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## Electronic Resource Access Failures in Next-Generation Library Service Platforms: Research and Practice (Postprint)

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### Abstract

[Purpose/Significance] With the widespread adoption and implementation of the new-generation library management platform ALMA and discovery systems represented by PRIMO in China, issues of electronic resource access failures in the new library service platform environment have become increasingly prominent, affecting user experience and posing challenges for librarians. Due to the complex etiology of such failures, their underlying mechanisms and countermeasures have become a focal point of concern for libraries. [Method/Process] This study conducts a literature review of research on electronic resource access failures related to discovery systems both domestically and internationally; analyzes the workflow from when users trigger search requests in the discovery system to accessing full-text resources; and examines several cases of electronic resource access failures since the deployment of the ALMA system. [Results/Conclusion] The study summarizes research progress on the causes and resolution mechanisms of electronic resource access failures in discovery system environments; systematically outlines the workflow from user initiation of search requests in the discovery system to full-text access; based on case studies, conducts a detailed analysis of the primary causes of electronic resource access failures from three aspects: metadata quality in Primo Central Index, ALMA data quality and related configurations, and changes in electronic resource information itself. It proposes that libraries can address access failures by providing users with user-friendly feedback channels for reporting access issues, collecting and analyzing access failure cases, establishing workflows for electronic resource failure resolution, and enhancing librarians' capabilities in resolving electronic resource failures.

**Full Text**

**Preamble**

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**Research and Practice on Electronic Resource Access Problems in New Library Service Platform Environments**

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**Abstract:** [Purpose/Significance] With the domestic promotion and application of next-generation library management platforms such as ALMA and discovery systems represented by PRIMO, electronic resource access problems in new library service platform environments have become increasingly prominent, affecting user experience and troubling librarians. Due to the complex causes of electronic resource access failures, their mechanisms and response mechanisms have become a focus of library attention. [Method/Process] This study conducts a literature review on electronic resource access troubleshooting in discovery systems both domestically and internationally; analyzes the workflow from when users trigger search requests in the discovery system to when they access full-text resources; and examines several cases of electronic resource access problems since the ALMA system went live. [Result/Conclusion] The paper summarizes research progress on the causes and resolution mechanisms of electronic resource access problems in discovery system environments; outlines the workflow from user search request initiation to full-text access; and analyzes the main causes of access problems in detail from three aspects: metadata quality in Primo Central Index, data quality and related configurations in ALMA, and changes in electronic resource information itself. The paper proposes that libraries can address access problems by providing users with easy-to-use feedback channels, collecting and analyzing access problem cases, establishing electronic resource troubleshooting workflows, and enhancing librarians' ability to resolve electronic resource access issues.

**Keywords:** ALMA; Primo; discovery system; electronic resources; access problems

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Electronic resources refer to materials that require computer access, whether through personal computers, mainframes, or handheld mobile devices. They can be accessed remotely via the internet or used locally. Common types include: electronic journals, e-books, full-text (integrated) databases, index/abstract databases, reference databases (biographies, dictionaries, directories, encyclopedias, etc.), numeric and statistical databases, electronic images, and electronic

audio/video materials [1]. Data from the *2017 China Academic Library Development Report* shows that expenditures on electronic resources have already exceeded half of total document resource procurement costs, with both the average amount and proportion showing a year-by-year increasing trend since 2006 [2]. The increasing proportion and quantity of electronic resource expenditures indicate that electronic resources have become an important component of library collections. In this environment, libraries, publishers, and system operators are all considering how to effectively manage electronic resources and enhance their discoverability. The level of electronic resource management and access has also become an important measure of library development. The Association of College and Research Libraries' revised *Standards for Libraries in Higher Education* (2018) includes "discovery services" as one of nine performance dimensions [3].

