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Core Functions and Service Recommendations for University Library Makerspaces: Postprint

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Abstract

[Purpose/Significance] In the maker era, university libraries should continuously extend their service reach and innovate service methods with makerspaces as their base, vigorously cultivate college students' innovative literacy and entrepreneurial vitality, and thereby reconstruct the core value system and competitive advantages of university libraries. [Method/Process] Based on the development status and policy environment of makerspaces in university libraries both domestically and internationally, this paper demonstrates the six core functions of university library makerspaces in areas such as innovative knowledge aggregation and dissemination, scientific research innovation and inquiry-based learning, innovation and entrepreneurship capability education, creative project outcome incubation, innovation and entrepreneurship information sharing, and maker literacy cultivation, and proposes reflections and recommendations regarding the construction, management, operation, and collaboration of makerspaces. [Result/Conclusion] Exploring the functional transformation and service innovation of university libraries with makerspaces as the main thread serves as an entry point for university libraries to comprehensively, continuously, and fully embed themselves into the innovation talent cultivation system, and represents one of the primary pathways for university libraries to enhance their core value and positional advantages in the maker era.

Full Text

Preamble

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Abstract

[Purpose/Significance] In the maker era, university libraries should use maker spaces as a base to continuously extend their service reach and innovate service methods, vigorously cultivate college students' innovative literacy and entrepreneurial vitality, and thereby reconstruct the core value system and competitive advantages of university libraries. **[Method/Process]** Based on the development status and policy environment of maker spaces in university libraries both domestically and internationally, this paper demonstrates six core functions of university library maker spaces: innovative knowledge aggregation and dissemination, scientific research innovation and inquiry learning, innovation and entrepreneurship education, creative project incubation, innovation and entrepreneurship information sharing, and maker literacy cultivation. It also presents considerations and recommendations for the construction, management, operation, and collaboration of maker spaces. **[Result/Conclusion]** Exploring functional transformation and service innovation of university libraries with maker spaces as the main thread represents an entry point for libraries to comprehensively, continuously, and fully embed themselves in the innovative talent training system, and constitutes a primary pathway for university libraries to enhance their core value and positional advantages in the maker era.

With the development of the Internet, libraries should pay greater attention to innovating the diversified circulation and exchange environment of knowledge in new cyberspaces, transforming libraries into third spaces that support and promote innovative development. It is against this backdrop that maker spaces have emerged. Through the reconstruction and functional reorganization of space, resources, and services, libraries can provide a good opportunity for library transformation and a new direction for service innovation. Maker spaces have become an important carrier and symbol of service innovation in global university libraries. Compared with foreign countries, the start of maker spaces in China's library community was not late, and they are currently being developed and constructed steadily. University libraries are actively carrying out talent cultivation and service innovation work using maker spaces as their base.

1. Current Status of University Library Maker Spaces

Maker spaces are community-operated workspaces, also known as makerspaces, hackerspaces, or fablabs, where people with shared creative ideas or interests (typically in computers, machinery, electronics, or digital art) can gather, socialize, and collaborate to transform more ideas into products. Originating from MakerFaire in the United States in 2006, maker spaces quickly became popular across America, driven by a profound maker culture and spirit. In early 2012, American libraries incorporated maker spaces into their service systems. By June 2015, among 1,929 well-known maker spaces worldwide, the United States accounted for 38.4%, with libraries comprising the vast majority. In the

process of promoting maker spaces, American universities first strengthened the cultivation and promotion of maker culture, and then focused on the construction of maker spaces and the initiation of maker activities. Regarding the role and positioning of libraries in the maker movement, the American university library community generally believes that maker culture not only injects new vitality into social production and life, but also provides a new entry point for the functional transformation and service innovation of university libraries. Currently, maker spaces have become an important fulcrum for service innovation in university libraries.

