Review of Domestic and International Research and Practice Developments in Library Resource Discovery Systems over the Past Decade: Post-print

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Date: 2023-04-01T16:15:51+00:00

Abstract

[Purpose/Significance] To review and systematically organize the development history and research progress of library resource discovery systems, and to promote deep integration and innovation between resource discovery systems and library business development.

[Method/Process] By searching databases including CNKI, Web of Science, Emerald, Elsevier, and Taylor & Francis SSH, and employing content analysis and case study methods, this study summarizes research on theoretical studies, system selection, deployment and implementation, promotion, effectiveness evaluation, and impact of library resource discovery systems.

[Results/Conclusion] The study finds that: resource discovery systems have been rapidly applied in libraries; research on resource discovery systems exhibits obvious periodicity and stage characteristics; differences exist in the development and evolution of domestic and international resource discovery systems; research content is primarily practice-oriented with insufficient theoretical depth; research methods are dominated by case studies and questionnaire surveys, with relatively few quantitative research methods. It is proposed that research on library resource discovery systems should be deeply integrated with library services, expand research scope and strengthen research depth, and enhance user profiling research on resource discovery systems.

Full Text

A Review of Research and Practice Progress on Library Resource Discovery Systems at Home and Abroad in the Past Decade

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Abstract:
[Purpose/Significance] This paper reviews and synthesizes the development trajectory and research progress of library resource discovery systems, aiming to promote deeper integration and innovation between resource discovery systems and library service development. [Method/Process] Through systematic retrieval of Chinese and international literature from 2010-2019 in databases including CNKI, Web of Science, Emerald, Elsevier, and Taylor & Francis SSH, this study employs content analysis and case study methods to summarize theoretical research, system selection, deployment implementation, promotion, effectiveness evaluation, and impact studies related to library resource discovery systems. [Result/Conclusion] The study reveals that resource discovery systems have been rapidly adopted in libraries, with research exhibiting obvious periodicity and stage characteristics. Development trajectories differ between domestic and international contexts, with research content focusing primarily on practical work while lacking theoretical depth. Research methods predominantly employ case studies and questionnaires, with relatively few quantitative approaches. The paper proposes that future research should achieve deeper integration with library services, expand research scope and depth, and strengthen user profiling studies for resource discovery systems.

Keywords: resource discovery system; discovery service; knowledge discovery; technology diffusion; university library
Classification Number: G250.7
DOI: 10.13266/j.issn.0252-3116.2020.06.014

In the digital environment, abundant digital scholarly resources have gradually become the dominant academic resources in university libraries. However, significant differences in the structure, distribution, and access methods of massive digital resources have created considerable inconvenience for users in searching and utilizing these materials. Initially, the library community proposed federated search as a solution, which could simultaneously search multiple databases and return a unified result set. Nevertheless, because federated search systems are based on application-layer information integration technology, they are constrained by the varying data interfaces of different resource objects, making it difficult to achieve deep revelation and integration of content-heterogeneous or isolated resources [1]. With the rapid adoption of Google Scholar, it has gradually become the primary pathway for university users to discover and access library information resources. Therefore, reviewing the practice and research of

library resource discovery systems over the past decade and summarizing their impacts and experiences holds significant value for the improved application and technological development of these systems.

2 Research Methods and Data

2.1 Research Methods

This paper primarily employs qualitative methods to systematically review and synthesize research and practice progress in library resource discovery systems within the field of library and information science. Specifically, the study first systematically retrieved and screened relevant journal articles, dissertations, survey reports, and case materials on resource discovery systems from the past decade (2010-2019) both domestically and internationally. Second, through content analysis, the collected materials were read individually, compared and analyzed repeatedly, and research themes were identified to form a research framework that comprehensively and accurately reveals the research landscape in this field. Third, through detailed literature analysis of each theme, case implementations were used as supporting evidence in the narrative. Finally, through inductive analysis and theoretical speculation, research characteristics were summarized to reveal fundamental trends and propose recommendations aimed at indicating future research directions and practical priorities.