As next-generation library management systems represented by ALMA and resource discovery systems represented by Primo have been successively launched domestically, the visibility of electronic resource data in resource discovery systems has significantly improved, but this has been accompanied by an increase in electronic resource access problems. Since accessing electronic resources from user search request initiation to full-text access involves multi-layered data matching and mapping processes in both the ALMA system and Primo Central Index (PCI), the causes of electronic resource access failures are complex, making electronic resource troubleshooting a complex and challenging task. Currently, the domestic library community is in the learning and exploration stage regarding next-generation library management systems, and relevant literature reports on electronic resource access problems in discovery systems are still relatively rare. Domestic research on next-generation library management systems represented by ALMA and resource discovery systems represented by Primo has mainly focused on system functions and comparative studies of different discovery systems [4-5]. Research on access problems has gradually attracted attention from the international library community, with studies concentrating on case collection and analysis of electronic resource access problems and preventive and response measures [6-7]. For example, S. Mann proposed a conceptual model for the causes of electronic resource access problems, involving six aspects: server configuration, metadata errors and display, link resolver failure or matching errors, knowledge base data errors, platform data content gaps, and interlibrary loan [8].

## 2. Full-Text Acquisition Process for Electronic Resources in Discovery Systems

The Primo discovery system works by integrating multi-source heterogeneous metadata, performing format conversion, deduplication, and merging to form standardized records in PNX (Primo Normalized XML) format, and building a unified search service through SOLR search engine technology. Metadata is the foundation and guarantee of discovery services. Issues such as non-standard metadata formats, irregular cataloging, and poor accuracy create obstacles for

users in accurately locating and quickly accessing resources.

Currently, users retrieve and access resources through Tsinghua University's resource discovery platform Primo (hereinafter referred to as "Shui Mu Search"), whose data sources mainly include: ALMA, Primo Central, and other locally purchased databases. The process from search to acquisition of a data object is typically completed through linking. Primo Central supports two linking methods: one calculates the data object's link address through a link resolver, which is maintained in ALMA; the other provides the link address through direct linking. For example, when a user searches for an article in "Shui Mu Search," if the article supports direct linking, the platform directly provides online access prompts and link addresses. If the article does not support direct linking, the system sends metadata such as the article's journal ISSN, author, title, page number, volume, and issue to the link resolver. The link resolver in ALMA matches whether Tsinghua University Library has subscribed to the resource, determines the resource's platform link address, and presents relevant prompts and information to the user. As shown in Figure 1 [Figure 1: see original paper], this illustrates the electronic resource access and acquisition mechanism based on ALMA and PRIMO Central.

### 3. Case Studies and Cause Analysis of Electronic Resource Access Problems at Tsinghua University Library

The authors analyzed 50 cases of access problems reported by readers and librarians since the ALMA system went live at Tsinghua University Library, as well as data on the top 35 most-requested articles without services (Top article title accesses via OpenURL requests without services in the previous year) exported from the ALMA system between April 2018 and April 2019. Typical cases of common access problems in the discovery system environment are listed in Table 1. Overall, problem causes concentrate in three aspects: metadata quality issues in Primo Central Index, data quality and configuration issues in ALMA, and changes in electronic resource information. Approximately 60% of access problems originate from Chinese databases.

#### 3.1 Primo Central Index Metadata Quality Issues

Primo Central Index is based on massive metadata repositories, providing article-level metadata indexing for discovery systems. Metadata quality issues in PCI are concentrated in several areas: incomplete metadata coverage, inaccuracy, non-standardization, update lags, different indexing granularities, different resource linking levels, and errors in PCI direct linking data. These issues often manifest as article matching errors, access failures, retrieval failures, or required authentication for access. Libraries typically play the role of discovering and reporting these issues, as they cannot resolve them unilaterally and must provide feedback to vendors for metadata corrections. Such problem resolution often has long cycles, leaving libraries in a relatively passive position

and creating difficulties in user communication and explanation. There are six specific situations:

