The Evolution and Driving Forces of University Library Space Reconstruction: Post-print

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Abstract

[Purpose/Significance] This study summarizes and analyzes the genesis and current status of space renovation in university libraries both domestically and internationally, aiming to provide reference and guidance for space renovation initiatives in Chinese university libraries.

[Method/Process] Through analyzing the origins and developmental status of university library space renovation domestically and internationally, this paper identifies constraining factors related to concept, scale, and standards in the spatial development process. Based on these findings, it delineates the innovation-driven pathways for space renovation in Chinese university libraries.

[Results/Conclusion] By embracing the concept of the third-generation library as the guiding philosophy for university library space renovation, this approach promotes the construction and practice of dynamic spaces, drives the cultivation of innovative talents and mechanism reconstruction, thereby comprehensively unleashing and enhancing the value and efficacy of library spaces.

Full Text

The Process and Driving Forces of Space Reengineering in University Libraries

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Abstract

[Purpose/Significance] This paper summarizes and analyzes the origins and current state of space reengineering in university libraries both domestically and internationally, aiming to provide reference and guidance for space transformation initiatives in Chinese university libraries. **[Method/Process]** Through

analysis of the origins and developmental status of university library space reengineering worldwide, this study identifies constraining factors in concepts, scale, and standards during the evolution of library spaces, and subsequently points out the innovative drivers for space reengineering in Chinese university libraries. [**Result/Conclusion**] The paper proposes adopting the third-generation library concept as the guiding philosophy for university library space reengineering, promoting the construction and practice of active learning spaces, driving innovative talent cultivation and mechanism reconstruction, and comprehensively unleashing and enhancing the value and efficiency of library spaces.

Space constitutes a crucial resource for libraries, serving as the foundation and guarantee for service expansion and transformation exploration. Consequently, space reengineering and service innovation have increasingly attracted attention within the library community. University library spaces should not be limited to reading functions alone, but should gradually evolve toward user-oriented models that emphasize competency-based drivers and innovative literacy cultivation. By creating interactive, community-oriented spaces with proactive service characteristics, libraries can fulfill their spatial agency role and comprehensively support national innovative talent development.

Keywords: university library; space reengineering; construction; inspiration
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1 The Evolution of University Library Space Reengineering

1.1 The Origins of Library Space Reengineering

Space reengineering represents a critical measure for service transformation and innovation in university libraries under new business models. American university libraries have consistently led global trends in space reengineering, pioneering both spatial layouts and functional services. The architectural history of American academic libraries has evolved through functionalist, rationalist, and innovation-examination periods [1]. Beyond basic collection and reading functions, these libraries have emphasized shaping readers' humanistic literacy, learning capabilities, and innovative skills—constituting the fundamental driving force behind library space reengineering.

The origin of space reengineering can be traced to the "Information Arcade" proposed by the University of Iowa Library in August 1992 [2], which became the global precursor to the Information Commons (IC) model. In 1999, the University of North Carolina Library opened its IC space, whose director D.R. Beagle first introduced the IC concept with two dimensions: first, a fully online virtual environment where digital technology integrates "completely different information resources" into an IC space, enabling users to simultaneously search collections and various online digital resources through a single interface;

second, a new physical facility—either a library department or an entire floor—specifically designed to organize workspaces and provide services around this integrated virtual environment. An American Library Association (ARL) report indicated that by July 2004, 30% of ARL member libraries had implemented IC construction and offered innovative services [3]. In 2005, IFLA advocated for enhanced information commons development among libraries worldwide. Beagle further refined his theory in 2006, stating that a well-functioning IC space comprises three components: physical space, virtual space, and cultural space. Physical space includes computer hardware, furniture, and traditional library collections; virtual space encompasses digital collections, online tools, e-learning resources, and portals; and cultural space comprises environments for learning, discussion, tutoring, and collaborative research [4].

In China, the information commons concept was introduced in 2005, proposing changes to traditional library spatial layouts and emphasizing the value and advantages of libraries as places [5]. The first Chinese university to practice this concept was the Shanghai Institute of Visual Arts at Fudan University, which renovated and established an information commons in September 2006 featuring information consultation, group discussion, multimedia viewing, and individual study functions [6]. Since then, Chinese university libraries have begun experimenting with and focusing on information commons development.