2.2 Data Sources

The source databases for this study include SCI-E and SSCI abstract databases on the Web of Science platform, as well as Emerald, Elsevier, Taylor & Francis SSH, EBSCO, and Wiley foreign journal databases, ProQuest dissertation database, and Chinese databases including CNKI, Wanfang, and VIP. Foreign search terms included "Web-scale Discovery Services," "Summon," "Primo," and "EDS," while Chinese search terms included "资源整合系统" (resource integration system) and "资源发现系统" (resource discovery system). The retrieval timeframe spanned from January 2010 to May 2019. After deduplication, supplementation, and individual screening of the retrieval results, a total of 226 foreign and 195 domestic literature sources were obtained, as shown in [Figure 1: see original paper]. Additionally, this study utilized Baidu Scholar and Google Scholar to retrieve web-based literature from domestic and international sources.

3 Research Results and Analysis

3.1 Conceptual Connotation of Resource Discovery Systems

In 2005, following the release of Google Scholar, M. Breeding first proposed a model for resource discovery systems, arguing that the distributed search of federated search systems could not compete with the centralized search of Google Scholar. He proposed developing a "centralized search model" that would first

collect extensive data, process it into an index, and provide instant results for searchers' queries [2]. In 2007, C.J. Belliston and J.L. Howland et al. found that undergraduate students preferred federated search systems over traditional single-database searching because federated search could return results [7]. Nie Hua and Zhu Ling conceptualized resource discovery services as the preprocessing of metadata and partial object data from various heterogeneous resources to form a unified metadata index, ultimately providing unified search and services through a search engine [8]. R. Rowe [9] and F.W. Chickering and S.Q. Yang [10] identified features such as a single search box, relevance ranking, and faceted navigation as characteristic of resource discovery systems. In 2015, M. Breeding provided a comprehensive overview of resource discovery system features: a single search box in the end-user interface providing simple and advanced search functions, centralized indexing of collection resources, faceted functionality, links from abstracts to full text, and interoperability with library ILS systems to display circulation status [11]. Although different documents describe discovery system features differently, there is broad consensus on their main characteristics: single search box, centralized indexing, relevance ranking, faceted functionality, fast response, simplicity, ease of use, and compatibility with other library systems to integrate library data and services.

3.2 Development Motivations for Resource Discovery Systems

3.2.1 User Behavior OCLC research has found that when searching for resources, an increasing number of users prefer search platforms like Google or Google Scholar rather than library websites [12]. Although users consider library resources more authoritative and detailed, they find the search process and result organization cumbersome, and the fragmented management of library information resources significantly reduces their usability [13]. Resource discovery systems can simulate the web search environment, meeting users' expectations for complete discovery and instant access to library information resources [14].

3.2.2 Resource Integration Resource discovery systems combine full-text and citation data from journals and books, commercial data, and institutional data to achieve comprehensive coverage of library resources. Unlike federated search systems that perform real-time queries on heterogeneous, distributed databases, resource discovery systems are unified, normalized massive metadata pre-indexing repositories that enable deep revelation and integration of resources, offering significant improvements in search scope, efficiency, and result quality compared to federated search [15]. Discovery systems overcome the limitations of federated search technology, truly enabling one-box searching for library resources.

3.2.3 Discovery Services As a specific service platform integrating librarians' professional knowledge and library academic resources [16], resource discovery systems serve as discovery platforms for resource revelation and retrieval and represent an important form of knowledge discovery services, such as the

knowledge discovery services oriented toward disciplines implemented at Nanjing University of Chinese Medicine Library based on literature resource discovery [17]. Discovery systems are an important pathway for libraries to improve resource utilization and extend services [18].