1. **Incomplete metadata coverage:** A survey by NISO's Open Discovery Initiative (ODI) working group on libraries, content providers, and discovery service platform vendors showed that among 74 content provider respondents, 93% mentioned they provided all or partial metadata to discovery service platform vendors, while 7% provided no metadata [9]. Therefore, article-level discovery and access for databases not covered by this metadata are prone to problems. Although users can check "Alternative Collections" in PCI to enable full-text retrieval for such databases, this coverage is incomplete, so some article-level access cannot be achieved through the discovery platform. The two most typical databases with this problem are EBSCO and CNKI.
2. **Metadata inaccuracy:** Inaccurate metadata often results in full-text linking errors or access failures. This issue commonly occurs in integrated databases such as EBSCO and Chinese databases. Inaccurate OpenURL links do not direct users to the expected article but often to the first article on the page. As shown in the example in Figure 2 [Figure 2: see original paper], when a user searches for the article "Neuroscience People Identified from brain activity" in "Shui Mu Search," clicking "Online Full Text" redirects to another article, though the target article can be found in the "Associated Content" section of that page.
3. **Non-standardized PCI metadata:** For example, a "0" in metadata is actually an "O," or the hyphen in journal issue numbers should be half-width "-" but is full-width "—."
4. **Metadata update lags:** Lagging metadata updates cause data packages in the ALMA knowledge base to not cover all currently available resources. Although PCI sets update cycles for each data package, actual testing does not achieve the update frequency provided to users. Another situation occurs when suppliers do not provide all articles for a certain issue or the issue's index. In such cases, even if the content is within the accessible period provided by the supplier, linking will fail. These two situations are common in commentary and newspaper article retrieval [10].
5. **Different metadata indexing granularities:** A common situation is when a user searches for an article, clicks "Online Full Text," but the page does not directly jump to the specified article, requiring the user to search again for the required article link or related information on that page. This occurs because a database vendor may combine many sub-articles into one document under a single title. In such cases, the required search result appears in the "Associated Content" section of the page.
6. **PCI direct linking data errors:** This causes full-text calls from PCI data sources presented on the Primo end to fail, preventing users from

obtaining full text through that data source, as seen in the Gale scholar database access problem in Table 1.

### 3.2 ALMA Data Quality and Configuration Issues

The key to ALMA's basic workflow for electronic resource management lies in managing the types of electronic resource subscriptions, linking parameters, and bibliographic data. Configuration or data issues in any of these links may cause access problems, with causes generally appearing in resource data and bibliographic data. Some subscription resource data problems can be solved by catalogers uploading local subscription data or correcting erroneous data in the ALMA knowledge base. However, most electronic resource data subscribed to by the library is directly called from the ALMA shared zone, especially for resource packages maintained through automatic updates. The update frequency, types, configuration parameters, or quality of MARC data will all affect search results on the Primo end.

ALMA's management hierarchy for electronic resources is relatively simple. In ALMA, libraries can manage databases, electronic journal information within databases, and e-book metadata. Librarians need to maintain the list of databases and their covered electronic resources purchased or permanently acquired by the library, along with their coverage periods, and configure linking parameters in batch mode. ALMA regularly and automatically publishes data from ALMA to Primo. For a specific resource database, its included electronic resource information and related linking parameters directly affect user resource retrieval and acquisition on the Primo end.

Compared with ALMA, Primo Central manages metadata at a richer, more granular level and broader scope. A journal, an article, or even a chart within an article can be indexed by Primo as a data object.

MARC data quality issues in the ALMA knowledge base mainly exist in several aspects:

1. **ALMA knowledge base linking parameter errors:** Incorrect linking parameters for resource databases or their included electronic journals or books directly cause linking failures.
2. **Incomplete or erroneous bibliographic data in the ALMA knowledge base:** For example, incorrect issue numbers recorded in MARC data fields 022*a* or 776*x* in the Community Zone (CZ) cause incorrect journal matching in search results. Incomplete MARC data information commonly manifests in electronic journals as failing to reflect continuation relationships, such as lacking fields 780 (preceding entry) and 785 (succeeding entry) (as in the Taylor journal case in Table 1) and the 245 field often lacking subtitles. MARC data quality affects the accuracy of portfolio activation and confuses users in retrieval. For example, Chinese journal MARC data in the ALMA knowledge base are often simple cata-

logging data with common field errors, triggering incorrect link activation. Taking *China and Foreign Education Weekly* as an example (see Figure 3 [Figure 3: see original paper]), due to cataloging issues in fields 246, 260, and 880 of this journal in the ALMA knowledge base, the accuracy of user search results in the discovery system is directly affected.

