PI-Oriented Embedded Subject Services in University Libraries Under the "Double First-Class" Initiative: A Case Study of Northeast Normal University (Postprint)

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Abstract

[Purpose/Significance] With the launch of the "Double First-Class" strategy, universities have successively introduced reforms to their scientific research management systems and academic systems. Institutions such as Northeast Normal University have begun implementing the principal investigator (PI) system. This paper aims to explore an embedded subject service model oriented toward PIs. [Method/Process] By examining embedded subject service models and service content both domestically and internationally, this study designs a framework for PI-oriented embedded subject services and explores their practical implementation. [Results/Conclusion] Oriented toward the PI system, the library of Northeast Normal University has carried out practical explorations in decision support services guided by PI needs, research support services guided by the research lifecycle, and teaching support services guided by the cultivation of research-oriented talent.

Full Text

Preamble

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Exploring Embedded Subject Services in University Libraries Oriented Toward PIs Under the "Double First-Class" Initiative: A Case Study of Northeast Normal University

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Abstract

[**Purpose/Significance**] With the launch of the "Double First-Class" strategy, Chinese universities have introduced reforms in research management and academic systems. Institutions such as Northeast Normal University have implemented the Principal Investigator (PI) system. This paper aims to explore an embedded subject service model oriented toward PIs. [**Method/Process**] By examining embedded subject service models and content both domestically and internationally, this study designs a service layout oriented toward PIs and explores practical implementations of PI-based embedded subject services. [**Result/Conclusion**] In response to the PI system, Northeast Normal University Library has developed PI-demand-oriented decision support services, research lifecycle-oriented research support services, and research talent cultivation-oriented teaching support services.

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1. Introduction

In October 2015, the State Council issued the "Overall Plan for Coordinated Promotion of World-Class Universities and First-Class Disciplines," aiming to accelerate the development of world-class universities and disciplines. In February 2016, the Ministry of Education issued the "Key Points of Ministry of Education Work in 2016," which formulated implementation measures for the "Double First-Class" initiative [1]. Subsequently, construction plans for "Double First-Class" were announced by leading universities including Peking University, Tsinghua University, Fudan University, Shanghai Jiao Tong University, Beijing Normal University, Renmin University of China, and Nankai University [2]. Research indicates a strong positive correlation between disciplinary level and university development, with disciplinary status significantly influencing a university's international standing and academic reputation [3]. In essence, first-class academic teams are synonymous with first-class disciplines. Reforms in academic and resource allocation systems aim to establish rational talent management mechanisms for recruitment, cultivation, motivation, and mobility [6]. Driven by the "Double First-Class" initiative, both Jilin University and Northeast Normal University have implemented the Principal Investigator (PI) system for project organization and management. Jilin University calls it the "Chief Scientist Responsibility System," establishing project responsibility groups comprising chief scientists and responsible scientists for discipline construction projects at various levels, with final approval by the university's discipline construction leadership group [7]. Northeast Normal University terms it the "Discipline Leader Responsibility System," selecting and recognizing key disciplines within the school's first-level discipline framework, with one discipline leader position for each key direction and open recruitment for PIs [8]. This paper uses the "Double First-Class" construction as an opportunity and

the PI system as its main thread to explore embedded subject service models in university libraries oriented toward PIs.

Since disciplinary level largely depends on the research capacity of academic teams [4], universities' "Double First-Class" plans involve reforms in research management and academic systems to stimulate high-level output and establish rational talent management systems. Tsinghua University's "Double First-Class" plan aims to improve funding mechanisms and increase the proportion of independently controlled funds for basic research [5]. Peking University has reformed its talent cultivation, personnel, and governance systems [6]. The PI system has gradually attracted attention from many universities, with institutions such as Tianjin University [16] and Huazhong University of Science and Technology [17] exploring its establishment. To advance "Double First-Class" construction, Jilin University and Northeast Normal University have also implemented the PI system.

