Empirical Analysis of Literature Support for University 2011 Collaborative Innovation Centers: A Case Study of Wuhan University (Postprint)

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Date: 2023-08-26T00:00:00+00:00

Abstract

[Purpose/Significance] To investigate the level of literature support provided by university libraries for the 2011 Collaborative Innovation Centers, propose recommendations for improving literature support services, and thereby support the development of these centers.

[Method/Process] Taking Wuhan University as an example, we collected citation information from Chinese journal papers published by three collaborative innovation centers led or participated in by Wuhan University, summarized citation characteristics through data analysis, and compared these citations with Wuhan University Library's collection resources to calculate the level of literature support provided by the library for the three centers.

[Results/Conclusion] University libraries should enhance the effectiveness of literature support for collaborative innovation centers by exploring collaborative support mechanisms, emphasizing the development of special literature resources, improving the discoverability of collection resources, and utilizing open access resources.

Full Text

Preamble

ChinaXiv Cooperative Journal, Vol. 62 No. 5, March 2018

Empirical Analysis on Literature Guarantee of University 2011 Collaborative Innovation Centers: A Case Study of Wuhan University

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Abstract

[**Purpose/Significance**] This study investigates the literature guarantee provided by university libraries to 2011 Collaborative Innovation Centers and proposes recommendations for improving literature guarantee work to support the development of these centers. [**Method/Process**] Taking Wuhan University as a case study, we collected citation information from Chinese journal articles published by three Collaborative Innovation Centers led or participated in by Wuhan University. Through data analysis, we summarized the citation characteristics and compared these citations with Wuhan University Library's collection resources to calculate the library's literature guarantee rate for the three centers. [**Result/Conclusion**] University libraries should enhance the effectiveness of literature guarantee for Collaborative Innovation Centers by exploring collaborative guarantee mechanisms, emphasizing the construction of special literature resources, improving the discoverability of collection resources, and utilizing open access resources.

Keywords: 2011 Collaborative Innovation Center; university library; literature guarantee; citation analysis
Classification Number: G255
DOI: 10.13266/j.issn.0252-3116.2018.05.002

1. Introduction

1.1 Research Background

As the document resource center of a university, one of the primary tasks of university libraries is to "construct the university's document information resource system and provide document information guarantee for teaching, scientific research, and discipline construction" [1]. This resource construction is typically carried out according to the university's relevant departments or discipline settings, thereby forming conventional collection resources. However, when facing special research needs, such conventional construction may not necessarily guarantee adequate literature support.

The "2011 Collaborative Innovation Center" represents the primary platform and organizational form for implementing the Higher Education Institution Innovation Capability Enhancement Plan (2011 Plan). Its establishment aims to "actively promote collaborative innovation, facilitate the organic integration of higher education with science and technology, economy, and culture, and substantially enhance the innovation capacity of higher education institutions to support the construction of an innovative country and a human resources powerhouse" [2], representing another manifestation of China's higher education system executing national strategic will. Collaborative Innovation Center construction has been underway for many years, playing a positive role in promoting interdisciplinary integration and industry-university-research collaboration in universities to meet major national needs. However, as a new type of research platform, it also presents new requirements for library literature re-

source construction, a topic that has received insufficient attention from both the profession and academia.

1.2 Related Research

Research in library science on the "2011 Plan" and 2011 Collaborative Innovation Centers has primarily focused on the plan's impact on libraries and corresponding library strategies. Wang Huili [3] argues that libraries should cultivate an organizational culture of collaborative innovation and provide collaborative knowledge services to offer practical and efficient literature information guarantee for university teaching and research collaboration. Zhang Xiu [4] addresses the shortcomings of traditional university library management methods in supporting collaborative innovation for complex scientific problems under the 2011 Plan background, proposing a multi-disciplinary collaborative innovation digital library resource sharing service model. Cheng Bo and Zhang Ling [5] analyze the main content of Collaborative Innovation Center service needs and propose a service strategy of "stimulating demand and actively integrating; open service and win-win cooperation."