Maker spaces entered China in 2010, with a start time not much later than Europe and America. In January 2011, China's first maker space—Beijing Makerspace—was officially established, becoming a bellwether for the maker industry. Maker spaces then rapidly emerged in China, particularly in the library community, where they are opening the door to knowledge in new ways and driving library transformation and innovation. In 2013, the “Creative Space” established by the Chinese Academy of Sciences became the first practical case of a library maker space in China. In October 2015, the world's largest campus maker space, iCenter, was delivered for use at Tsinghua University. By March 2016, the Wuhan University Library maker space was completed. After just six years of development, maker spaces have taken root in China's library field. In 2015, the Chinese government included “mass entrepreneurship and innovation” in its government work report, and the State Council's “Guiding Opinions on Developing Mass Innovation Spaces to Promote Mass Entrepreneurship and Innovation” filled innovation enthusiasts with hope for the future. According to statistics from the Global Maker Space Wiki website in March 2015, 21 Chinese maker spaces were registered on the site, while other maker spaces with fixed venues and specialized equipment have sprung up like mushrooms. In April 2016, the Ministry of Education strongly advocated that universities should “focus on cultivating a new force for mass entrepreneurship and innovation.” As a supporting educational institution, university libraries should find their reasonable positioning and play a role in innovation and entrepreneurship education with their own advantages, becoming an important force in supporting and serving mass entrepreneurship and innovation. According to statistics, there are currently more than 20 successfully established maker spaces in Chinese universities and colleges. University libraries have the responsibility to participate in the national “mass entrepreneurship and innovation” talent cultivation, and through the construction of maker spaces, the rendering of maker culture, and the cultivation of maker spirit, they should fully exert their supporting and leading role in the maker era.

As a representative of maker spaces, the Shanghai Library's Innovation Space has transformed the library into a “geek pioneer,” “designer home,” and “maker paradise” that readers expect. It regularly holds maker work exhibitions, attracting a large number of readers to participate in maker activities and stimulating readers' creative design and innovative vitality. The Wuhan University Library's maker space has become an important practice base for college stu-

dents, regularly offering courses or practical activities such as creative education and maker sharing to create a maker atmosphere and solidify maker services. Although university library maker spaces can be supported by rich collections, they still have certain gaps compared with public maker spaces in terms of innovation and creativity, particularly in achievement transformation and financial support. Wu Jianzhong, former director of the Shanghai Library, pointed out that libraries are currently transitioning to third-generation libraries. Future libraries will not only be knowledge centers, but more importantly, learning centers and exchange centers. They should focus on cultivating users' information literacy, technical literacy, and creative literacy, and transform libraries into spaces for interactive dialogue among various communities. Therefore, whether from the perspective of the macro social environment or the drive for library service transformation and innovation, it is imperative for university libraries to build maker spaces, cultivate users' innovative consciousness, and stimulate users' entrepreneurial vitality. This also represents a new mission for university libraries in the maker era.

2. Core Functions of University Library Maker Spaces

As an important physical resource of university libraries, space has been endowed with more connotations and carries more innovative functions in the information age. Maker spaces are an important manifestation of this trend. By analyzing the construction, functional positioning, and service systems of maker spaces in university libraries both domestically and internationally, we can summarize the functional system of university library maker spaces at the current stage, which should possess six core functions.

2.1 Function of Innovative Knowledge Aggregation and Dissemination

University library maker spaces not only provide readers with workspaces, social spaces, and resource-sharing spaces, but more importantly, they provide them with integrated platforms for resources or information such as innovation and entrepreneurship information, teams, projects, and investment. They offer low-cost, comprehensive, and professional services for grassroots entrepreneurs, creating a growth environment that promotes communication and community formation among entrepreneurs and building a comprehensive, three-dimensional, and mutual-assistance innovation and entrepreneurship service ecosystem.

2.1.1 Strengthening Collaboration. Through activities such as teacher salons, student boot camps, alumni training, and practice competitions, we can promote creative sharing among entrepreneurs to achieve collaborative progress and mutual assistance, generating “fusion” through “aggregation.”

