Conditions and Strategies for University Library Participation in Makerspace Construction: Post-print

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Abstract

[Purpose/Significance] This study demonstrates the rationality of university libraries' participation in cultivating maker spaces, providing a theoretical exploration for securing development space for university libraries. [Method/Process] Employing literature review methodology, it analyzes the current construction needs of maker spaces and the motivations for university libraries' involvement, while examining the inherent conditions that enable university libraries to support and nurture maker spaces. [Results/Conclusion] Through establishing an off-campus collaborative innovation mechanism embedded within the government-industry-academia nexus and an on-campus collaborative cultivation mechanism involving multiple stakeholders, optimizing internal service coordination for maker spaces within university libraries, and strengthening policy support from government and university authorities, university libraries can effectively participate in the construction process of maker spaces.

Full Text

Conditions and Strategies for University Libraries to Participate in Maker Space Construction

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Abstract

[Purpose/Significance] This paper demonstrates the rationality of university libraries participating in maker space cultivation and provides a theoretical exploration for libraries to expand their development space. **[Method/Process]** Through literature investigation, this study analyzes the current needs of maker

space construction and the reasons for university library participation, while examining the conditions that enable university libraries to support and cultivate maker spaces. [**Result/Conclusion**] By constructing an external collaborative innovation mechanism embedded in government-industry-academia relations and an internal collaborative cultivation mechanism involving multiple campus stakeholders, optimizing internal maker space service coordination within university libraries, and strengthening policy support from government and universities, university libraries can effectively participate in the maker space construction process.

Keywords: maker space; incubator; maker space; university library

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To steadily implement the innovation-driven development strategy, address challenges posed by the new normal in economic development, and adapt to the new trend of mass entrepreneurship and innovation in the big data era, the General Office of the State Council issued the "Guiding Opinions on Developing Maker Spaces to Promote Mass Entrepreneurship and Innovation" as early as 2015. This policy emphasizes the need to maintain market orientation, strengthen policy integration, enhance open sharing, innovate service models, stimulate the creative vitality of millions of people, and create a new engine for economic development. It calls for promoting the in-depth development of maker spaces and giving full play to the synergistic role of government, enterprises, and universities. Based on relevant literature, this study examines the internal logical rationale for university libraries to collaboratively cultivate maker spaces with multiple stakeholders and proposes relevant recommendations, with the hope that maker spaces can better serve as an important support for implementing the innovation-driven development strategy.

1. Definition of Related Concepts

1.1 Maker Space

The concept of maker space can be traced back to Hackerspace, recognized as the world's first maker space, which was established in Germany in 1995 with the purpose of popularizing computer-related knowledge. When Hackerspace entered China in 2001, it was called a "maker space." The term "maker" originally had a limited scope, generally referring to technical researchers or other individuals engaged in innovation and entrepreneurship. Maker spaces are products of the Innovation 1.0 era (technology R&D-oriented, with scientific researchers as the main body and research laboratories as the platform), aimed at serving makers with two prominent characteristics: educational and public welfare nature. Through the information technology revolution, maker spaces have gradually become socialized and open, focusing on the transformation and incubation of creative ideas. Against the background of knowledge flow in society, the democratization of innovation has become increasingly evident. The Chinese government proposed "mass entrepreneurship and innovation," and the

establishment of maker spaces has received high-level attention. In 2015, the State Council officially issued the "Guiding Opinions of the General Office of the State Council on Developing Maker Spaces to Promote Mass Entrepreneurship and Innovation." Maker spaces are open, low-cost, convenient, and full-service platforms built through market mechanisms, professional services, and socialized operations [3]. Openness and low cost mean that maker spaces are open to all members of the public with innovative intentions, adopting a model of partial fee-based and partial free services. Convenience means that maker spaces provide venues, office facilities, registration services, legal consultation, policy application, training lectures, and project roadshows to facilitate the growth of enterprises. Full-service refers to the chain-like services provided by maker spaces.