In practice, the main approach for university libraries to guarantee literature for Collaborative Innovation Centers is to build characteristic special collections tailored to each center's needs. For example, Henan Agricultural University Library has built a wheat and corn characteristic database to directly guarantee the literature needs of the Henan Grain Crops Collaborative Innovation Center [6]; Xiamen University Library has constructed a distinctive Southeast Maritime Research Database to serve the China South China Sea Research Collaborative Innovation Center [7]; and Zhejiang University of Technology Library has conducted "patent information service push" to meet the patent literature needs of the Yangtze River Delta Green Pharmaceutical Collaborative Innovation Center [8].

Citation analysis is a bibliometric method that uses mathematics and statistics to analyze citing and cited phenomena of research objects to reveal their characteristics and patterns, which can be used to study the characteristics of users' literature needs [9]. By further comparing citations with collection resources, libraries can more accurately examine their literature guarantee situation, an approach with rich research experience both domestically and internationally. T.E. Nisonger [10] randomly selected literature from six political science journals and used two methods to analyze their citations, investigating the literature guarantee situation of five university libraries in the Washington area for this discipline. T. Heidenwolf from the University of Michigan Public Health Library [11] used citation analysis to explore library literature guarantee for interdisciplinary research. J.T.Y. Ching and K.R. Chennupati [12] used citation analysis to evaluate the collection of Singapore's Ministry of Education Library, concluding that the library should increase monograph acquisition, reduce subscription to low-utilization journals, and improve interlibrary loan efficiency to meet user needs. R. Leiding [13] analyzed the literature guarantee capacity of libraries

for rapidly developing research institutions by sampling citations from 101 student theses between 1993-2002. In China, Ma Jianhua [14] identified highly cited foreign journals by analyzing citations in doctoral dissertations in organic chemistry at Peking University from 1995-1999, providing reference for library journal procurement. Li Feng [15] examined library literature guarantee for theoretical physics at Peking University's School of Physics using citations from 42 doctoral dissertations between 2003-2009.

Overall, academic discussions on the "2011 Plan" have mostly been from macro perspectives, with few studies examining specific literature demand characteristics of Collaborative Innovation Centers and actual guarantee situations from micro perspectives. Currently, Wuhan University leads or participates in three 2011 Collaborative Innovation Centers: the Geospatial Information Technology Collaborative Innovation Center (hereinafter "Geospatial Center"), the National Territorial Sovereignty and Maritime Rights and Interests Collaborative Innovation Center (hereinafter "Territorial Center"), and the Judicial Civilization Collaborative Innovation Center (hereinafter "Judicial Center"). To understand the literature demand characteristics of these three centers and Wuhan University Library's guarantee situation, this paper employs citation analysis, a commonly used bibliometric method. Based on collecting and processing citation information from Chinese journal articles published by the three centers, we summarize citation characteristics regarding quantity, type, timeliness, language, monograph disciplines, and core cited journals, compare these citations with the library's collection resources, calculate the actual guarantee situation, and finally propose recommendations to guide future collection construction and support the development of Collaborative Innovation Centers.

2. Citation Data Collection

We retrieved and downloaded literature from CNKI, Wanfang Data, and VIP Chinese Journal Service Platform using search terms combining each center's name with "Wuhan University" (search date: February 16, 2017). After browsing author information and excluding literature by non-Wuhan University researchers, we obtained 144, 37, and 77 sample articles from the three centers respectively, totaling 258 articles.

A convenient and common method for obtaining citation information is downloading from reference lists in databases. However, we identified several issues during sample browsing: (1) Inconsistent citation formats—most followed the GB/T 7714-2015 standard, while some used MLA or APA formats; most articles had reference lists, but some used footnotes or in-text citations instead. (2) Incomplete citation coverage in databases—missing citations, particularly those not indexed in the database, foreign citations, and footnote citations. (3) Incomplete citation information, requiring additional searches to supplement.

To avoid these defects and ensure comprehensive and accurate samples, we manually browsed each article and registered citations individually, obtaining 4,898

citations from the 258 sample articles, which were then classified by type for further analysis.

3. Citation Data Analysis

3.1 Citation Volume

Citation volume measures authors' ability to absorb and utilize existing research [16] and most directly reflects their literature demand quantity. Among the 258 sample articles, citations ranged from 2 to 111. The most cited article in the Geospatial Center was Xu Caijun et al.'s "InSAR Technology and Application Research Progress" with 90 citations; in the Judicial Center, Liao Yi's "Also on 'Ordinary People's Legal Attitudes'—A Discussion with Professor Liu Xing" with 67 citations; and in the Territorial Center, Hu Dekun and Huang Xiangyun's "The Origin and Essence of the United States' 'Neutral Policy' in the China-Japan Diaoyu Islands Dispute" with 111 citations. The average citations per article for the three centers were 17.62, 17.95, and 22.04 respectively, all higher than the domestic science and technology journal average of 8.86 citations and the international standard of 15 citations [17]. Notably, the Territorial Center's average was significantly higher than the other two centers, indicating greater literature demand.