1.2 Progress in Library Space Reengineering

Driven by personalized and diversified reader needs and influenced by the spatial turn paradigm, university libraries worldwide have rapidly advanced space reengineering initiatives. Under Japan's Ministry of Education, Culture, Sports, Science and Technology guidance, Japanese university libraries have incorporated space reengineering into strategic plans and steadily implemented practical transformations. For instance, the University of Tokyo Library aims to construct and implement academic commons, while Kyushu University Library positions itself as an academic information infrastructure space supporting learning, education, and research activities [7]. By the end of 2010, 27 Canadian university libraries (approximately 27.6% of all universities) had established learning commons, with Queen's University Library representing the most typical case through its two-phase renovation emphasizing collaborative learning and research environment construction [8]. Australian university libraries have focused on creating diversified service-integrated learning spaces with emphasis on effectiveness evaluation, such as Deakin University Library's attention to diversification, interactivity, technological advancement, and humanization when designing reader space requirements.

Relative to international developments, Chinese university library space construction started later. Although libraries in Hong Kong, Taiwan, and some coastal provinces have developed rapidly, the overall progress has been weak with noticeable gaps. In recent years, with the normalization of space development, projects such as Tsinghua University's "iCenter," Shanghai Jiao Tong

University's "SJTU-JD Maker Space," and Wuhan University's "Maker Space" have become benchmarks for Chinese university library space construction [9]. Chongqing University Library has focused on developing cultural spaces with a "Republic of China style" theme, including the Boya Academy, new book reading rooms, and collections of rare books and cultural relics to evoke readers' memories of Republican-era culture and history. Shenyang Normal University (hereafter "SYNU") Library has developed ten spaces centered on reading spaces, including art appreciation, classic recitation, creative picture books, and Chinese studies lectures, highlighting the functions and characteristics of teacher education. Shanghai Jiao Tong University Library's "SJTU-JD" maker space concentrates on innovation and entrepreneurship support, providing knowledge sharing, creative exchange, and collaborative creation.

2 Weaknesses in University Library Space Reengineering

2.1 Weak Concept Validation

Although space has become a crucial resource and leverage point for library transformation and development, weak concept validation remains the greatest obstacle to space renovation and service innovation. This stems primarily from three factors: First, mindset resistance—space transformation involves not merely functional upgrades but a fundamental subversion of traditional library functions and learning modalities. Introducing non-traditional services to broaden libraries' cultural functions inevitably impacts traditional services offered within limited spaces, posing an ideological challenge for some libraries [10]. Second, unclear objectives—space renovation represents functional innovation that cannot be accomplished overnight but remains an ongoing process continuously adapted to changing reader needs and external environments. For example, Northeastern University Library's space reengineering has been achieved through cyclical processes of "assessment → renovation → re-assessment → re-renovation" [11]. Third, skepticism about effectiveness—space service outcomes include both long-term effects (such as improvements in reader capabilities and literacy) and short-term effects (such as resource utilization and audience size), with some being explicit and immediately visible while others remain implicit. Therefore, objective evaluation criteria are essential; effectiveness cannot be judged based on a single indicator alone.

2.2 Slow Implementation Pace

Although reader demand-oriented renovation of traditional library spaces represents new momentum for innovative library development, the overall progress of university library space reengineering has remained slow after nearly two decades. Major influencing factors include: First, unscientific planning—space renovation requires forward-looking and sustainable planning, preferably through top-level design, otherwise directly affecting renovation progress and effectiveness. Japanese university libraries generally incorporate space renovation into development plans to ensure sustainable development; for

example, the University of Tokyo Library formulated a 2012–2018 development plan when renovating its old building [5]. Second, insufficient funding—some universities face tight budgets with minimal investment in library space reengineering and lack social capital injection, severely affecting renovation progress. This phenomenon is particularly evident and difficult to resolve in China's economically underdeveloped regions. Third, spatial constraints—some university libraries are limited by physical premises without adequate space for renovation, a common challenge faced by many university libraries, especially older facilities.