2. Meaning and Characteristics of the PI System

The U.S. National Science Foundation (NSF) defines a PI or co-PI as an individual designated by the grantee and approved by NSF who is responsible for the scientific and technical direction of a project [9]. The National Institutes of Health (NIH) defines a PI as an individual identified by the applicant organization who has the appropriate level of authority and responsibility to direct a grant-supported project or program [10]. Both NSF and NIH specify PI responsibilities in detail but impose no special requirements on qualifications. Professors, associate professors, or even assistant professors can become PIs if they meet the selection criteria. The PI system is the primary operational model for U.S. laboratories and plays a crucial role in American scientific and technological innovation [11]. Practice has proven that the PI system can effectively stimulate researchers' innovative activities and improve research efficiency [12]. In China, the PI system has been variously translated as "project leader responsibility system," "chief scientist system," or "academic leader system" [13]. Chinese reports on PIs began in the 1980s. In 1999, China's highest-funded national key basic research project implemented the internationally recognized chief scientist system [14]. The same year, the Chinese Academy of Social Sciences began piloting the PI system after extensive research, establishing corresponding management measures [15].

In summary, the PI system is an advanced research management mechanism that centers on project leaders for human resource allocation, project funding and cost accounting for financial resource allocation, and research resource sharing for physical resource allocation [18]. The PI system can stimulate disciplinary internal momentum and vitality, construct an integrated teaching-research organization based on academic teams, highlight key disciplinary construction areas, and thereby promote "first-class discipline" development. Under this PI-centered research organization and management model, how to maximize the effectiveness of university library subject services is a question worth

exploring.

3. Scanning of Embedded Subject Services at Home and Abroad

To design a service layout oriented toward PIs and explore practical implementations, it is necessary to scan the current state of embedded subject services domestically and internationally to provide reference.

3.1 Scanning of Embedded Subject Service Models

B. I. Dewey introduced the concept of the "embedded librarian" in 2005, noting that librarians play a central role in advancing university development strategies through continuous collaboration. Embedding into as many areas as possible ensures that librarians, collections, and services are more fully integrated into all aspects of campus life [19], making embedded librarians the most successful marketing tool for library services [20].

With exponential growth of information resources and rapid development of information technology, user needs have become increasingly diverse. Early fragmented, individualistic subject service models can no longer effectively meet user demands, and subject librarians cannot rely solely on individual efforts to provide complete services. In recent years, some libraries have begun focusing on subject service team construction and changing previously decentralized management models by establishing specialized work organizations [21]. According to research, U.S. university libraries that have implemented subject services have all adopted collaborative subject service models without exception, with many employing multiple collaborative models simultaneously [22]. In China, Nankai University Library has established five major subject service teams in humanities, social sciences, mathematics and physics, engineering, and biochemistry, with members being part-time subject librarians with senior professional backgrounds [23]. Shanghai Jiao Tong University Library has set up engineering, science, and literature subject service departments, each led by subject librarians who coordinate with reference librarians and reading room administrators to provide vertically integrated subject services to various schools [24].

3.2 Scanning of Embedded Subject Service Content

Based on the three-in-one disciplinary construction responsibilities of PIs, we scan embedded subject service practices domestically and internationally from three aspects: decision support services, research support services, and teaching support services.

3.2.1 Decision Support Services To support "Double First-Class" construction, many top Chinese university libraries have conducted research and practice in decision support services. For example, Huazhong University of

Science and Technology Library completed statistical analysis reports on important research outputs for a national laboratory (under construction) and comparative analysis reports on scientific paper outputs between domestic and international related institutions [25]. Peking University Library provided an in-depth research report on "Development Trends in Marine Energy Disciplines and Analysis of Related Disciplines at Peking University" for the newly established Peking University Marine Research Institute [26]. Tongji University Library completed an analysis report on "Collaboration and Competitive Advantages of Tongji University's Civil Engineering Discipline" based on paper output, collaboration, and influence [27]. Research indicates that university library decision support services can be divided into four levels: basic data services focused on research data collection and organization, advanced search services focused on factual inquiries, comprehensive analysis services focused on integrated research reports, and deep mining services focused on forward-looking predictions [28].