2.1.2 Emphasizing Integration. By combining teams with talent, innovation with entrepreneurship, online with offline, campus with off-campus, and integrating different innovation and entrepreneurship communities and forms, we can fully leverage the initiative and creativity of innovation and entrepreneur-

ship mentors, helping maker enthusiasts complete the transformation from ideals to reality.

Through the large platform of maker spaces, libraries can achieve the aggregation and dissemination of innovative knowledge, providing necessary information services and knowledge services for makers. From a collaborative innovation perspective, assisting maker practice is an important function of maker spaces.

2.2 Function of Scientific Research Innovation and Inquiry Learning

Supporting scientific research innovation and deepening inquiry learning are also important functions of maker spaces, including in-depth study of information related to research-oriented innovation and entrepreneurship training projects issued from the national level to local governments and even grassroots institutions, as well as experience, skills, methods, and policies related to maker activities. Ultimately, this enhances makers' scientific research innovation capabilities and their ability to master relevant knowledge in the maker field.

2.2.1 Supporting Scientific Research Innovation. Against the backdrop of maker spaces, we should actively promote the application and research of innovation and entrepreneurship projects, introduce third-party resources, and provide practical opportunities for campus makers. University libraries should focus on information about various entrepreneurship project applications, guide makers to actively participate, and continuously expand entrepreneurship resources by connecting with university-run innovative enterprises and alumni startups. This ensures that entrepreneurship does not remain at the theoretical model stage in maker spaces but helps makers transform these theoretical models into practice. Enterprises or companies can be commissioned to provide them with comprehensive entrepreneurship services such as entrepreneurship training, investment and financing docking, business model construction, team integration, policy application, industrial and commercial registration, legal and financial affairs, and media information.

2.2.2 Promoting Deep Inquiry Learning. Help makers correctly interpret policies at all levels, provide them with policy consultation and support, and create a positive innovation and entrepreneurship ecological environment. Collect, store, classify, build databases, and share entrepreneurship experience and skills to facilitate knowledge flow among makers and stimulate the vitality of the maker community.

2.3 Function of Innovation and Entrepreneurship Education

A more important function of maker spaces is to carry out targeted innovation and entrepreneurship education activities relying on the advantages of the space to promote the improvement of users' innovative literacy and entrepreneurial capabilities. University libraries can achieve the combination of theoretical and practical education models by developing entrepreneurship topics and holding

entrepreneurship activities, strengthening the accumulation of diversified innovative literacy and the enhancement of entrepreneurial capabilities among makers. For specific problems, makers can directly connect with entrepreneurship mentors for consultation or collaborative discussion, stimulating entrepreneurial inspiration and innovative vitality.

2.3.1 Developing Innovation Topics and Strengthening Innovation Education. Library maker space services can promote the education of college students' innovative capabilities and cultivate and stimulate the innovative spirit and creative abilities of maker enthusiasts. Zhang Yaohui, Dean of the Entrepreneurship School at Jinan University, pointed out that students with well-trained innovation and entrepreneurship capabilities are more competitive. Therefore, the Entrepreneurship School firmly focuses on innovative literacy education, teaching, and micro-incubation. Ninety percent of the projects in Jinan University's "Hong Kong, Macao, Taiwan, and Overseas Chinese Mass Innovation Space" were incubated by the Entrepreneurship School. Libraries can achieve foundational education for innovative capabilities, playing a supporting role in innovation and entrepreneurship education.

2.3.2 Holding Entrepreneurship Activities and Consolidating Entrepreneurial Heritage. Libraries can fully play their core role in the maker community, flexibly allocate entrepreneurship resources, and hold entrepreneurship activities: (1) Utilize internal campus entrepreneurship resources to hold maker lecture halls, enabling interaction between entrepreneurship mentors and maker enthusiasts; (2) Invite off-campus entrepreneurship experts to hold entrepreneurship reality shows, sharing their entrepreneurial achievements; (3) Establish entrepreneurship circles, with libraries playing a leading role in stimulating community vitality and integrating a more authentic and supportive entrepreneurship community.