3.3 Research on Resource Discovery System Selection

3.3.1 Selection Criteria Selection research builds upon system performance studies to examine key evaluation indicators based on practical needs. Early research primarily focused on comparing product features and functions. For example, R. Rowe compared resource discovery systems based on criteria including content, user interface, price, and contract options [9]. S.Q. Yang and K. Wagner compared commercial and open-source discovery tools based on user interface features, including search options, faceted navigation, result ranking, and Web 2.0 features [19]. Qin Hong et al. conducted comparative research on three popular discovery service systems—Summon, EDS, and Primo—from four aspects: metadata, architecture and functionality, search and interface, and business factors [20]. Many researchers have provided key indicators for resource discovery system selection to assist libraries in their decision-making processes. A. Hoeppner proposed a series of critical factors such as the breadth and depth of indexing, search and faceting options, customization features, and the ability to save, organize, and export search results [21]. A. Hoseth identified end-user characteristics, library objectives, costs, vendor support, and technical compatibility as primary evaluation criteria [22]. Liu Wanguo et al., in addition to listing resource coverage scope and system architecture as evaluation indicators, noted that data sources and user groups are also important considerations [23]. J. Deodato argued that the selection process should be inclusive, goal-oriented, data-driven, user-centered, and transparent [24].

3.3.2 Selection Cases As resource discovery systems have become more widely adopted, an increasing number of libraries have undertaken selection and evaluation efforts. presents typical cases of resource discovery system selection in domestic and international libraries. Evaluation and selection processes generally involve four elements: evaluation objects, evaluation subjects, evaluation indicators, and evaluation timelines. Resource discovery system selection is a comprehensive and thorough systematic evaluation project requiring significant time and personnel investment. Establishing a selection indicator system is the core task of this project. Based on a review of relevant research and cases at home and abroad, lists the main evaluation indicators for resource discovery system selection. These indicators clarify the strengths and weaknesses of each system, enabling libraries to select the most suitable resource discovery system based on their actual circumstances and needs.

3.4 Deployment and Implementation of Resource Discovery Systems

3.4.1 Deployment and Implementation Cases Different resource discovery systems have different architectures and consequently adopt different deployment strategies. The Summon and EDS system architectures employ cloud deployment, requiring no local installation and relatively low local technical requirements during implementation. In contrast, Primo's architecture combines cloud deployment with local installation, requiring corresponding hardware equipment and human resources for maintenance. Regardless of the architecture, resource discovery system implementation requires collaboration and division of labor among different library departments. lists representative cases of resource discovery system implementation in domestic and international libraries.

Survey cases reveal that libraries both at home and abroad primarily select three representative discovery systems: Summon, Primo, and EDS. This is partly due to these systems' reliable performance, after-sales service, and compatibility with library business systems, and partly due to inter-library communication and learning.

3.4.2 Implementation Content Based on the implementation experiences summarized in , the work can be categorized into the following aspects: (1) Data configuration: primarily referring to the subscription and configuration of commercial electronic resources and the mapping and synchronization of local resources; (2) Search functionality: optimizing search and retrieval options to improve search precision, speed, and relevance ranking; (3) Interface design: customizing the resource discovery system interface according to user needs; (4) Enhanced service capabilities: integrating with local library systems; (5) Testing and evaluation: summarizing issues and further optimizing the aforementioned work; and (6) Promotion and publicity.

3.5 Promotion and Publicity of Resource Discovery Systems

Post-implementation promotion and publicity are essential for enhancing system usage and impact. The University of Texas at San Antonio Library developed short videos to promote mobile access to the Summon resource discovery system [43]. Peking University Library shared its promotion methods for the "Weiming Academic Search" [44]. Primary promotion methods include: (1) employing various promotional forms such as creating user manuals, posters, videos, and micro-films; (2) incorporating resource discovery systems into regular library training programs and producing micro-courses for convenient user learning; (3) conducting related activities to attract broad user participation, such as the prize questionnaire survey and search contest organized by Peking University Library; (4) improving user experience and optimizing system functions to gain recognition from advanced users such as faculty, which can effectively increase resource discovery system usage [45]; and (5) providing usage assistance

through multiple channels such as email, virtual reference, and BBS to collect user feedback and answer various usage questions.

3.6 Effectiveness Evaluation of Resource Discovery Systems

After implementing a resource discovery system, evaluation is needed regarding its performance, usage effectiveness, and impact. From an evaluation perspective, there are three main approaches:

3.6.1 Evaluation Based on Usage Data Usage data sources include: (1) Resource discovery system usage data—mining and analyzing system log data provides valuable references for deployment, application, and optimization [46]; (2) Data from Google Analytics—by establishing and deploying GA tracking codes on resource discovery system pages to track and record user behavior, researchers both domestically and internationally have begun using Google Analytics to collect detailed usage statistics [47-48]. Research on user behavior provides references for library resource integration and discovery service optimization.