2.3 Lack of Standardized Implementation

In recent years, as cultural institutions, library spaces have exhibited characteristics of diversification, integration, and academic orientation. Various forms of learning spaces have emerged in university libraries. However, the absence of unified standards and norms has resulted in libraries undertaking renovations without guidelines, leading to vastly different service outcomes: First, lack of construction standards—no basic requirements for area, lighting, equipment, networking, or resources, resulting in uneven space quality, with some spaces containing only a few tables and chairs. Second, lack of management standards—such as whether dedicated departments or professional personnel manage spaces, including reservation auditing, equipment debugging, usage guidance, and librarian support, and whether effective support from space to services can be provided. Third, lack of service standards—no clear requirements for services that spaces should provide or functions they should support, particularly lacking systematic long-term planning for reader capability development and enhancement.

3 Driving Forces for Space Reengineering in Chinese University Libraries

3.1 Embracing the Third-Generation Library as the Guiding Philosophy

Wu Jianzhong's concept of the third-generation library originated from research conducted for the Shanghai Library East Branch. The third-generation library is not only a knowledge center but also a learning center and communication hub, emphasizing human needs, accessibility, openness, ecological environment construction, and organic resource integration [12]. Thus, the third-generation library represents both a subversion and transcendence of traditional libraries in terms of functions and missions, indicating the future direction of library development. Its main characteristics can be summarized as: promoting knowledge supply and circulation through diverse carriers to meet reading needs; innovating communication environments to facilitate reader interaction and social functions that support innovative development; emphasizing multi-element literacy and cultural inclusiveness to ensure equal information access rights;

and stimulating community vitality by rooting knowledge services in communities to promote knowledge sharing [10]. As important campus cultural centers and second classrooms, university libraries should fully exploit their value and significance as places, adapting to the transformation from borrowing-oriented to activity- and connotation-oriented operations. Both external spatial expression and internal spatial functions will break through the traditional three-part model of preservation, processing, and reading spaces.

The concept's characteristics manifest in three aspects: (1) Spatial form diversification and decentralization—innovative communication environments have injected new vitality into library space reengineering, gradually breaking through three-part limitations. With readers as the main body and activities as the center, spaces evolve from information commons to learning commons, from knowledge commons to research commons, and from academic commons to maker spaces, with multiple forms collaboratively supporting reader growth. For example, Shanghai Jiao Tong University Library's "SJTU-JD Maker Space" jointly created with JD.com focuses on supporting innovation competitions and entrepreneurial practice, while Dongbei University of Finance and Economics Library's academic discussion space emphasizes academic salons and thematic seminars. In terms of distribution, spaces are not limited to centralized locations within libraries but present decentralized, radiating patterns extending from the library to dormitory areas, teaching zones, experimental areas, or academic departments. For instance, SYNU Library's "Classic Reading Book Bars" co-created with the School of Marxism and School of Chinese Language and Literature are located within secondary colleges. (2) Spatial resource digitalization and intelligence—digital technology has accelerated library data evolution, making resource dataization a trend and characteristic that enables structuring and semanticization. By capturing and analyzing reader usage trajectories, libraries can create intelligent resource environments where resources extend wherever readers are located. For example, Chongqing University Library's smart service portal launched on September 21, 2016, represents a new-generation smart library service platform based on resource metadata, achieving data integration and intelligent services that lead China's library digitalization and intelligence direction [13]. (3) Spatial service proactivity and cultural orientation—space services are not limited to simple space utilization but actively and proactively create collaborative, diversified, and communicative interactive communities driven by reader needs, providing comprehensive three-dimensional and proactive support to attract reader participation. Cultural orientation primarily manifests in spatial cultural functions, where services should not be limited to lectures, salons, or reports but should emphasize 挖掘 cultural elements behind activities, reflecting cultural inclusiveness and making spatial services more culturally vibrant and appealing, particularly in reading culture leadership, campus culture construction, and classical culture inheritance. For example, Shanghai Jiao Tong University Library's "IC^2 Humanities Expansion Program" launched in 2009 promotes campus cultural construction with the mission of "illuminating reading, inspiring humanities, and promoting culture" [14].