1.2 Incubator

An incubator (business incubator) refers to a centralized space that provides various conveniences such as capital and management during the early stages of enterprise establishment, aiming to incubate high-tech achievements, technology-based enterprises, and startups to promote cooperation and exchange and help enterprises grow stronger. Social development has driven the evolution of incubators from 1.0 to 4.0: (1) Incubator 1.0: providing space; (2) Incubator 2.0: providing space + basic services; (3) Incubator 3.0: providing space + in-depth services + financing; (4) Incubator 4.0: providing space + precise services + financing. From Incubator 1.0 to 4.0, the number of incubators has increased dramatically and diversified in form. Especially in the Incubator 4.0 era, the most fundamental change lies in the scope of services, transforming from providing single space to creating a low-cost, open, full-service platform for entrepreneurs. The digitalization, chain-based specialization, platformization, and sharing of carriers have met the needs of the maker (crowd innovation) era, and traditional incubators have evolved into new types of incubators [1].

In China, incubators first appeared in 1987 at the East Lake Entrepreneurship Service Center and have gone through four development stages, as shown in Figure 1 [Figure 1: see original paper].

1.3 Comparison of Maker Spaces, Traditional Incubators, and Maker Spaces

Maker spaces, maker spaces, and incubators all satisfy creative exchange and achievement transformation. Due to the fluidity of the knowledge society, traditional incubators have developed into maker spaces and finally into maker spaces. In the Incubator 2.0 era, traditional incubators had already begun evolving toward maker spaces, entering the stage of new-type incubators. Through co-development with maker spaces, maker spaces emerged. Li Yanping once proposed that "maker space = maker space + entrepreneurship incubation" [2]. The three have undergone a series of changes in internal elements such as

marketization, space requirements, and functional supply, as shown in Table 1 .

Table 1. Comparison of Elements Among Maker Spaces, Maker Spaces, and Traditional Incubators [4]

Element	Traditional Incubator	Maker Space	Maker Space
Space Carrier	Small-scale general service carrier	Interest and technology-driven community	Comprehensive entrepreneurship service platform
Functional Supply	Focus on investment and services	Focus on exchange and sharing	Chain-like services
Target Group	Startup enterprises, projects (teams)	Creators, geeks, etc.	Aspiring entrepreneurs
Development Stage	Enterprise establishment period	Creative incubation period	Entrepreneurship incubation period
Entrepreneurial Atmosphere	Strong entrepreneurial atmosphere	Entrepreneurial value not yet explored	Entrepreneurial concept not yet deepened

2. Literature Review

Chris Anderson [5] proposed that makers are groups that use various tools to transform creative ideas into physical achievements. Foreign scholars' research on combining maker spaces with university development mainly discusses the advantages of university libraries in building maker spaces and how to construct them. T. Trust et al. [6] integrated maker space research with university curricula, pointing out that students' participation in maker space activities is beneficial to improving their own abilities. A. C. Michael [7] emphasized that university libraries have the function of providing knowledge services and are equipped with relevant equipment and tools, which gives them natural advantages in participating in maker spaces and helping makers realize creative transformation. H. M. Moorefield-Lang [8] analyzed two key factors in the construction and operation of maker spaces in university libraries: the operational ability of librarians and the usage ability of users. K. M. Oliver [9] analyzed the influencing factors of university library maker spaces from three perspectives: design, configuration, and operation.

Domestic research literature on university library maker spaces emerged in 2014 [10]. The article "Maker Space: A New Trend in University Library Services" by Lü Yajuan and Zhang Xing is the pioneering work in this field in China, elaborating on the significance and implementation methods of introducing maker spaces into university libraries. Since then, the combination of university libraries and

maker spaces has become a research hotspot in the library community. Beginning in 2015, maker spaces adapted to the development of the Innovation 2.0 era, and the national level promoted the construction of maker spaces. Scholars' research gradually shifted to the combination of university libraries and maker spaces. At the theoretical level, research mainly focuses on the principles and integration models of university library participation in maker space construction, providing theoretical guidance for practice. Chu Jiewang [16] started from the concept of maker spaces, repositioned the functions of library maker spaces such as providing knowledge information services and creative incubation, and proposed measures for library development of maker spaces. Liu Tianjiao [11] proposed that university library participation in maker space construction should not be arbitrary but should follow principles of acting within capacity, integrating theory with practice, prioritizing patented technologies, and combining internal and external factors. Huang Xuemei [7] analyzed the ecosystem structure of their combination and proposed three possible development models: cooperative model, independent model, and innovative model. At the practical level, scholars have proposed experiences and enlightenment based on case studies of university library participation in maker space construction. Wang Qing [12] examined U.S. library practices and proposed that influencing factors in library maker space operation include the allocability of basic resources, the accessibility of funding sources, the effectiveness of personnel management, and the reliability of partnerships. Yang Ying [13] analyzed several libraries including Fayetteville Library in the U.S., the University of Nevada, Reno Library, Victoria Park Public Library, and Oslo Public Library in Norway, and proposed specific strategies for developing maker spaces in Chinese university libraries based on their foundational conditions.

