and interaction. In the future, with the continuous development and progress of science and technology, the innovation ecosystem will continue to play an important role in promoting innovation and growth.

3. THE STUDY HYPOTHESIS

This study holds that the classification of complementary assets can represent the internal structure of the special organization of technology intermediary, with different asset allocation and structure, which limits the operation (selection) behavior of technology intermediary, and then enables the growth of small and medium-sized enterprises through resource sharing and knowledge overflow; and the social network relationship of technology intermediary can regulate the performance of technology intermediary with different asset structures.

3.1. Objective of Science and Technology Intermediary Service Demand for Complementary Assets of Science and Technology Intermediary

Most of the innovation subjects served by science and technology intermediaries are small and medium-sized science and technology enterprises, and the disruptive innovation is often initiated by small and medium-sized science and technology enterprises, and causes the predicament of large enterprises in the industry. Since the complementary assets required for the commercialization of disruptive innovation are not in the hands of the current large enterprises, the small and medium-sized technology enterprises engaged in this kind of innovation hope to borrow such assets from the

technology intermediary services, which puts forward the demand for the asset structure of the technology intermediaries themselves. Continuity innovation can be initiated by incumbent large enterprises or small and medium-sized enterprises in science and technology. The complementary assets on which the successful commercialization of continuous innovation are usually in the hands of incumbent large enterprises. Therefore, small and medium-sized technology enterprises have less demand for such assets of technology intermediaries, and a large demand for conventional assets such as information and capital.

Through the analysis of the above innovation behaviors, we can distinguish the different needs of different innovation behaviors for the complementary assets of technology intermediaries. Accordingly, this study proposes the following assumptions:

Hypothesis 1 Universal complementary assets are positively correlated with the growth of SMEs in technology intermediaries.

Hypothesis 2 Professional complementary assets are positively correlated with the growth of smes in technology intermediaries.

3.2. The Impact of Resource Sharing and Knowledge Spillover of Science and Technology Intermediaries on the Complementary Assets of Science and Technology Intermediaries

Under the promotion by the government, the resource sharing of science and technology intermediaries in China presents the following characteristics:

Although it is not an official, it indirectly has a certain right of resource allocation, and the government is strong in the network relations. Most of our country technology intermediary is from the original research institutes or departments directly under the government transformation, they have ties with relevant government departments, so our country technology intermediary resources sharing presents the characteristics of a strong contact, the strong contact helps technology intermediary to obtain universal complementary assets and professional complementary assets. For example, with government subsidies, some technology intermediaries can obtain general assets such as business premises at a lower cost. With government matchmaking, some technology intermediaries are relatively easy to investigate and build technology research and development database.

Due to the deepening division of labor in technology research and development, technology intermediaries must meet various service needs through knowledge spillover. With the continuous promotion of scientific and technological progress, the accumulation and dissemination of knowledge has become more rapid and extensive. Technology intermediaries can constantly absorb, integrate and apply all aspects of knowledge to better meet the changing service needs. Through knowledge spillover, technology intermediaries can deliver advanced technology and experience to a wider range of users, thus improving the overall service level and quality. This sharing and dissemination of knowledge will not only help science and technology intermediaries to improve their competitiveness, but also promote the healthy development of the entire science and technology innovation ecosystem. Therefore, in the face of the deepening of the division of technology research and development, it has become an inevitable choice to meet the needs of various services through knowledge spillover, which will also bring new opportunities and challenges to the development and innovation ability of science and technology intermediaries.

Through the above analysis, the following assumptions are proposed for verification:

Suppose 3. The strong empowerment of technology intermediaries is positively correlated with the resource sharing of technology intermediaries and the degree of knowledge spillover.

Hypothesis 4 The strong empowerment of technology intermediaries helps to increase their generic complementary assets.

Hypothesis 5 The strong empowerment of technology intermediaries helps to increase their professional complementary assets.

4. RESEARCH MODEL AND RESEARCH METHODS

4.1. Theoretical Model Construction

According to the literature review and research hypotheses, the theoretical model of the relationship between the variables is shown in Figure 1.