3.2.2 Research Support Services As subject services continue to deepen, how to effectively embed into the entire research process to provide strong support for scientific and technological innovation [29] has become a new direction for university library subject services. Research support services in U.S. research university libraries have developed rapidly. Cornell University Library provides services supporting the entire research lifecycle for researchers (including students and all faculty), such as high-level research consultation, data analysis, academic communication, intellectual property, and publishing services [30]. Columbia University Library's research support services involve professional subject librarian consultation, course-related teaching and workshops, citation management software services, specialized research guides, online training, and massive research resources [31]. Johns Hopkins University has constructed a service ecosystem supporting the research lifecycle, including copyright, open access, grant applications, resource development, text mining, data visualization, thematic modeling, GIS, open journal hosting, scholarly metrics, data management, and data sharing [32].

3.2.3 Teaching Support Services Providing teaching support services is a primary component of subject services in university libraries both domestically and internationally. Service methods include creating course guides to help users understand course-related resources and conducting embedded teaching to enhance students' information literacy. Stanford University Library's course guide page provides guides for over 200 courses offered between 2013 and 2018, including research skills, recommended databases, subject librarians, and assistant subject librarians [33]. The University of Chicago Library provides personalized teaching services, with embedded course instruction focusing on highlighting library resources related to courses, helping teachers design effective library assignments that align with classroom teaching objectives, making students understand the library's role in their university life, and promoting classroom discussion [34].

4. Layout of Embedded Subject Services Oriented Toward PIs

To fulfill PIs' three-in-one disciplinary construction responsibilities of "team building, scientific research, and talent cultivation," we design a layout for embedded subject services oriented toward PIs from the perspectives of service process design and service content design.

4.1 Service Process Design for PI-Oriented Embedded Subject Services

Facing the PI system, a team-based embedded subject service model can better align with its three-in-one service needs, making it easier to provide more precise, specific, and in-depth service content and more flexible, diverse, and direct service methods. PI-oriented subject services can follow the process of "investigation and research—selecting PI pilots—forming PI subject service teams—conducting embedded subject services—evaluating service effectiveness."

1. **Investigation and Research**: User needs are the logical starting point for subject services [35]. Conducting subject services should begin with understanding the actual needs of service targets. The library forms a PI investigation team to comprehensively understand the needs of first-class discipline PI teams through department visits, questionnaires, PI interviews, and online communication. When necessary, the library director or deputy director leads the team to conduct face-to-face communication with PI research groups.

2. **Pre-Service Assessment**: D. Shumaker believes that not all users need embedding. Embedded librarians should conduct several assessment tasks before launching services. First, assess the current working status and embedding level from dimensions such as user liaison, collaboration, feedback, and leadership support to identify gaps and possibilities for change. Second, assess their own willingness and ability to change the current situation. Simultaneously, evaluate the user organization. Only after passing the assessment can embedding work begin [36]. We agree with this view. The investigation team carefully analyzes survey data and selects PI teams that are manageable, potentially expandable, and within capacity as pilots based on service demands and subject librarian capabilities.

3. **PI Team Structure**: A PI team is an academic research unit in a disciplinary direction, centered around the PI and generally comprising assistant PIs, professors (researchers), associate professors (associate researchers), lecturers (assistant researchers), and graduate students. Correspondingly, the PI subject service team consists of a service PI, subject librarians, resource development librarians, learning support librarians, document delivery librarians, sci-tech novelty search librarians, information service librarians, and technical support librarians. The service PI is responsible for developing development plans and task schedules, re-

porting directly to the library director or deputy director. Members of different PI subject service teams can cross over.

4. **Service Implementation**: University libraries have always regarded serving teaching, learning, and research as their mission. The five aspects of "Double First-Class" construction—first-class faculty, cultivating top innovative talents, enhancing scientific research levels, inheriting and innovating excellent culture, and promoting achievement transformation—all require library support. PI-oriented embedded subject services include both universal service content and unique services tailored to different PI team development models and personalized needs. PI subject librarian teams explore service content and methods that meet diverse PI needs in practice.