In summary, most research on university libraries and maker spaces focuses on the construction of library maker spaces within universities, with little research on university libraries participating in external social maker spaces. This paper focuses on the theoretical level, explaining the necessity and sufficiency of university library participation in maker spaces from both perspectives. By constructing industry-academia-research collaborative mechanisms and internal campus collaborative mechanisms, this study creates conditions for university library participation in maker spaces to engage in social innovation and serve social and university innovation and entrepreneurship groups.

3. Driving Forces for University Library Participation in Maker Space Construction

3.1 Maker Space Construction Requires University Library Participation

Currently, China's maker spaces are developing rapidly, but this new form of entrepreneurship has not yet formed a mature paradigm. Problems exposed during rapid development have led to service homogenization, specifically in-

cluding: (1) Lack of supporting professional services. Maker spaces are platforms that inspire makers, promote maker exchange, drive creative sharing, and realize creative transformation, providing comprehensive services for innovation and entrepreneurship enterprises including venues, office equipment, knowledge resources, service teams, organizing entrepreneurship training, industry consultation, competitions, and providing upstream and downstream industry docking services. They should follow the "innovation-incubation-industrialization" path to meet the needs of more entrepreneurs and form industrial chain services. However, China's maker space services still remain at the level of renting space and basic business agency services [14], lacking professional and high-level services in policy interpretation, professional consultation, and market analysis, making them easily replicated and imitated. Therefore, improving professional service levels and enhancing soft power development is the direction for sustainable development of maker spaces. (2) Lack of professional and efficient entrepreneurship mentor teams. Maker spaces need to establish mentor teams with industry background and management experience to integrate capital, knowledge information, technology, and media resources for innovation and entrepreneurship teams, combining online and offline services with incubation and investment. Currently, China's maker space mentor teams are mainly part-time, with significant differences in personnel quality and coaching ability and low professionalization, causing bottlenecks in key incubation areas such as technology development, capital docking, knowledge updating, and market expansion.

Most social maker space cultivation processes do not involve university libraries. Some universities only play a coordinating role through departments such as the Youth League Committee and Academic Affairs Office to solve issues of land and management rights for campus maker spaces, without fully recognizing the essential information, talent, and knowledge services required by maker spaces. They fail to inject university library resources into maker spaces or establish long-term cooperation mechanisms with enterprises. Such university maker spaces are insufficient to meet makers' needs for creative cultivation and transformation, making them unsustainable. For example, at Anhui Agricultural University, there were three coffee shops: Miao Coffee, Barbie Coffee, and 308 Coffee. Miao Coffee survived well due to the university library's superior environment and pricing, while 308 Coffee and Barbie Coffee have closed. At Anhui University, the Baicaoyuan Coffee Bar closed after several years of operation, but the "1928 Youth Innovation Coffee" selected through entrepreneurship competitions held by the university library became very popular among students and operates well. University maker spaces lack the support of university library resources and creative transformation mechanisms.

3.2 University Libraries Need Transformation and Development

University libraries bear important responsibilities in serving teaching and scientific research innovation. With the rapid development of information technol-

ogy, university libraries are no longer merely providers of literature materials but must adapt to the trend of innovation and entrepreneurship. They urgently need to expand service content, transform development direction, and become platforms for intellectual development, creative display, and innovation assistance. As university library service systems gradually integrate into modern public cultural service systems, they implement concepts such as equality and sharing from idea to practice. Maker spaces provide development opportunities for university libraries, promoting interdisciplinary output and regeneration, urging library staff to actively engage in knowledge innovation service-oriented business activities [15], enriching service content, innovating service models, and extending service scope.