3.2 Advancing Space Reengineering from the Perspective of Innovative Talent Cultivation

In recent years, the pace and scale of global innovation and entrepreneurship have reached unprecedented heights, becoming key to worldwide economic rebalancing and enhancing national core competitiveness [15]. Since China implemented the "Mass Entrepreneurship and Innovation" national strategy in 2014, innovative talent cultivation has become an important goal of university education reform and development planning, simultaneously driving libraries to comprehensively and 全程 participate in innovative talent cultivation exploration and practice. Serving innovative talent cultivation aligns with both national strategic needs and university libraries' intrinsic demands for functional transformation and service deepening. Specific driving factors include three aspects:

(1) Serving innovative talent cultivation represents the proper role of libraries as core carriers of innovative knowledge reserves and promotion applications. University libraries play vital roles in shaping campus culture, enhancing readers' information literacy capabilities, and fostering innovation and entrepreneurship atmospheres. Various maker spaces and crowdsourcing spaces have emerged as important bases and effective tools for libraries to drive innovative talent cultivation. These spaces provide not only venues for community interaction but more importantly, strong support for cultivating innovation capabilities, stimulating creative inspiration, and supporting entrepreneurial practice. For example, Tsinghua University's iCenter is currently the world's largest campus maker space, serving as a comprehensive innovative talent education and training base combining creative discussion and advanced manufacturing workshops, engineering training bases, open maker studios, and interdisciplinary research labs, playing a benchmark role in promoting readers' innovative knowledge accumulation and capability shaping [16].

(2) Serving innovative talent cultivation represents a strategic choice for libraries' supply-side structural reform. In recent years, library visitation rates have declined significantly, with obvious resource idleness and particularly prominent "supply failure." The reality is not that readers do not need libraries, but that library services on the supply side cannot effectively meet readers' real demands on the demand side [17]. Reader demand-driven passive service models urgently need transformation. Through supply-side structural reform, libraries can deeply 挖掘 and comprehensively enhance service efficiency, shifting from passive to proactive supply services: adhering to people-oriented principles, promoting supply through demand, emphasizing reader experience and implicit demands; advancing precise resource supply; strengthening librarians' innovative service capability construction; and reinforcing integrated collaborative service capabilities of resources, librarians, and spaces to reproduce spatial value. For example, SYNU Library uses its maker space as a base for innovation and entrepreneurship education and practice

guidance, offering innovation courses and providing incubation support for entrepreneurship through maker gas stations, creative workshops, and maker lecture halls.

(3) Serving innovative talent cultivation represents libraries' responsibility and commitment to comprehensive participation in collaborative education. The "Regulations on Libraries in Regular Institutions of Higher Education" issued by the Ministry of Education on December 31, 2015, clearly states that the main functions of academic libraries are educational and information service functions [18]. In reality, libraries have focused more on information service functions while educational functions remain relatively weak with insufficient attention and professional cultivation [19]. Faced with dual pressures of declining visitation and circulation rates, libraries cannot ignore how to strengthen educational functions. Educational functions refer not only to supporting readers' learning capability improvement but also to shaping innovative capabilities including practical ability, creativity, reading ability, cultural quality, moral quality, and artistic quality. Libraries should conduct space renovations to create foundational educational environments and fully leverage their mission in collaborative and innovative education. For example, Southwest University Library's music space launched in 2017 is dedicated to enhancing readers' musical literacy.

3.3 Actively Promoting University Library Space Reengineering and Service Models

From ancient book repositories to modern libraries, library spaces have evolved through collection spaces, circulation spaces, dissemination spaces, and communication spaces. Their functions have expanded from initial book preservation to reading and documentation support centers, and further to comprehensive, digital media resource support [20]. Mobile internet-based cross-platform knowledge services are accelerating library space reengineering, as spatial resources determine libraries' stages and missions. University library space reengineering has always progressed through exploration and experimentation, comprehensively supporting school innovation talent cultivation and cultural inheritance. Specific implementation should proceed from several aspects:

(1) Ubiquitous and hierarchical reading spaces. As reading promotion deepens, readers demand more nuanced reading spaces, content, and carriers. First, driven by mobile internet, print book reading has declined significantly. Reading should not be limited to physical spaces but should actively expand to networked reading communities and promote fragmented reading. For example, Wuhan University Library's "Cloud Reading" represents a successful practice of mobile, digital, and ubiquitous reading spaces based on smart terminals, allowing readers to enjoy reading anytime and anywhere. Second, reading content directly determines readers' reading intentions. While Patron-Driven Acquisitions (PDA) has become normal-

ized for online and offline readers, content push should systematically analyze readers' effective reading data, research data, and learning data to achieve precise and hierarchical aggregation and push, reducing readers' time costs and improving content acquisition accuracy. Finally, reading carriers have diversified due to content digitalization, with libraries providing different knowledge forms and service models. For example, Chongqing University Library's e-book reading service jointly launched with JD Reading, supported by JD's professional readers and massive e-book collections, creates an ecological reading service. Tsinghua University Library Li Wenzheng Library's waterfall-style e-books represent a streaming carrier service providing readers with entirely new reading experiences.

(2) Diversified and community-oriented communication spaces. Influenced by the third-generation library concept, library spaces increasingly focus on inspiring, discovering, and cultivating readers' community capabilities, constructing interactive spaces oriented toward the future and communication. First is functional diversification—communication spaces should not be limited to learning discussions but should expand to language exchange, writing exchange, maker exchange, and cultural exchange, supporting activities of different scales including speeches, reports, sharing sessions, roadshows, and exhibitions, equipped with corresponding hardware, resources, and technical support. Second is service community-orientation—the purpose of communication lies in community sharing and creation to promote individual capability enhancement. The general process involves first describing individual creativity within a community scope, then through brainstorming and other forms, diverging thinking and broadening horizons, ultimately focusing on innovation and cultivating readers' innovative thinking capabilities.

(3) Professionalized and systematic maker spaces. Against the "Mass Entrepreneurship and Innovation" social backdrop, university libraries using maker spaces as positions to leverage professional advantages and build systematic platforms for comprehensively supporting readers' innovation and entrepreneurship capability cultivation has become an unshirkable responsibility and mission. First, maker space environments must be standardized and professional—whether cultivating innovation literacy or shaping entrepreneurial capabilities, they must strictly follow relevant industry standards and operational processes while providing professional equipment, technology, and human resources support to ensure high starting points and strict requirements. Second, maker services must be continuous and systematic—the cultivation of readers' innovation and entrepreneurship capabilities should be conducted as core library business with normalized operations, potentially establishing dedicated departments for management, with services provided continuously and dynamically to offer systematic guidance, services, and support.

(4) Open and integrated cultural spaces. Cultural confidence constitutes an inexhaustible driving force for a nation's sustainable development. As campus cultural centers, university libraries should assume responsibility for cultivating readers' cultural confidence. First, construct diversified and open cultural spaces—cultural confidence originates from cultural perception and cognition. By creating characteristic spaces for music appreciation, art analysis, cultural exhibitions, classic recitation, and regional culture, libraries create opportunities for readers to access elegant and traditional culture, adhering to inclusive, open, shared, and progressive principles. For example, SYNU Library has created university motto cultural walls on floors one through four and a university anthem wall in its maker space to promote campus cultural inheritance. Second, promote cultural integration and innovation—university libraries should gradually improve readers' cultural capabilities through cultural spaces, inviting masters for professional interpretation and popularization to guide future directions and continuously promote the common prosperity of diverse cultures. Additionally, libraries should strengthen the digitalization, long-term preservation, and utilization of their institution's original resources to promote original content generation. For example, Chongqing University Library's newly established University Archives comprehensively collects and displays original works by faculty and students both online and offline, creating a cultural atmosphere to promote cultural re-creation.