2.4 Function of Creative Project Incubation

Creative project incubation relies on maker spaces. Under the leadership and promotion of libraries, and through school support or social capital injection, maker spaces help makers complete the transformation from creative cultivation to achievement incubation, providing necessary financial support and social security conditions. This can be accomplished through three specific approaches: (1) Continue to play a core role. As a promoter of the school's maker movement, the library can gather numerous advantages and resources, using policy as guidance, capital as motivation, and connections as advantages to help users establish docking with enterprises and comprehensively promote the commercial transformation of creative achievements into operational models; (2) Establish entrepreneurship investment guidance funds. Within the university, unite relevant functional departments to establish a fund management system led by the library, while guiding the inflow of social capital as the main body of the fund. The fund typically includes entrepreneurship training and internship funds, entrepreneurship seed incubation funds, and venture capital funds, aiming to focus

on investing in university student entrepreneurship enterprises with high technological content, strong innovation, good growth potential, and in the early stages of entrepreneurship, jointly providing continuous and reliable financial support for achievement incubation; (3) Establish diversified marketing channels. At the school level, create environments and develop marketing channels for makers, fully relying on the power of alumni and the university's social reputation to explore markets, but mainly cooperating with regional physical companies, venture capital firms, and angel investors to build platforms that ensure the sustainable commercialization of project achievements.

2.5 Function of Entrepreneurship Information Sharing

Entrepreneurship information is generated around entrepreneurship activities and runs through every stage of entrepreneurship. Its purpose is to provide makers with valuable information, intelligence, and knowledge services, with the goal of supporting innovation, inspiring creativity, and boosting entrepreneurship. The collection of entrepreneurship information usually includes preliminary entrepreneurial concepts and intentions, mid-stage insights and corrections, and post-stage experiences and lessons, as well as some professional information related to entrepreneurship. It comprises a series of case information from the initial stage of entrepreneurship to success or failure, mainly providing comprehensive information services for entrepreneurial groups. Entrepreneurship information content has two main categories: (1) Professional theoretical information, which is highly discipline-specific, innovative, and educational, consisting mainly of discipline-specific databases and self-built information such as various policies, announcements, information, courses, and projects; (2) Entrepreneurship practice information, which has strong practical guiding significance, mainly consisting of real-person sharing, entrepreneurship experiences, and simulated entrepreneurship experiences and insights.

The sharing forms of entrepreneurship information are mainly divided into two types: (1) Online, based on mashup technology, providing cross-service-provider and cross-platform information co-construction and sharing services. This is a cloud service system built by libraries based on "Internet Plus," capable of achieving automatic collection, intelligent classification, distributed storage, and intelligent push of entrepreneurship information. It is a virtual entrepreneurship service model based on the real entrepreneurship environment that can be embedded in users' personal information spaces, especially social network spaces, and achieve precise push and intelligent sharing through big data technology; (2) Offline, mainly including thematic bookshelves, human libraries, entrepreneurship lecture halls, and entrepreneurship reality shows. The characteristic of physical sharing is that it can create an innovation and entrepreneurship atmosphere, provide users with a strong sense of reality, and lead users to understand and enter the world of entrepreneurship. Through the clustering management of entrepreneurship content and the fusion and supplementation of entrepreneurship forms, we can build an ecological operation mechanism for

entrepreneurship information, promoting the integration of entrepreneurship information resources and dynamic collaborative services.