3.3 University Libraries Have Advantages in Participating in Maker Space Construction

Maker spaces aim to provide venues, equipment, continuous knowledge resources, mentor teams, and conditions for creative transformation for innovation and entrepreneurship. University libraries themselves are knowledge and information sharing spaces with experienced librarian teams. As public departments, they have the need and ability to provide advanced equipment for readers either free of charge or for a fee. Additionally, some university libraries serve both aesthetic and practical functions, equipped with lecture halls, exhibition halls, and shared spaces that can provide venues for innovation activities requiring brainstorming, creative sharing, skill training, and achievement transformation. These conditions make university libraries advantageous participants in maker space construction. Compared with other social institutions, the most prominent advantage of university libraries is their ability to provide full-factor services, forming a service chain that greatly reduces the cost of building maker spaces. University library participation in maker space cultivation can achieve full integration of high-quality internal resources with social resources to build a relatively complete innovation and entrepreneurship service chain. Kunming University of Science and Technology's "Maker Action of KUST" mobilized the entire university, integrated library resources, utilized its information advantages, gave full play to disciplinary characteristics, and jointly built the "KUST Maker Incubator" with China Mobile, providing one-stop comprehensive services for makers and building a "talent-project-discipline-industry" linkage mechanism, forming a good long-term operational model due to multi-stakeholder participation.

4. Supporting Conditions for University Library Participation in Maker Space Cultivation

For university libraries to effectively participate in maker space construction, certain conditions are required. Currently, some conditions are already in place, such as information resources, personalized services, and management models. Some conditions need strengthening but can be achieved in the short term,

such as 3D printing equipment and knowledge services. Others require longer timeframes, such as artificial intelligence application, smart library construction, and librarian innovation and entrepreneurship teams.

4.1 New Functional Positioning

Modern university libraries are service institutions that integrate information exchange, knowledge sharing, creative cultivation, and achievement transformation, capable of meeting various needs of makers [16]. Their basic functions are to preserve human cultural heritage, conduct social education, transmit scientific information, and develop intellectual resources. University library participation in maker space cultivation requires providing cloud services, big data resources, organizing creative education and competitions, strengthening connections with enterprises to promote marketization of creative achievements. In this chain-like service process, university libraries must transform innovation service concepts, optimize innovation service content, strengthen innovation functions, better adapt to knowledge economic society development, and achieve modernization of university libraries as an important path for transformation and development [17].

From the perspective of library functions, university library services share much in common with maker space services, providing reliable conditions for maker space construction. As shown in Table 2 :

Table 2. Comparison of Maker Space Services and University Library Services

Service Element	Maker Space Service	University Library Service
Space Carrier	Internal design should be distinctive, with scientific planning and humanistic environment. Includes public reception areas, project exhibition areas, meeting rooms, leisure activity areas, and professional equipment areas.	Provides comfortable environment, convenient services, and elegant learning space from external environment construction to internal atmosphere creation.
Infrastructure	Provides equipment for creative realization at low cost due to the “grassroots” nature of maker groups.	Smart building facilities and office cloud services provide emerging digital fabrication tools such as 3D printers and projectors.

Service Element	Maker Space Service	University Library Service
Knowledge Resources	Provides paper literature and electronic resources related to innovation projects, holding at least 10 entrepreneurship salons, roadshows, competitions, and training activities annually.	Has rich collections, providing large amounts of digital resources, literature resources, and scientific and technical information services, conducting scientific education, organizing maker education and training lectures, maker exhibitions, and competitions.
Team Resources	Ministry of Science and Technology requires professional incubation service teams with at least 3 full-time personnel with professional service capabilities and at least 3 part-time mentors.	Librarian service teams with different professional knowledge collaborate and cooperate, providing knowledge services such as scientific and technical novelty searches and information analysis.
Creative Transformation	Provides series of services for transforming creativity into achievements, making innovation results meet market demand as much as possible.	Has professional staff with knowledge in intellectual property and scientific and technological achievement transformation, establishing cooperative relationships with relevant enterprises.

4.2 New Service Concepts

The favorable conditions for university libraries to cultivate maker spaces are mainly reflected in: (1) Building strategic partnerships with service objects. University library subject services are deeper-level information services adapted to the information environment, relying on library literature and internet electronic resources, with knowledge services as the core, building subject service platforms to provide comprehensive information resources and technical support to help makers complete achievement transformation. A typical example is Tongji University Library, which implements a "dual partnership" plan, providing conventional services such as literature retrieval and training for teachers and students, and personalized knowledge services for key discipline construction and research teams, forming close strategic partnerships between librarians and research groups. Most university libraries have laid a good foundation for

internal collaboration through teaching services, subject librarian services, and personalized subject services [18].