3.6.2 Evaluation Based on Collection Usage Domestic and international research on collection usage primarily focuses on changes in digital resource usage. Numerous studies indicate that the impact of resource discovery system implementation on each school and each database is uncertain. D. Way used statistical data to study the impact of Summon on library resources, finding results largely consistent with expectations: abstract and index database usage decreased significantly, while full-text database usage increased dramatically [49]. Z. Evelhoch found that after implementing a discovery service system, both database and e-journal usage at the library decreased significantly [45]. P.P. Yeo's research found that after implementing a resource discovery system, overall usage of e-journals and e-books increased, but individual analysis revealed that while some databases showed significant increases, others not only failed to increase but actually decreased [27]. Conversely, research from Beijing Normal University Library found that implementing a resource discovery system had no significant impact on database resource usage [50].

Research on changes in print journal and book usage is scarce. L. O'Hara found that print resource usage declined after implementing a resource discovery system, though the author was uncertain whether this decline was related to the system [51].

3.6.3 Evaluation Based on User Experience This primarily manifests in three aspects:

(1) **Usability evaluation**: Based on user perceptions, ratings, and task completion during testing, users generally hold positive attitudes toward resource discovery systems, rating their usability and quality highly. How-

ever, various subjective and objective factors affect user experience during actual use, including: (a) barriers in understanding library-specific terminology—terms such as journal, article, magazine, serial, HTML full text, and PDF full text pose obstacles to understanding resource discovery services, as students find these terms ambiguous [52]; (b) difficulties using faceted functionality—users often feel confused when selecting and applying facets to optimize searches, unable to determine which facets and refinement functions can improve their search results [53]; and (c) obstacles in full-text access paths—users experience confusion regarding link resolver usage and understanding [54-56].

(2) **User satisfaction**: Differences among user groups create varying functional requirements for resource discovery systems [57]. A large-scale online survey conducted one year after implementing a resource discovery system at the University of Birmingham showed an overall rating of 71.13% as "good" or "very good," with undergraduate students being most satisfied and faculty members least satisfied [58]. Notably, librarians, as implementers of resource discovery systems, are also their harshest critics, with studies showing that librarians believe resource discovery systems cannot meet their personal research needs and prefer subject-specific databases [59]. Compared to graduate students and researchers, resource discovery systems are more suitable for undergraduate students and general researchers [60-61].

(3) **Relevance judgment**: B. Lee and E.K. Chung compared the relevance of search results between EDS and four databases (ERIC, ERC, LISA, and LISTA) from a user perspective, finding a significant gap between EDS's ranking results and participants' relevance judgments [62]. Accurately identifying search results that meet users' professional needs within the massive result sets of resource discovery systems is highly challenging, requiring further optimization of resource indexing schemes and improvement of search result relevance ranking.

3.7 Impact Research on Resource Discovery Systems

Resource discovery systems have significantly impacted user services, resource development, librarian development, and scholarly publishing. Analyzing these impacts helps comprehensively evaluate the value of resource discovery systems for accurate and timely improvement, and also helps extend library services, expand service depth, and innovate service models based on resource discovery systems.

3.7.1 Impact on Library Users Resource discovery systems enable proactive discovery, allowing users to maximize resource discovery and mining based on their search intentions, thereby greatly expanding users' horizons [63]. Simultaneously, resource discovery systems significantly reduce requirements for users' information retrieval capabilities, providing convenience for new users

in particular. "Simple, intuitive, fast, and massive results" is common user feedback, though the massive result sets require users to possess higher resource evaluation and selection capabilities [64]. Critical thinking during the document selection process represents the greatest obstacle for users [65]. Meanwhile, resource discovery systems provide objective basis for personalized services, as user behavior log data objectively reflects users' real intentions and needs, serving as the foundation and integration point for library personalized services [66].