3.2 Citation Types

Analyzing citation types reveals researchers' differential demands for various literature types and provides basis for libraries to configure and optimize collection structure. Overall, journals and monographs were the most demanded literature types, accounting for 56.3% and 15.0% of total citations respectively, followed by online resources (10.2%), conference proceedings (6.6%), and dissertations (2.8%).

Different centers showed distinct preferences for literature types. As shown in [Figure 1: see original paper], the Geospatial Center focused most on journals (74.5%) and conference proceedings (12.2%); the Judicial Center emphasized journals (51.8%) and monographs (39.5%); while the Territorial Center distributed attention across journals (31.1%), online resources (25.0%), monographs (20.9%), institutional documents (10.8%), and archives (4.5%). These differences likely relate to each center's disciplinary background and research objects: (1) The Geospatial Center's background in surveying and mapping science, technology, and computer science—engineering fields—makes it favor journals with short publication cycles, wide dissemination, and novel content, while also valuing high-value conference proceedings. (2) The Judicial Center's background in law and political science—social science fields—creates high demand for both journals and systematic, comprehensive monographs. (3) The Territorial Center's research spans law, political science, history, surveying, hydraulic engineering, environmental science, etc., requiring not only typical resources like journals and monographs but also archival materials (e.g., Diaoyu

Islands, South China Sea archives), domestic and foreign news reports (e.g., online coverage of South China Sea arbitration), and international organization materials (UN, International Tribunal for the Law of the Sea), resulting in the most diverse resource types.

3.3 Citation Timeliness

Analyzing citation years reveals each center's demand for literature timeliness, helping libraries allocate resources by publication year. The earliest citations were: 1948 article "Underwater Ambient Noise" in *Journal of Marine Research* for the Geospatial Center; 1931 monograph *Social Jurisprudence* by Zhang Zhiben (Shanghai Law Compilation Press) for the Judicial Center; and the 1825 Treaty of Amity, Commerce and Navigation between Great Britain and Rio De La Plata for the Territorial Center. Based on collected citation year information, we created statistical tables for citation year distribution (online resources excluded due to publication/access date variations), shown in .

shows that the Geospatial Center demands the most current literature, with 72.32% of citations published after 2006, requiring libraries to prioritize recent resource guarantee. The Judicial Center shows relatively even distribution across all periods, demonstrating demand for literature from all eras. The Territorial Center has the widest time span, citing two 19th-century documents, with 61.86% demand for post-2006 publications and substantial demand (18.3%) for pre-1990s literature, requiring libraries to emphasize retrospective collection development.

3.4 Citation Languages

Citation language reflects researchers' attention to domestic and international studies and helps libraries configure foreign language resources. Overall, foreign language citations exceeded half of total citations at 52.2%, with English as the dominant foreign language (94.6% of foreign citations), Japanese (2.5%) concentrated in the Territorial Center's research on Diaoyu Islands and China-Japan relations, Russian (2.1%) concentrated in the Territorial Center's research on Soviet/Russian issues, and Korean, German, and French combined accounting for 0.8%. Details are shown in .

reflects the proportion of foreign language citations in major citation types (numbers in parentheses indicate total citations of each type by each center). Key findings: (1) The Geospatial Center has the highest foreign literature demand (58.9% of all citations), particularly valuing foreign conference proceedings and showing significantly higher demand for foreign than Chinese journals. (2) The Judicial Center has the lowest foreign literature demand but notably values foreign translated works (treated as Chinese resources here), citing 64 translated works versus 51 foreign originals. (3) The Territorial Center also shows high foreign literature demand, particularly in foreign online resources, monographs, journals, and institutional documents.