(2) Serving regional economic and social development. Many university libraries use their collections and advanced technical equipment to provide information services for society, with government and enterprises being important service objects. Through information collection and processing, university libraries provide knowledge services for government and enterprises, establishing a good collaborative foundation. This includes government-university support cooperation and public information service development. The Shenzhen Cultural Bureau planned and constructed the "University Library City" project, developing the "Shenzhen Literature Port" information service platform. University libraries actively integrated their information resources and carried out information consulting services, providing complete knowledge and information support for local knowledge innovation and independent entrepreneurship [19]. A batch of university libraries including Shanghai Jiao Tong University have opened "knowledge platforms" for enterprises, stepping out of campus walls to provide knowledge and team services, gaining recognition from many enterprises.

(3) Serving national development strategies. Achieving national strategies cannot be separated from knowledge and information resources. As cultural institutions, university libraries bear important cultural service functions. To adapt to national emerging strategies, university libraries have explored around knowledge services, forming distinctive digital resource databases, think tank talent teams, and knowledge service products, creating a new think tank knowledge service system that provides reliable information and intelligence resources for government decision-making [20].

4.3 New Technical Means

Maker spaces are places that provide innovative services for makers and require personalized information and knowledge services. University libraries are equipped with basic equipment such as scanners and printers, and massive paper and electronic resources can meet the needs of different professionals. By strengthening service means and providing emerging media, tools, and technologies to create information for makers, university libraries can improve their business functions. Against the background of diversified symbiosis and rapid change, university libraries have accelerated the process of automation, digitalization, and networking, possessing various modern service means. Relying on traditional rich collections and internet development, many university libraries have broken through traditional paper-based borrowing methods, increasingly providing various platforms for readers through various new media, providing fast and convenient services to meet the diverse needs of makers.

Many university libraries are transforming into intelligent libraries, fully uti-

lizing big data resources, combined with virtual reality technology, computer network technology, and special visual effects technology, to build integrated technical applications including intelligent navigation, intelligent management, and intelligent services. This includes smart discovery, think tank services, and intelligent reference services [21], which can better analyze makers' information needs, usage behaviors, research needs, and preferences, extending the breadth and depth of personalized services for makers and providing precise services.

4.4 New Personnel Skills

University librarian teams are the main body providing services for makers. Cultivating maker spaces inevitably requires librarians to improve their knowledge structure, accumulate professional skills, and participate more in professional guidance of maker activities. First, professional literacy: possessing certain information literacy and professional skills, mastering multimedia knowledge such as databases, electronic journals, and web pages, organizing, managing, and evaluating disciplinary resources in the library, mastering comprehensive academic materials, having rich knowledge reserves, and being able to accurately locate resources and services needed by makers. Second, entrepreneurship service capability: maker space service librarians should preferably have SYB (Start Your Business)/SIYB entrepreneurship training instructor qualifications uniformly trained and certified by the International Labour Organization and the Ministry of Human Resources and Social Security of China, capable of conducting entrepreneurship awareness and business plan training.

5. Basic Strategies for University Libraries to Participate in Maker Space Cultivation

5.1 Constructing an External Collaborative Innovation Mechanism Embedded in Government-Industry-Academia

The "Guidelines for the Construction of Specialized Maker Spaces" issued by the Ministry of Science and Technology highlights four major characteristics of specialized maker spaces: "First, they are built relying on leading enterprises, research institutes, and universities, and can provide effective supply for entrepreneurship. Second, they utilize the research and manufacturing capabilities, management and market channel resources of the construction entities, with a good foundation and high level of resource sharing. Third, they rely on the industry status of the construction entities to help form an innovation and entrepreneurship ecosystem and industrial ecology. Fourth, they focus on professional fields to provide makers with more integrated services that are high-level, specialized, and characteristic, and more suitable for industrial features" [23].