3.7.2 Impact on Information Literacy Education Resource discovery systems have fundamentally changed users' scholarly search methods, forcing instructors to reconsider how to teach students to find information. As library searching becomes increasingly easy through discovery systems, the focus of information literacy should shift to cultivating students' critical thinking for resource evaluation [67]. After implementing Summon, Hong Kong Baptist University librarians changed their teaching objectives, shifting focus from introducing resources and operational steps to exploring, evaluating, and using information—such as the information creation process, information types, and how to assess information quality and relevance [68]. Mining and analyzing user behavior data from resource discovery systems helps improve information literacy teaching strategies [47].

3.7.3 Impact on Collection Development Two years after implementing Summon, Pennsylvania State University Library saw a 57% decrease in undergraduate interlibrary loan requests and a 22% decrease in total interlibrary loan demand after four years, enabling librarians to reallocate resources to develop new services [69]. Additionally, research shows that after implementing resource discovery systems, library electronic resource usage—particularly e-journal usage—increased dramatically, while print collection circulation declined sharply [70]. These data provide valuable references for collection policy adjustment and resource integration.

3.7.4 Impact on Librarian Development The impact of library resource discovery systems on librarians' information literacy instruction remains unclear, with divisions among librarians. Some support resource discovery systems for their simplicity and ease of use despite imperfect search results, while others worry that resource discovery systems reduce users' information literacy capabilities and believe greater emphasis should be placed on cultivating students' search strategies and research skills [7]. Surveys also reveal that few institutions require librarians to incorporate discovery systems into their teaching content [71].

3.7.5 Impact on Academic Publishing Usage data from the University of Huddersfield shows that as long as publishers provide high-quality content indexes to resource discovery systems, even small and medium-sized companies

can effectively increase content visibility. Resource discovery systems provide fair competition opportunities for article discovery and can effectively balance competition among academic resource content providers [72]. However, data transmission between publishers and discovery service providers may introduce discrepancies due to various factors, requiring strengthened cooperation among academic publishers, discovery service providers, and libraries to minimize differences and improve index content quality [73].

4 Research Conclusions and Recommendations

4.1 Summary of Research and Practice

Based on the above review, this paper synthesizes research and practice progress on library resource discovery systems from three dimensions: "theory—practice—impact." The synthesis yields the following characteristics:

4.1.1 Technology Diffusion Characteristics of Resource Discovery System Application Library resource discovery systems represent a technology application that, over time, follows the five stages of technology diffusion: knowledge, persuasion, decision, implementation, and confirmation [74], corresponding to the five practical steps of development motivations, system selection, deployment implementation, promotion and publicity, and effectiveness evaluation. Spatially, resource discovery systems have diffused from foreign research libraries to domestic university libraries, and from top-tier university libraries such as Peking University and Tsinghua University to ordinary institutional libraries.

4.1.2 Differences in Domestic and International Development Trajectories The concept of discovery services originated abroad, with both the meta-search concept and system models initially proposed by foreign scholars. The development trajectory of foreign resource discovery systems generally follows the logical path of "proposing concepts—building models—case studies—application research—effectiveness and impact." Specifically, after identifying the limitations of federated search and the threat from search engines like Google Scholar, the meta-search concept and model were proposed, followed by comprehensive exploration of resource discovery system entities, applications, effectiveness, and impact. Domestic practice began relatively later, focusing more on specific case implementations, with insufficient exploration of effectiveness and impact, particularly regarding users' subjective experiences and evaluations, effectiveness assessment, and resource discovery system impact.

4.1.3 Periodicity and Staged Characteristics in Research Process From a temporal perspective, the first stage focused on introducing resource discovery systems, analyzing needs, and selection research; the second stage examined discovery service deployment cases and evaluated service effectiveness; the third stage investigated library discovery system

impacts and deep integration with library business and systems, presenting an S-shaped life cycle growth pattern. Additionally, practical research on library resource discovery systems shows obvious periodicity, with "development motivations—system selection—deployment implementation—promotion and publicity—effectiveness evaluation" forming an interconnected, progressive sequence of system application steps that scholars have studied with different emphases at each stage.