2.6 Function of Maker Culture and Literacy Cultivation

While carrying out innovation and entrepreneurship services based on maker spaces, university libraries can also realize the function of cultivating readers' maker literacy and maker culture. Maker culture is the most active and vital soft power generated in a specific era that can change people's thoughts and behaviors, and is a kind of "spark culture" that easily ignites creativity and even sets off a prairie fire of entrepreneurship. The cultivation of users' maker literacy is the subtle educational function that libraries play in the process of carrying out maker services, covering aspects such as maker consciousness, maker ethics, maker ability, maker technology, and maker spirit among student users. Maker consciousness refers to cultivating the thinking mode that generates creative ideas in practice; maker ethics refers to the moral standards and bottom lines that makers adhere to in the production process; maker ability refers to the professional disciplinary knowledge and interdisciplinary comprehensive knowledge reserves that makers possess when discovering, analyzing, and solving problems; maker technology refers to various scientific and technological means and methods adopted by makers in implementing innovative production; maker spirit refers to the internal driving force, production values, and sharing attitudes that makers demonstrate in creative production. Maker literacy is the inexhaustible source and driving force for makers to implement innovative activities. The core element of both maker culture and maker spirit is innovation, and libraries have the function of cultivating maker literacy and reshaping maker spirit in maker services.

3. Recommendations for University Library Maker Space Services

Maker services rely on the core functions of maker spaces, typically including creative concept cultivation, innovative consciousness shaping, and entrepreneurship practice guidance, and extending to reading promotion, literacy improvement, and cultural inheritance. These cannot be accomplished through a single activity, lecture, or practice, but usually require a complete service system to achieve the desired effect. The service system must be supported by the core functions of maker spaces to play its role. The author proposes some guiding recommendations for the development of maker services.

3.1 Strengthening Maker Space Construction Concepts

Maker space construction has become a new force in China's higher education reform. Conducting innovation and entrepreneurship education based on maker spaces is becoming a trend and a need of the times, providing new ideas for the cultivation of innovative talents in universities. In China's university

library community, maker space construction is showing a flourishing development trend and has become a primary pathway and important carrier for university libraries to seek functional expansion and service innovation. Under such positive demand-driven and policy-driven circumstances, maker spaces have ushered in unprecedented development opportunities. However, in the process of developing maker spaces, university libraries that only pursue form and quantity will lead to mutual imitation and homogenization, resulting in serious homogenization and hollowing-out phenomena. They should focus on connotation, emphasize practical results, act according to local conditions and capabilities, and build maker spaces suitable for their own university conditions based on their disciplinary advantages, student characteristics, and talent training plans. Only by always adhering to the purpose of promoting innovative education and improving entrepreneurial capabilities can they be fully embedded in the university's talent training system.

3.2 Establishing a Dedicated Maker Service Department

From construction to management, and from operation to service, maker spaces constitute a complete service chain and system. Different from other business types in university libraries, maker spaces should always focus on exploring and developing individual users' creative abilities and do not primarily pursue economic benefits. Therefore, establishing a dedicated department is necessary to manage, operate, and maintain maker spaces to fully exert their functions. Maker space management involves venues, environments, equipment, personnel, activities, training, and achievements, with specific management content including: environmental decoration and design, equipment management and maintenance, activity planning and organization, curriculum design and training, ability shaping and cultivation, and achievement release and display, as well as cooperation with other innovation institutions within the university and cross-university maker linkages. By establishing a dedicated department, we can achieve optimized management and efficient operation of maker spaces, promote the establishment and relationship optimization of maker communities, help makers connect with schools, governments, and enterprises, complete the transformation from ideals to reality, and leverage the advantages and roles of maker spaces as incubators and industrial parks, making maker services effective, sustainable, and ecological.