5.1.1 Actively Participating in Social Maker Space Construction to Serve Social Makers The collaborative innovation among the three main

entities of government, enterprises, and universities is mainly driven by market demand and technological factors. Government, universities, and enterprises break down barriers to form a new type of innovation consortium, performing their own functions while playing synergistic roles. In the process of cultivating maker spaces, the government focuses on institutional and policy innovation, serving as the top designer of the innovation system and an important guiding force. Additionally, due to the non-competitive and non-exclusive nature of public goods, the government must bear this social responsibility, as enterprises invest less due to low returns while public service products require substantial human, material, and financial resources from construction to operation. Since 2014, the State Council and ministries have issued 32 official documents on cultivating maker spaces, and local governments have issued 218 related documents, providing macro-level guidance for maker space cultivation, creating a strong innovation and entrepreneurship culture, optimizing the allocation of innovation resources according to market mechanisms and subject collaboration, encouraging universities to leverage their advantages in professional teams and technical accumulation around characteristic disciplines, and achieving organic combination with enterprises and various maker groups to effectively play the positive role of synergistic effects and achieve achievement transfer and transformation [24].

University libraries' social services have gradually become part of their service content. For example, Shihezi University Library has developed multiple databases to guide plant protection and agricultural technology training in Xinjiang, achieving good economic and social benefits [25]. University libraries' social services can be combined with social maker space construction. Compared with university libraries, social maker spaces rarely have large amounts of specialized digital and literature resources in different fields. Establishing a good long-term mechanism between university libraries and social maker spaces can provide social makers with basic services such as literature borrowing and digital resource services, as well as in-depth services including information consulting, scientific and technical novelty search, and training activities, using university libraries' social networks to provide basic capital for social makers' entrepreneurship [26] and building exchange platforms.

5.1.2 Actively Participating in Internal University Maker Space Construction to Serve University Makers In his speech at Tsinghua University's 100th anniversary celebration, Comrade Hu Jintao clearly pointed out: "We must actively promote collaborative innovation, encourage universities to carry out in-depth cooperation with research institutions and enterprises through institutional innovation and policy guidance, establish strategic alliances for collaborative innovation, and promote resource sharing" [27]. Through continuous innovation in mechanisms and talent cultivation models, integrating resources, and strengthening connections with enterprises to pay timely attention to enterprise needs for R&D and talent cultivation, the cultivation of innovative talents and scientific research can be more targeted, thereby

increasing support for the transformation of scientific and technological achievements.

Currently, many Chinese universities already have their own maker spaces. Shenyang Normal University Library has established ten major maker spaces including Maker Lecture Hall, Creative Workshop, Maker Activity Room, Creative Discussion Area, Maker Gas Station, New Function Experience, Multimedia Production, Classic Reading Space, Creative Exhibition Area, and Academic Lecture Hall. The complete functional areas equipped with professional equipment provide normalized dual-creation services for university makers. By inviting dual-creation experts and entrepreneurial talents to provide in-depth learning opportunities for university makers, and through creative competitions to explore dual-creation resources and stimulate maker enthusiasm, student participation has reached more than 5,000, winning 8 innovation and entrepreneurship projects and 3 national awards. The maker space created by this library has received widespread media attention and full industry recognition [28]. University libraries have massive literature resources, relatively complete infrastructure, and professional librarian service teams. Their participation in internal university maker spaces is mainly based on information collection, analysis, and reorganization capabilities. According to the needs of university makers, they provide knowledge innovation services through reference consultation service models, static knowledge service models, dynamic knowledge service models, team-based reference consultation models, and knowledge management service models [29]. University libraries injecting knowledge services into internal university maker spaces not only helps solve difficulties encountered by university makers but also contributes to the long-term development of university maker spaces.

5.1.3 Developing Market-Oriented Operation Models to Achieve External University Collaboration and Innovation The ultimate goal of cultivating university library maker spaces is to improve students' ability to adapt to society. Relying solely on university libraries is difficult to meet students' practical needs. The government should actively encourage social forces such as enterprises and professional teams to participate [30]. Enterprises' innovation advantages lie in their accurate grasp of market demand, good market development capabilities, and marketing channels. In cultivating maker spaces, they should actively respond to government policies, make good use of innovation policies, strengthen cooperation with knowledge production institutions, and establish long-term cooperation mechanisms with universities for benefit sharing and risk sharing through commissioned R&D, cooperative R&D, and participation in the transformation of university scientific research achievements [31-32]. University libraries collaborating with enterprises to cultivate maker spaces can effectively combine library resources with enterprise resources in talent, technology, and information, making full use of university library resources while providing practical bases for makers to transform creative achievements. Through this collaboration, the integration of industry, academia, and research