5. **Effectiveness Evaluation**: Effectiveness evaluation assesses the results and impacts of subject services on users, with the key being evaluation of value-added services. An evaluation team can be established to assess PI subject services, with primary indicators being satisfaction and service benefits of the served PI teams (weighted heavily), supplemented by self-evaluation, peer evaluation, and library leadership evaluation. A comprehensive subject librarian service performance evaluation system can be constructed by developing performance guidelines, standardizing evaluation checklists, refining evaluation practices, and deploying evaluation systems [37]. The evaluation system should shift focus from what subject librarians do to what impacts their work has on users, whether service design meets user needs, and whether service results satisfy user expectations [38]. Only scientific and fair assessment can reward excellence and motivate subject librarians [39], promoting the healthy development of PI subject services.

4.2 Service Content Design for PI-Oriented Embedded Subject Services

According to Northeast Normal University's PI system regulations, PIs fully undertake their disciplinary direction's development planning and three-in-one construction responsibilities of "team building, scientific research, and talent cultivation" (see Figure 1 [Figure 1: see original paper]).

- **Team Building**: PIs are responsible for team construction, including identifying and recommending urgently needed high-end talents, determining team members' career development plans, establishing task division and assessment standards, and creating team communication, collaboration, and incentive mechanisms.
- **Scientific Research**: PIs lead teams in refining research directions, building and opening research platforms, organizing major research projects, and producing significant innovative achievements.
- **Talent Cultivation**: PIs lead teams in undergraduate and graduate cur-

riculum development and instruction to improve talent cultivation quality.

PI-oriented subject services shift library objectives from pursuing "comprehensive but superficial" to "specialized and refined" services. Libraries can start with first-class or promising disciplines as pilots, forming multiple PI subject service teams to explore PI system service models in practice. Based on PI responsibilities, libraries can support PI teams in decision-making, research, and teaching:

1. **Decision-Making Support**: Assistance in talent recruitment, team development planning, disciplinary competitiveness analysis, disciplinary integration, and international cooperation.
2. **Research Support**: Help in disciplinary resource development, project application, publication, output analysis, data analysis, and achievement management.
3. **Teaching Support**: Embedded services in information literacy education, curriculum resource development, course management, video instruction, and teaching achievement demonstration.

The PI system requires embedded subject services that are not generic or standardized but rather tailored to each PI team's disciplinary nature, research direction, development positioning, and PI needs according to the five-stage development model of "forming, storming, norming, performing, and adjourning" [40], creating specialized one-to-one service teams with exclusive, characteristic, and differentiated service content.

5. Practice Exploration of PI-Oriented Embedded Subject Services

Following the service layout, Northeast Normal University Library has conducted embedded subject service explorations oriented toward PIs, focusing on PI-demand-oriented decision support services, research lifecycle-oriented research support services, and research talent cultivation-oriented teaching support services.

5.1 PI-Demand-Oriented Decision Support Services

PI teams are the most basic academic units in university teaching and research, with PIs as their leaders. The research team organization model has been described as "master + team" [41], making meeting the needs of these "masters" the primary task of PI subject services. Since PIs are fully responsible for disciplinary direction development and bear important responsibilities for discipline construction, they inevitably need support in high-end talent recruitment, disciplinary competitiveness analysis, and disciplinary development forecasting. After establishing extensive contact with PIs, subject service teams shift from passive waiting to proactive communication, paying closer attention to PIs'

micro-level needs and providing timely decision support services oriented toward PI demands.