### 3.3 Electronic Resource Information Changes

The electronic resource information mentioned in this paper refers to information displayed by electronic resources on their database platforms. For electronic journals, this generally includes transfers, platform changes, mergers, and changes in journal titles and issue numbers. Changes in electronic journal information commonly lead to incomplete and untimely revelation of electronic journal information content on database platforms. A study on NISO electronic resource standards and specifications pointed out that placing digitized content of pre-title-change journals under current journal titles and using current ISSNs seriously hinders researchers from finding and identifying needed content [11]. In practice, catalogers find that different database platforms have inconsistent standards for displaying and identifying electronic journals, causing confusion for catalogers in verifying and revealing journal data. When electronic journal information changes, if database vendors fail to communicate relevant information with libraries in a timely manner, or if catalogers fail to reveal or configure parameters on the ALMA platform in a timely manner, access problems may occur. For example, when a journal transfers from Platform A to Platform B, the library needs to reactivate and configure corresponding access parameters in ALMA. Another example is when a journal ceases publication in a certain year, requiring modification of its accessible coverage period in ALMA.

## 4. Library Response Mechanisms for Electronic Resource Access Problems

The gradual promotion and application of next-generation library management systems represented by ALMA in China has facilitated libraries' implementation of full lifecycle management of electronic resources. Based on analysis of several electronic resource access problem cases received by Tsinghua University Library since the ALMA system went live, the authors believe that problem causes concentrate in three aspects: PCI metadata quality, ALMA data quality, and electronic resource information changes. After identifying the causes of electronic resource access problems, libraries need to consider how to respond. The authors propose that libraries can address access problems from five aspects:

### 4.1 Provide Users with Easy-to-Use Access Problem Feedback Channels

With large numbers of users accessing electronic resources through discovery systems, providing effective problem feedback channels is essential. A survey

by Milner Library on faculty feedback regarding electronic resource problems showed that faculty believed libraries could improve problem feedback mechanisms by maintaining current systems and integrating “Report a problem” into all library pages, providing feedback forms for reporting all types of issues (including electronic resources, email, printing services) [12]. Website surveys reveal that establishing a “Report a problem” page on the library homepage is a currently common user feedback method adopted by libraries. For example, the University of Toronto Libraries [13], Karolinska Institute University Library [14], and the Royal Danish Library all use form submission for problem feedback. For a journal article problem report, feedback information should include journal title, volume/issue, article-level URL, article title and author, whether remote access was used, and error message content. Currently, Tsinghua University Library mainly receives electronic resource access problem reports through an electronic resources email group that covers librarians responsible for all departments involved in the electronic resource management workflow.

#### **4.2 Collect and Analyze Access Problem Cases and Their Causes**

A librarian at Auraria Library believes that broken links, inaccurate metadata, platform changes, and other issues trouble libraries. Although libraries have established corresponding workflows and working groups attempt to solve these problems, there are few reports on collecting valuable access problem data. This librarian collected 100 access problem cases at Auraria Library, analyzed their causes, created a tag cloud classification of problem causes, and categorized them into library-controllable and uncontrollable causes, arguing that libraries should pay more attention to controllable causes [15]. At Tsinghua University Library, faculty and interlibrary loan departments are the main users of the discovery system, with problem reports from interlibrary loan accounting for the majority of feedback. These reports can help librarians discover underlying problems in electronic resource management. Therefore, libraries should emphasize the analysis, collection, and organization of electronic resource problems to improve resource quality and reduce problem occurrence rates. Additionally, libraries should actively take measures regarding controllable factors, such as ensuring comprehensive and accurate resource revelation, configuring the display order of data sources on search result pages, activating the EBSCO full-text linking API, and configuring Related Records to enable data linking when publication titles or issue numbers change.