in maker spaces can be achieved. Tianjin University Beiyang Campus Library and Tianjin Changrong Jianhao Cloud Printing Technology Co., Ltd. jointly established the "Changrong Jianhao Cultural Maker Space," providing innovation and entrepreneurship, online and offline integration, and incubation and investment integration through university-library-enterprise collaboration, which is the crystallization of industry-academia-research integration. At the same time, they organize entrepreneurship lectures and design innovation competitions to stimulate students' creative inspiration and entrepreneurial passion [33].

5.2 Constructing a New Mechanism for Multi-Subject Collaborative Cultivation Within the University

University libraries should collaborate with other campus departments including asset management, logistics, and personnel departments to fully utilize internal resources, providing material guarantees to ensure that maker space cultivation has funding, venues, equipment, and personnel, and promptly handling malfunctions in maker spaces. This allows multiple campus management departments to form a community of shared destiny in maker space cultivation. For example, to enrich and improve library functions, Anhui University selected students with excellent entrepreneurial ideas and practical abilities, providing a platform for learning, practice, and entrepreneurship for young students. The Anhui University Library collaborated with the Student Affairs Office, Academic Affairs Office, University Youth League Committee, and Beijing Century Superstar Information Technology Development Co., Ltd. to jointly hold the "Superstar Cup" Campus Coffee Bar Operation Creativity Competition. Through participation of multiple campus management departments, comprehensive opinions were heard, and comprehensive regulations were made regarding venue provision, facilities, cost management, service teams, and breach of contract penalties, ensuring that university library maker space operations closely follow the construction purpose. The internal university collaborative mechanism is the guarantee for the long-term sustainable development of university library maker spaces.

5.2.1 Improving the Collaborative Mechanism for Joint Innovation and Entrepreneurship Within the University Various campus management departments should establish the concept of collaborative innovation, highlighting the important position of "collaboration" in the school-running philosophy and emphasizing the importance of "innovation" in the educational concept. They should build a scientific and effective organizational management system, establish specialized collaborative innovation management institutions, strengthen internal organizational coordination, and provide a formal and unified management model for university collaborative innovation work, forming a strong work synergy. In response to possible asset purchase needs, a special service mechanism centered on maker space needs should be established. Through collaboration among various departments, preparations for building maker spaces should be made, including venues, funding, equipment, and per-

sonnel. A relatively complete supervision system should also be established to strengthen mid-term inspections and performance evaluations of maker spaces, dynamically adjust policy support, grant certain rights to well-operated spaces, and provide timely guidance or termination for poorly operated spaces. The internal joint innovation and entrepreneurship mechanism is the guarantee for the legal, reasonable, and effective operation of university library maker spaces, achieving low-cost, convenient, full-factor, and open university library maker spaces through multi-department collaboration to meet students' diversified space needs.

5.2.2 Accelerating the Reform of Maker Education System University libraries collaborating with multiple subjects to cultivate maker spaces is not just about providing literature materials; creative education for makers is one of its important tasks. Through diverse forms such as course guidance, expert lectures, creative sharing, innovation competitions, and achievement exhibitions, students' innovation interest, awareness, and ability can be enhanced. University libraries are the main carriers for students to receive innovation and entrepreneurship education. University library maker education courses should be developed around maker spaces, organically combined with creative projects, and effectively connected with practical activities, directly linked to student grades [34], carrying out heuristic teaching, discussion-based teaching, and participatory teaching, exploring new mechanisms for collaborative education through school-enterprise and school-locality cooperation. Discipline leaders and outstanding enterprise talents should jointly write scientific, advanced, and applicable innovation and entrepreneurship education textbooks [35]. Chengdu Vocational and Technical College has opened entrepreneurship small classes that jointly hold projects with enterprises, with enterprises designing and implementing courses to consolidate the practical foundation of entrepreneurship projects, which has reference significance for university library maker education reform.