3.5 Monograph Disciplines

Monographs constitute a major part of library collections. Analyzing monograph disciplinary characteristics reveals researchers' demand for different subject content, providing basis for library book acquisition. Chinese Library Classification (CLC) numbers characterize monograph subjects. We retrieved and completed CLC numbers for cited monographs through CALIS [18] and created a disciplinary distribution statistics table, shown in .

shows: (1) The Geospatial Center's monograph demand concentrates in class P2 (Geodesy) subclasses P22 (Geodetic Surveying), P20 (General Issues), and P23 (Photogrammetry and Remote Sensing), with additional demand for classes TN9 (Communication) and TP3 (Computer Technology). (2) The Judicial Center focuses most on class D9 (Law), particularly subclasses D90 (Legal Theory), D91 (Legal Departments), and D92 (Chinese Law). (3) The Territorial Center emphasizes classes D8 (Diplomacy, International Relations) and D9 (Law), with D8 concentrated in D81 (International Relations) and D82 (Chinese Diplomacy), and D9 almost entirely in D99 (International Law). Additionally, this center shows demand (17%) for class K (History, Geography) monographs.

3.6 Core Cited Journals

The 80/20 rule suggests that 80% of researchers' literature demand concentrates in 20% of core journals, with the remaining 20% in "long-tail" journals. For the three Collaborative Innovation Centers, we classified all cited journals by language, then sorted them by citation frequency. The number of journal titles and cited articles in the top 20%, 25%, and 30%, and their proportions of total citations, are shown in .

reveals: (1) Based on data from the Geospatial and Territorial Centers (the Judicial Center cited too few foreign journals for reliable analysis), journal literature distribution concentration is independent of language, with similar proportions for Chinese and foreign journals at each ranking level, likely related to the objective distribution pattern of disciplinary knowledge (Bradford's Law). (2) Distribution doesn't strictly follow the 80/20 rule: 75% of the Geospatial Center's journal literature concentrates in 30% of journals, 65% for the Judicial Center, and 58% for the Territorial Center, suggesting that broader research scope involves more disciplinary knowledge and weaker concentration. (3) Based on , we can treat the top 30% of journals as core cited journals for each center (partial list in), which libraries should prioritize while not neglecting the long tail.

4. Wuhan University Library's Guarantee Situation

4.1 Guarantee Rate

Using citations to evaluate collection guarantee is called citation checking [19]. We searched each citation sample through Wuhan University Library's website,

recorded results, and calculated literature guarantee rates. Note that: (1) Online resource citations with explicit URLs were presumably obtained by authors through those sites rather than the library; (2) Archival literature is preserved in various archival institutions beyond library guarantee; (3) Computer recognition of Russian characters is poor, and our limited ability prevented checking Russian citations, though their small quantity limited impact on results. After excluding these three resource types, the library's guarantee situation for each center is shown in -.

4.2 Analysis

Wuhan University Library's overall guarantee rate for the three Collaborative Innovation Centers is 91.3% (with 6.9% of resources requiring interlibrary loan). The remaining 8.7% are not held: the library provides best guarantee for the Geospatial and Judicial Centers, with comprehensive guarantee rates of 95.7% and 95.9% respectively, basically meeting their needs. The Territorial Center's guarantee effect is lower, with 20.9% (243 citations) not held, and the highest interlibrary loan proportion at 10.5%.

Analysis of non-held resources reveals: For the Geospatial Center, conference proceedings, dissertations, and other types have lower guarantee rates because: (1) Conference proceedings are published and distributed dispersedly, with some resources not publicly available, making systematic collection difficult for database vendors and libraries; (2) Dissertations have confidentiality periods during which they cannot be guaranteed; (3) Many "other" citations have incomplete information, making identification and searching difficult, though actual guarantee rates may be slightly higher.

The Judicial Center's lower guarantee rates involve foreign monographs and newspapers. Low foreign monograph guarantee results from "historical objective reasons and insufficient funding" [20], while unguaranteed newspapers like *Legal Weekly* and *Oriental Morning Post* are mostly available online.

The Territorial Center requires numerous institutional documents (184 citations) from organizations like the United Nations, International Tribunal for the Law of the Sea, and International Court of Justice, mostly accessible only through institutional online repositories (e.g., UN Document Center). Its research also demands many foreign monographs, with poor library guarantee effect—63% of non-held foreign monographs were published in the last century, requiring focused supplementation. Non-guaranteed newspapers are mainly pre-1949 publications requiring alternative access.