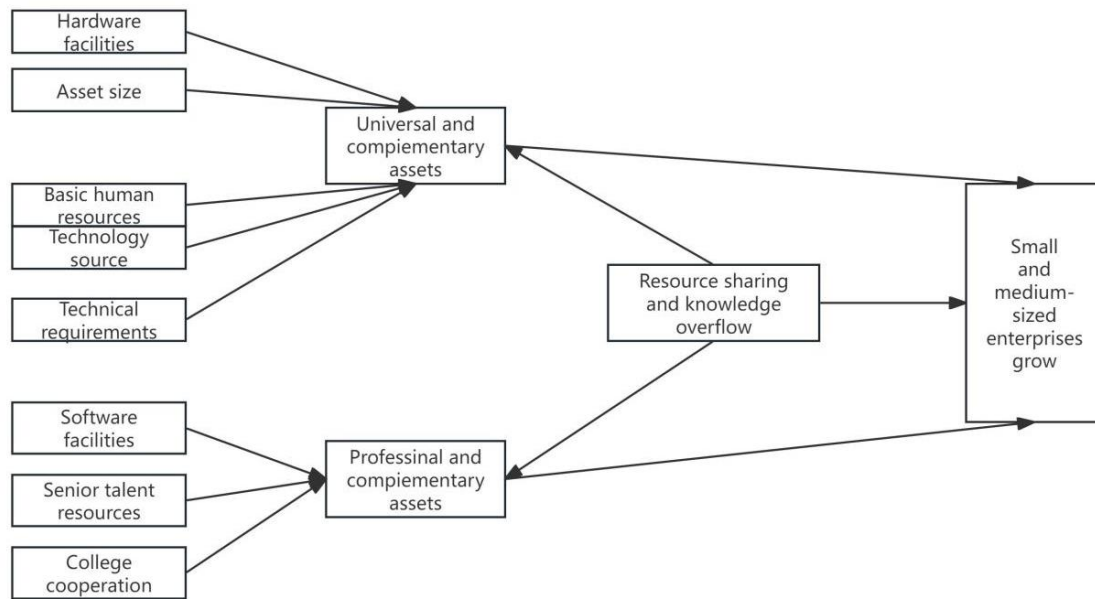


Figure 1. Theoretical analysis framework

4.2. Variable Measurement

The scale of complementary assets of technology intermediaries mainly refers to the relevant studies of Massimo, Chiu et al. The universal complementary assets of this paper are measured from five aspects: hardware facilities, asset scale, low-level human resources, technology source channels and technology demand side channels, while the professional complementary assets are measured from three aspects: software facilities, high-level human resources and the depth of cooperation with other institutions, with a total of 23 items. The above questions are scored by Likert 7 comment scale method.

In this paper, the sum of each item and found that the correlation coefficient between all other items and the sum except the asset size was significant. After excluding the asset scale items, the KMO value of the whole scale is 0.854, and the significance level of Bartlett's sphere test is less than 0.05, which meets the requirements of factor analysis.

4.3. Study Samples and Data Processing

Taking Wuhu General Aviation Innovation Park as the research object, questionnaires were distributed to science and technology intermediaries, enterprises, relevant government departments, industry associations, scientific research institutes, financial institutions, etc. The assets, number, performance and other indicators in the questionnaire are all the values of 2023. In this study, 700 questionnaires were distributed, and 147 valid questionnaires were recovered, with an effective recovery rate of 21%. The statistical analysis results show that the Cronbach's α value of each variable is greater than 0, indicating that each item is reasonably designed and can effectively support the

variable; however, the Cronbach's α value of hardware facilities and low-level human resources are 0.71 and 0.80 respectively, which is slightly lower than other items, due to the heavy proportion of intangible assets of technology intermediary and the ordinary employees with low skills have weak contribution to the performance. In addition, the KMO value of universal complementary assets is 0.803, and the explained variance percentage is 64.32%; the KMO value of professional complementary assets is 0.851, and the explained variance percentage is 68.56%, indicating that the overall model has high reliability, and the asset classification of technology intermediary can be described by universal complementary assets and professional complementary assets..7

5. RESULTS AND ENLIGHTENMENT

5.1. Results Analysis

Universal complementary assets have a significant positive correlation on the growth of small and medium-sized enterprises; H1 is verified; professional complementary assets have a significant positive correlation with the growth of small and medium-sized enterprises of technology intermediaries; H2 is verified; the resource sharing and knowledge spillover with the performance of technology intermediaries; H3 is verified; the strong empowerment of science and technology intermediaries has a significant positive correlation with the generic complementary assets and professional complementary assets, and H 4 and H 5 are supported.

5.2. Conclusions and Enlightenment

According to the innovation chain technology intermediary in the middle link, the fundamental characteristics of service innovation system, this paper proposes with complementary assets to depict its internal structure, with knowledge sharing and resource overflow agent external environment, on the basis of building the science and technology intermediary technology can assign small and medium-sized enterprise influence mechanism model, empirical results show that: technology intermediary complementary assets does contribute to its power effect, but the key role is professional complementary assets rather than universal complementary assets.

By exploring the construction of the innovation ecosystem, this study found that the technology intermediary plays an important role in the innovation ecosystem. Building a good science and technology intermediary innovation ecosystem can promote the interaction between resource exchange participants, improve innovation performance, and promote regional economic development. At the same time, the transformation ability of science and technology intermediary has an important impact on the innovation performance and contribution rate, and the concepts of dynamic ability and modularity also play a key role in the development of the ecosystem.

Based on the findings of this study, we put forward four theoretical frameworks, aiming to provide theoretical support and practical guidance for the formation and improvement of the technology intermediary innovation ecosystem, the improvement of innovation transformation ability and the growth of small and medium-sized enterprises. Future studies can further explore the specific operation mode of these mechanisms and verify them combined with empirical research to promote the construction and development of the technology intermediary innovation ecosystem.

However, at present, the research on the technology intermediary innovation ecosystem mainly focuses on the overall framework and basic operation mechanism, and the specific construction path and mechanism still need to be further studied. In particular, there are still research gaps in stimulating the innovation momentum of smes and improving the innovation ability of technology-based smes. Therefore, future research can pay more attention to the supporting role of science and technology intermediary for technology-based SMEs, and explore the path and mechanism of building a science and technology intermediary ecosystem conducive to the innovation of technology-based smes.

In short, the construction of a good science and technology intermediary innovation ecosystem is of great significance for promoting scientific and technological innovation and promoting economic development. Through in-depth study of the role and influencing factors of science and technology intermediaries, we can provide useful reference and guidance for future policy formulation and practice, promote science and technology intermediaries to play a greater role in the innovation ecosystem, and promote the innovation and development of small and medium-sized enterprises.

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