3.3 Finding the Balance Between Functions and Services

The establishment of university library maker spaces is to provide users with a place to turn ideas into reality. To this end, university library maker spaces are fully equipped with computers, multimedia projection equipment, 3D printers, etc. While space and equipment are necessary for innovative and creative activities, they are not the core of library maker space services. With limited library funds, to make maker spaces more competitive, they should highlight their core function of literature and information guarantee during development. For

example, Shenyang Normal University Library has established a maker space based on its own advantages, consisting of seven functional areas: classic reading space, digital media space, maker workshop, learning discussion area, and multimedia production area, aiming to solve problems such as smooth and guaranteed information mining for makers in the innovation process. In this maker space, different makers can analyze the future development trends of things based on different literature resources, propose creative ideas, and share them. The understanding generated in this environment is more comprehensive. No matter how mobile Internet technology develops, the basic functions of libraries in protecting human cultural heritage, conducting social education, transmitting literature and information, and developing intellectual resources will not disappear. In other words, libraries cannot establish maker spaces at the expense of weakening their basic functions. Only by balancing the relationship between literature resource construction, user services, and maker spaces can university library maker spaces achieve long-term development.

3.4 Constructing a Maker Space Education System

Relying on maker spaces, constructing an open and diverse maker space education system can enable maker spaces to fully play their roles in maker culture precipitation, maker spirit cultivation, innovation capability improvement, and entrepreneurship project incubation. The construction of the maker space education system should take the university's talent training plan as the starting point, pay attention to the needs of local economic and social development for talent innovation capabilities, and in the specific design of activities, strengthen the stimulation of college students' creativity and practical guidance, interact more with entrepreneurship models, alumni, and guidance teachers, and establish a benign linkage mechanism with maker companies to constantly broaden their horizons and dare to explore the unknown. Activity forms should also be flexible and innovative, including maker gathering areas, maker sharing sessions, creative workshops, creative time and space, creative education, and entrepreneurship practice. In short, the maker space education system should provide necessary soft environment support services for college students' innovation and entrepreneurship, social practice, cultural exchange, and achievement display, such as creative guidance, policy interpretation, intelligence consultation, and commercial transformation, and through participation in activities, effectively improve college students' innovation and entrepreneurship capabilities and boost local economic and social development.

3.5 Improving the Maker Activity Management Mechanism

The management mechanism refers to the connections and operation principles within the management system and is the core and key to determining management effectiveness. The maker activity management mechanism mainly refers to the planning of activity projects and the selection of entrepreneurship mentors, as well as community establishment and creative stimulation between them. Due

to the polymorphic, rich, and precise characteristics of maker activities, higher standards and requirements are also placed on the management mechanism to achieve effective control and optimized coordination of maker elements. The maker activity management mechanism mainly includes the operation mechanism, motivation mechanism, and constraint mechanism: the operation mechanism refers to the design of project plans, the verification of expected effects, the construction of mentor databases, the review of operation indicators, and their collaborative promotion; the motivation mechanism refers to the driving forces or initiating factors that drive the development of maker activities, which may come from the subjective consciousness of competent departments or the objective needs of the external environment; the constraint mechanism refers to the limitations or corrections of maker activities to ensure that they can achieve expected effects and ensure that makers can achieve learning and practice based on innovation and creation, stimulating vitality and improving capabilities.

3.6 Implementing Collaborative Cooperation Among Relevant Departments

Although maker spaces are managed and operated by libraries, the training, activities, practice, publicity, and display carried out based on maker spaces require the collective efforts of numerous departments or institutions to complete. This requires collaborative cooperation among multiple departments to be more easily innovative and obtain the necessary guarantees for maker space development in terms of talent, equipment, technology, and funding. In the process of collaborative cooperation with relevant departments, attention should be paid to both internal and external cultivation and deepening collaboration. Within the university, we can cooperate with the academic affairs office, student affairs office, youth league committee, graduate school, university student innovation center, and other departments, integrating concepts such as “Internet Plus” and crowdfunding to solidify innovation and entrepreneurship services. Outside the university, we should strengthen exchanges and cooperation with various maker spaces to jointly build and share resources and services for innovation and entrepreneurship, and also do a good job in communicating with relevant government departments and startup companies to boost the commercial transformation of entrepreneurship projects.

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[Figure 3: see original paper]

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

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