Overall, the library holds 525 monographs, including 508 print copies and 17 electronic-only resources (all foreign monographs). In addition to increasing print book procurement, libraries should supplement electronic books to improve foreign monograph guarantee.

5. Recommendations for Literature Guarantee of 2011 Collaborative Innovation Centers

Except for the Territorial Center's need for numerous difficult-to-guarantee institutional documents, the library's literature guarantee for the three Collaborative Innovation Centers is generally at a high level, meeting researchers' needs. Based on this investigation, we propose the following recommendations for better literature guarantee work.

5.1 Explore Collaborative Guarantee Mechanisms

Collaborative guarantee mechanisms refer to operational mechanisms where participating institutions and relevant responsible organizations collaboratively conduct literature guarantee work. The essence of collaborative innovation lies in breaking knowledge boundaries between innovation subjects to achieve barrier-free knowledge exchange and promote knowledge innovation [21]. Universities with collaborative innovation platforms typically have libraries with substantial disciplinary literature foundations, but demand breadth still challenges guarantee capacity. As the 2011 Plan deepens, cross-institutional collaborative research will become more frequent, requiring university libraries to cooperate with Collaborative Innovation Centers, external libraries, and relevant departments of research and industrial institutions to actively explore collaborative guarantee mechanisms. Subject librarians should play crucial roles in these collaborations, bridging gaps, understanding situations, identifying and guiding needs, and taking relevant measures to positively impact literature guarantee for all collaborative parties.

5.2 Emphasize Special Literature Resource Construction

"Special literature" here refers to documents beyond common types like monographs and journals, including conference proceedings, dissertations, technical reports, newspapers, and institutional documents. Their diverse publication and distribution create difficulties for library acquisition and guarantee [22]. This survey shows journals (guarantee rate 98.3%) and monographs (90.9%) are significantly better guaranteed than special literature (66.7%), yet researchers demand these resources substantially (18.5% of demand, exceeding monographs' 17.1%). Libraries must particularly emphasize construction of these resource types.

5.3 Improve Collection Resource Discoverability

Collection resource discoverability [23] refers to users' ability to find and obtain needed documents through searching behavior in massive collections. University libraries typically use resource discovery systems and one-stop search platforms to improve discoverability. During our investigation, we found Wuhan University's "Luojia Academic" search engine has issues: (1) search results are not

sorted by subject; (2) incomplete resource description information; (3) the discovery system doesn't cover all collection resources. These details affect user search experience and reduce guarantee effectiveness. Libraries should adopt relevant technical measures to improve collection discoverability.

5.4 Utilize Open Access Resources

Effective utilization of open access (OA) resources can improve library collection quality and literature guarantee effectiveness [24]. In this survey, among the Geospatial Center's cited online resources, 11 were journal, conference proceeding, and report literature published on OA platforms. Moreover, most of the Territorial Center's 184 required institutional documents could only be obtained through institutional online repositories, representing typical OA resources.

6. Limitations and Outlook

This paper used citation analysis to examine citation characteristics (quantity, type, timeliness, language, monograph disciplines, core journals) of Chinese journal articles published by Wuhan University's three 2011 Collaborative Innovation Centers, compared citations with collection resources, and calculated actual guarantee rates. The study reveals that literature demand identified through citations does not equal actual reader demand. To a great extent, citation-reflected demand is far smaller than actual demand. Understanding researchers' actual literature needs is difficult, with no perfect method available. Therefore, citation analysis, despite limitations, offers good measurability due to actual citations' existence. Moreover, focusing on certain groups can avoid the partiality of individual citation disciplinary demands, providing substantial reference for disciplinary literature demand analysis overall.

However, as Collaborative Innovation Centers are relatively new, the time span of researchers' published papers is limited, affecting sample size and, to some extent, analysis scientificity. Additionally, in the digital era, as literature digitization and accessibility increase, many libraries have substantially reduced print subscriptions, relying more on inter-institutional cooperation and researchers' own online discovery capabilities for demand satisfaction. Therefore, exploring cooperation in literature procurement and services among relevant units through Collaborative Innovation Centers as examples still holds reference significance.

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Author Contributions: Ai Nanzhu: data collection and analysis, paper writing; Wang Xincai: paper revision.

English Title: Empirical Analysis on Literature Guarantee of the 2011 Collaborative Innovation Center at Universities: A Case Study of Wuhan University

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