When Northeast Normal University's Psychology Department separated from the Education Department to become an independent School of Psychology, the PI urgently needed to understand the development status and research output of high-level psychology disciplines nationwide to formulate disciplinary development plans. The library's subject service team seized this opportunity, proactively communicating with the psychology PI. After understanding the needs, the team quickly completed the report "Comparison of Academic Output of 24 Psychology Schools in China" and delivered it promptly, meeting the PI's urgent needs and receiving positive feedback. Subsequently, the team completed a series of decision support analysis reports oriented toward PI needs, such as ESI data analysis for psychology, professional journal statistics, and comparative analysis reports between *Acta Psychologica Sinica* and SSCI journals. To further support psychology development and expand the school's influence, the library received donations from renowned psychologist Mr. Che Wenbo, one of Jilin Province's psychology discipline leaders, and carefully planned and established the "Wenbo Study." The inauguration ceremony invited representatives from over 50 universities and research institutions nationwide, building a disciplinary exchange platform and greatly promoting psychology development.

For the rural education PI team, in addition to providing relevant disciplinary analysis reports, the library created a website for the "China Rural Education Development Collaborative Innovation Center" according to the PI's needs. This service had tight deadlines and heavy tasks, requiring multiple seminars and repeated design modifications between the PI team and subject service team. Beyond meeting basic needs, the library provided value-added services with relevant digital resources, earning high praise from the PI.

In summary, PI-demand-oriented decision support services should not be limited to providing basic data support reports, in-depth research support reports, and strategic data analysis and forecasting services. They should fully utilize the library's advantages in resources, talent, technology, and space to provide timely, precise, and effective services that meet PIs' diverse needs in team building, scientific research, and talent cultivation. With subject librarian teams as the service main body, individual capabilities are consolidated into team synergy. By embedding into PI teams, subject librarians fully integrate with PI teams, returning to the library's fundamental service purpose of meeting reader needs.

5.2 Research Lifecycle-Oriented Research Support Services

Lifecycle theory, first proposed by A. K. Karman in 1966, divides development processes into initial, growth, maturity, and decline stages. This theory has been widely applied across industries [42]. Applied to scientific research, it yields the research lifecycle theory. The UK Joint Information Systems Committee (JISC) identifies five research stages: ideas, partners, proposal writing, research

process, and publication [43]. RIN divides the research lifecycle into four stages: idea discovery, funding application, research implementation, and achievement dissemination [44].

PI-oriented research support services should also be guided by research data lifecycle theory, integrating PI subject services into all details and processes of scientific research throughout the entire lifecycle. Drawing on domestic and international university library practices, embedded research support services that libraries can provide for PI teams at different research stages include:

1. **Research Preparation Stage**: Professional and specific research consultation, project initiation consultation, novelty searches, research resource collection and acquisition, research frontier reporting, research dynamic reviews, and funding information.
2. **Research Implementation Stage**: Research data analysis, research tool usage, research data management, writing support, and resource acquisition.
3. **Research Output Stage**: Submission guidelines, academic publishing, open access, copyright consultation, patent consultation, and institutional repository services.
4. **Achievement Dissemination Stage**: Citation tracking, citation analysis, achievement demonstration, benchmarking analysis, and intellectual property services.

Different PI teams have varying emphases on research support service needs, requiring libraries to provide context-specific services that align with PI team needs based on research data lifecycle theory. In an embedded research process service environment, service providers must embed themselves into researchers' contexts as team members, grasping knowledge needs, organizing knowledge environments, customizing knowledge tools, and delivering service products through on-site interaction (including both physical and online channels) [45]. Meanwhile, information service products should be real-time, diverse, targeted, and user-friendly, emphasizing the organic integration of researchers' knowledge backgrounds, research tools, real-time dynamics in research fields, and research objectives with information service products [46].

Northeast Normal University's world classical civilization studies, involving Assyriology, Egyptology, Hittitology, and Western classical studies, have become a world-renowned research center for ancient history, languages, and archaeology. Classical civilization studies require researchers to master ancient scripts, historical culture, English, and other languages. The subject service team provides resource lists to the PI team, including highly relevant digital resources that changed previous notions of focusing only on foreign original paper materials. Through investigation, trial, and feedback, the library subscribed to specialized databases such as *Thesaurus Linguae Latinae*, *Online Egyptological Bibliography*, and *Bibliotheca Teubneriana Latina*. To preserve digital resources and promote research achievement demonstration, the library's subject service team built a world classical civilization literature data platform for the PI team.