3.4 Highlighting the Active Learning Concept for Talent Cultivation Mechanism Innovation

The active learning concept emphasizes readers' principal status, with cooperation, initiative, and innovation at its core. Through guidance, support, and promotion, it encourages readers to actively participate in library activities or management affairs. Supply determines demand, while demand simultaneously affects supply, helping readers acquire abilities or potential for autonomous knowledge construction and practical problem-solving, thereby optimizing talent cultivation models and advancing talent cultivation mechanism innovation. Active talent cultivation represents the demand and manifestation for university library space reengineering to comprehensively enter connotative, quality, and innovative development [21], where spaces are no longer limited to traditional borrowing functions but focus on 挖掘, discovering, cultivating, and sublimating readers' comprehensive capabilities. Specific implementation directions include:

(1) Creating active learning environments. Active learning environments constitute the prerequisite and foundation for talent cultivation mechanism innovation, providing readers with external soft environments characterized by exploration, collaboration, and reflection. First is institutional innovation—thoroughly transforming library or librarian-dominated learning models, emphasizing reader autonomy and creative thinking, advocating for experience, reflection, and practice, encouraging readers to become

masters of their learning, with effectiveness evaluation highlighting reader capability and literacy assessment rather than mere quantitative evaluation. Additionally, libraries should actively collaborate with academic affairs offices, student affairs offices, youth leagues, and innovation centers to promote active learning environment construction campus-wide. Second is conceptual innovation—recognizing the effectiveness of active learning, accepting the growth and changes it brings to readers, fundamentally transforming readers from "passive" or even "inactive" states, effectively helping readers engage in collaborative learning and design reflection sessions to continuously enhance autonomous learning capabilities.

(2) Constructing active learning spaces. Active learning spaces serve as venues and guarantees for talent cultivation mechanism innovation, redefining spatial attributes and functions based on space renovation to maximize space and service efficiency and cultivate learning interest. First is constructing ubiquitous reading spaces—under all-media influence, university libraries should not limit themselves to reconstructing physical reading spaces but should also emphasize digital reading space construction and promotion, fully utilizing readers' fragmented time to stimulate reading 意愿 and create ubiquitous online and offline reading atmospheres to improve reading capabilities. Second is constructing academic research spaces—research spaces should not remain at the discussion level but must possess certain academic support and service capabilities, such as disciplinary integration and embedding of resources and professional assistance from subject librarians, making spaces more than just spaces through professional resource allocation and service team embedding to provide diverse, active, and cross-disciplinary support for academic innovation. Finally is constructing collaborative sharing spaces—sharing spaces represent not just a physical form but a transformation of learning methods, such as maker spaces and crowdsourcing spaces that emphasize sharing, communication, collaboration, and innovation, stimulating readers' subjective initiative and creativity through activity planning and reader integration.

(3) Cultivating active learning capabilities. Active learning capabilities constitute the core and key to talent cultivation mechanism innovation. University libraries promote leapfrog improvements in readers' learning capabilities by constructing learning communities and breaking organizational boundaries [20]. First is thinking capability—during learning processes, readers gradually learn reasoning, judgment, and decision-making methods through externalized cognitive processes, effectively enhancing problem-solving and logical thinking abilities. Second is exploration capability—guiding readers to question, hypothesize, and critique real-world problems in specific contexts, encouraging exploration and cross-disciplinary practice in unknown fields, such as new function experiences and trials like 3D printing and VR to discover and cultivate readers' exploratory capabilities. Third is community capability—focusing on cultivating readers' collaborative abilities within social organizations, 善

于挖掘 individual capabilities, constructing group advantages, and stimulating community innovation and creativity. Finally is summarization capability—summarization involves abstract generalization of specific matters, helping readers identify problems, summarize experiences, and improve learning capabilities.

University library space transformation represents the dual focus of both university library service transformation and national innovative talent cultivation, as well as libraries' developmental needs to explore spatial turn and value bearing under the new normal. Driven and guided by third-generation library development concepts, future library spaces should emphasize knowledge exchange and interaction, reader literacy enhancement, and community vitality stimulation, developing toward fully unleashing spatial value and service efficiency.

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Author Contributions:

Wang Yu: Conceived research ideas and outline, guided and wrote the paper.
Sun Peng: Collected and retrieved materials, wrote the paper.
Hu Wande: Revised and proofread the paper.

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