5.3 Coordinating Maker Space Services Within the University Library

University library maker space services involve multiple subjects, requiring the establishment of efficient internal management mechanisms to achieve various types of collaboration among multiple subjects, including subject collaboration, goal collaboration, and resource allocation collaboration. University library-led maker spaces are formed by different institutions fully integrating their advantageous resources in planning and design, professional talents, information intelligence, social capital, physical space, and management experience. This is a process of collaborative advancement and continuous optimization by all subjects, including makers, service organizations, and librarian service teams. Specifically, in university library maker spaces, collaboration between makers and organizations should be well managed, classifying and organizing makers according to interests, professional backgrounds, research directions, and required tools and equipment, enabling makers to participate in maker activities in group

organizations, improving the degree of collaborative organization of makers, and helping librarian service teams provide targeted services. Collaboration between makers and librarians and among librarian service teams should be established, with technical librarians, consulting librarians, and data librarians collaborating and cooperating to provide technical guidance and support, research dynamic tracking services, achievement transformation information guarantee, and intellectual property protection data certification services for makers, jointly providing maker space services. Goal collaboration: Since their inception, university libraries have shouldered the mission of disseminating knowledge and inheriting human civilization, thereby promoting knowledge innovation and social progress. All participants in university library maker spaces actively respond to the "mass entrepreneurship and innovation" policy, creating a good knowledge innovation environment to achieve creative transformation. Resource collaborative allocation: Since university library maker spaces involve multiple participating institutions with different resource advantages, collaborative allocation of financial resources, human resources, tool and equipment resources, etc., in university library maker spaces can improve resource utilization and achieve optimal resource allocation [36].

5.4 Government and Universities Should Increase Policy Support

Government policies directly affect university libraries' collaborative cultivation of maker spaces with multiple subjects. From the central to local levels, governments have issued guiding documents on maker space cultivation, promoting the formation of synergy between universities and enterprises, making full use of favorable conditions such as university science parks, universities, and research institutes, giving play to the decisive role of market allocation of resources, building market-oriented maker spaces with social forces as the main body, leveraging the power of social organizations, and summarizing and promoting new incubation models such as maker spaces and entrepreneurship coffee [37]. To ensure the orderly progress of university libraries' collaborative cultivation of maker spaces with multiple subjects, the government should issue targeted measures, including establishing special funds for collaborative innovation, promoting the reform of university education systems, cultivating a relatively balanced benefit distribution mechanism, and encouraging enterprise participation in macro guidance. Universities should formulate specific university library participation in maker space cultivation plans around their own disciplinary advantages, giving full play to the resource advantages of university libraries. Therefore, university library collaborative cultivation of maker spaces with multiple subjects cannot be separated from the systematic policy system formed by the government and universities in terms of funding, equipment, personnel, and operation systems. The U.S. government and university library associations have jointly formulated maker space support plans with different institutions, universities, libraries, and related enterprises, established special funds, and developed multi-channel funding sources to provide sufficient financial security. The Lego Company subsequently provided tools and parts support for maker spaces embedded in libraries,

responding to and supporting youth maker programs [38].

6. Conclusion

University libraries should give full play to their own advantages and collaborate with government, universities, and enterprises to jointly cultivate maker spaces. In this process, the three main entities undertake different functions while jointly acting on maker spaces, enabling university library resources to be transformed into innovative products. By providing one-stop comprehensive services for social makers, university makers, and library-led makers, this model that makes full use of university library resources and collaborates with multiple subjects is conducive to solving different problems for different makers, improving the quality of China's maker spaces, and promoting the transformation and development of university libraries.

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Author Contributions:

Chu Jiewang: Determined the topic and framework, revised the paper;
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English Title and Abstract:

Conditions and Strategies for University Libraries to Participate in the Construction of Maker Space

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Abstract: [Purpose/significance] This paper is to demonstrate the rationality of the university library's participation in the cultivation of maker space, and to make a theoretical discussion for the university library to strive for development space. [Method/process] This paper mainly adopts the method of literature investigation to analyze the current construction needs of maker space and the reasons for the participation of university libraries, and to analyze the conditions for supporting the cultivation of maker space in university libraries. [Result/conclusion] By constructing the external collaborative innovation mechanism embedded in politics, production and education, and the internal collaborative cultivation mechanism with the participation of multiple subjects in the school, we can do a good job in the coordination of maker space service within the university library, increase the support of government and university policies, and make the university library effectively participate in the construction process of maker space.

Keywords: maker space; incubator; maker space; university library

Note: Figure translations are in progress. See original paper for figures.