For different PI teams, research support services should have different focuses. For the functional materials chemistry research PI, the subject librarian team started with patent search services to explore a patent information service model based on the research lifecycle. Currently, the team has established contact with the PI and is providing patent search and novelty services according to the PI's patent creation needs, with services gradually extending throughout the entire patent lifecycle, such as patent early warning, patent mining, and patent evaluation.

5.3 Research Talent Cultivation-Oriented Teaching Support Services

The service objects of PI-oriented subject services are PI teams centered on PIs. In addition to team building and scientific research responsibilities, PIs also shoulder talent cultivation responsibilities in their disciplinary directions. PI team members generally include master's and doctoral students. Therefore, from both PI and PI team perspectives, teaching support services should include not only traditional services for undergraduates and general graduate students but also high-end customized teaching support services aimed at enhancing research talent cultivation in PI teams.

Northeast Normal University's universal teaching support services include course-embedded teaching support, information literacy training through elective courses and daily instruction, literature resource development for teaching needs, online teaching support through the Blackboard platform, and physical learning space support through communication and sharing spaces. Research talent cultivation-oriented teaching support services should deepen and expand these contents. For information literacy services, this means embedding into existing courses or customizing exclusive teaching content for PI teams. Beyond cultivating information search capabilities, literature synthesis capabilities, and software tool usage, services should combine disciplinary characteristics to develop research methodology literacy, data literacy, funding application capabilities, and intellectual property literacy. For curriculum resource development, services involve ordering digital and paper resources, collecting open access and free course resources, digitizing resources, integrating resources, and building teaching resource platforms. For PI teams, these services are more specific, with subject librarians directly contacting PIs or core teachers one-on-one or in small groups to comprehensively collect available resources according to course content. Northeast Normal University is currently exploring the creation of a teaching resource network to provide teachers with integrated teaching resource and service platforms. For the course "Reading Original Classics of Chinese History and Culture," subject librarians clarified main teaching content through multiple consultations with the instructor, collected authoritative reference books, quality courses, videos, and academic papers, and after confirmation with the teacher, selected high-quality, highly relevant content to upload to the course platform, including 176 e-books in 18 collections, 41 quality courses, 78 academic videos in 8 collections, and relevant

excellent academic papers, dissertations, and renowned scholar information. The same subject librarian team tracks the same PI team, simultaneously providing research support and teaching support services to ensure seamless, gap-free service.

6. Conclusion

The core of "Double First-Class" construction is disciplines. The PI system, with its flexibility, collaboration, and orderliness, facilitates rational resource allocation, stimulates disciplinary internal momentum and vitality, and promotes interdisciplinary integration and development [47]. PI-oriented embedded subject services can ground subject services in the most basic academic units of universities, directly serving teams, research, and talent cultivation to enhance service effectiveness. Throughout the history of subject service development, these services have evolved continuously with environmental changes and user needs rather than remaining static. The "Double First-Class" strategy has opened a new chapter in Chinese higher education development. As an important support center for university teaching, learning, and research, libraries should seize this opportunity to expand the breadth and depth of subject services around new academic and research management system reforms, providing deep-level, high-quality, and characteristic subject services to better support "Double First-Class" construction.

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English Title: Research on Embedded Subject Service of University Library Based on PI System Under the Background of "Double First-Class" — Taking Northeast Normal University as an Example

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Abstract: [Purpose/significance] With the launch of "Double First-Class," universities have implemented reforms in research management and academic systems. Northeast Normal University and others have begun implementing the Principal Investigator (PI) system. This paper explores embedded subject service models oriented toward PIs. [Method/process] By scanning embedded sub-

ject service models and content domestically and internationally, this paper designs a PI-oriented service layout and explores PI-based embedded subject service practices. [Result/conclusion] Facing the PI system, Northeast Normal University Library has developed PI-demand-oriented decision support services, research lifecycle-oriented research support services, and research talent cultivation-oriented teaching support services.

Keywords: PI system; university; library; embedded subject service

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