4.1.4 Practice-Oriented Research Content with Insufficient Theoretical Depth Analysis of the development process of library resource discovery systems reveals that library practice is the main driving force behind research in this field. User needs, discovery system comparisons, implementation experience summaries, and discovery service evaluations are all closely connected to library practice, with librarians constituting the primary research force. However, theoretical summaries regarding user behavior theory, project implementation models, and discovery service evaluation theoretical frameworks for resource discovery systems are relatively lacking. Compared to foreign research, domestic research is insufficient in system effectiveness evaluation and impact studies.

4.1.5 Predominance of Case Studies with Few Quantitative Research Methods Qualitative research methods primarily include case studies, comparative analysis, and focus groups, mainly concentrated on resource discovery system implementation case studies and system selection comparative research. Quantitative research primarily employs questionnaires, experimental studies, and log analysis—questionnaires mainly investigate discovery system needs, usage behavior, and user satisfaction; experimental studies primarily examine users' information retrieval behavior using resource discovery systems; log mining analysis mainly mines user search logs. Additionally, correlation analysis, such as that between resource discovery and collection development, has also been applied.

4.2 Recommendations for Research and Practice

As previously noted, early research on library resource discovery systems was relatively popular while later research has been insufficient; practice-oriented research predominates while theoretical depth is lacking; and domestic research on discovery system evaluation and impact is inadequate. Therefore, this paper proposes the following recommendations:

4.2.1 Deep Integration of Resource Discovery Systems with Library Services Although library resource discovery systems have been applied in large and medium-sized university libraries, they primarily function as "one-stop" search portals, far from realizing their full potential. Future practice should strengthen effectiveness evaluation work to quantitatively analyze impacts on library user behavior, collection development, and information literacy

education, providing data support for related work optimization and innovation. Additionally, integration between resource discovery systems and other library service systems (such as document delivery and novelty search) and related service projects should be enhanced to achieve mutual association and fusion between systems and services, thereby realizing overall functionality and benefits.

4.2.2 Expand Research Scope and Strengthen Research Depth Regarding research scope, domestic research should expand into areas such as resource discovery system effectiveness and impact, conducting longitudinal studies on deployed systems and comparative studies across different libraries. Regarding research objects, user groups should be refined to analyze usage behaviors and impacts of different groups such as undergraduate students and researchers, while also conducting longitudinal tracking studies to analyze changes in user behavior before and after resource discovery deployment and training promotion. Regarding research data, multi-source data should be integrated to finely characterize usage effectiveness, user behavior, and impact studies of resource discovery systems. Regarding research methods, while employing case studies and questionnaires, attention should be paid to introducing eye-tracking research and big data methods.

4.2.3 Strengthen User Profiling Research for Resource Discovery Systems In the big data environment, user profiling represents an important approach and method for library data processing and personalized services. After years of resource discovery system implementation, massive amounts of user behavior data have been accumulated. Libraries can conduct in-depth systematic research on data collection, construction methods, processing platforms, and profiling development to provide references for personalized and knowledge-based services.

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A Review of Research and Practice of Library Resource Discovery Systems at Home and Abroad in the Past Decade

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Abstract: [Purpose/Significance] Reviewing and combing the development process and research progress of library resource discovery systems has important theoretical and practical significance for promoting the deep integration and innovation of resource discovery systems and library development. [Method/Process] Based on CNKI, Web of Science, Emerald Insight, Elsevier, Taylor & Francis SSH and other academic databases, this paper summarizes the theoretical research, system selection, deployment and implementation, promotion, effectiveness evaluation and impact research of library resource discovery systems by content analysis and case study. [Result/Conclusion] The research results show that resource discovery systems are rapidly applied in libraries; the research process of resource discovery systems has obvious periodicity and stage; there are differences in the development and evolution of resource discovery systems at home and abroad; the research content is practical but lacks theoretical depth; research methods are mainly case studies and questionnaires, with few quantitative research methods. Therefore, library resource discovery system research should be deeply integrated with library services, expand the scope of research and strengthen research depth, and strengthen user profiling research of resource discovery systems.

Keywords: resource discovery system; discovery service; knowledge discovery; technology diffusion; academic library

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