#### **4.3 Establish Electronic Resource Problem Resolution Workflows**

Electronic resource access problems involve the entire electronic resource management workflow and are affected by data quality from libraries, database vendors, ALMA system service providers, and content providers. Librarians involved in electronic resource management processes cover multiple departments including resource development, cataloging, technical services, and information/reference departments. Electronic resource access problems also involve

multi-system, multi-level issues including electronic resource subscription configuration, ALMA's management of electronic resources, metadata management of electronic resources in Primo Central Index, and front-end display in the Primo system. Therefore, libraries need to define problem causes according to different systems and assign librarians to track and resolve problems in corresponding system modules. Currently, Tsinghua University Library mainly uses an electronic resources service email group as the feedback channel for problem resolution, with catalogers who best understand system resource data serving as first responders to access problems. They judge problem causes and promptly resolve revelation-related problems, while referring non-revelation causes to technical staff for investigation, and PCI metadata-related problems to vendors for resolution through feedback mechanisms.

#### **4.4 Improve Librarians' Ability to Resolve Electronic Resource Problems**

The complex and diverse causes of electronic resource access problems place higher demands on librarians' understanding of various systems and their ability to quickly analyze and locate problems. Therefore, libraries should strengthen technical training for librarians and improve their problem-solving abilities. Literature surveys reveal that international counterparts have conducted research on training librarians for electronic resource problem management. For example, R. Taryne analyzed 113 access problem cases received through a medical library's virtual reference system and proposed a training program for librarians covering seven aspects: communication skills with users, faculty, and database vendors; ability to research access problems and collaborate with colleagues related to link resolvers and data retrieval platforms; ability to manage and trace the location of subscription electronic resource records; ability to improve control over the quality of electronic resource cataloging data and understand different system data management principles to judge problem causes; communication skills for contacting database vendors to report subscription or licensing status, authentication, link resolver, and content gap issues; understanding of the mechanisms and technical causes affecting on-campus and off-campus access to electronic resources, including IP addresses, servers, authentication, link resolvers, firewalls, usernames and passwords, and concurrent users; and understanding of licensing language and terminology meanings, such as perpetual access, embargo periods, authorized users, and their relationships with subscribed and free resources [16]. C. Sunshine and T. Stacie believe [17] that libraries should establish organized, robust training systems (training strategies, tools, curricula) to help librarians responsible for problem resolution improve their abilities. R. Angela et al. believe that communication skills, technical abilities, and training are important aspects of relevant librarian training [18].

#### 4.5 Strengthen Cooperation with Content Providers, System Providers, Resource and Service Consortia, and Among Libraries

Electronic resources are large in quantity, diverse in type, and change rapidly, making their management highly dynamic and complex. Liu Suqing, from the perspective of electronic resource management, mentioned in research on Chinese university library service platforms that from the current development of domestic next-generation library service platforms, we may not lack technology but rather the concerted cooperation and collaborative innovation from all parties such as content providers, system providers, resource and service consortia, and libraries [19]. H. Wolfgang's research suggests that in the ALMA environment, since data is no longer stored locally and user data acquisition depends on vendors, it is necessary to establish sufficient cooperative agreements between libraries and discovery system service providers to protect library users' interests [20].

Although this study focuses on causes related to the ALMA system and Primo Central knowledge base data, other causes of access problems exist, such as inaccurate, incomplete, issue number, or coverage period errors in subscription lists provided by database vendors. Some subscription lists provided by database vendors require multiple rounds of verification, communication, and revision, with the time cost reducing work efficiency. Additionally, off-campus access, IP ranges, user authentication related to servers, and usage authorization issues may also affect users' ability to obtain electronic resources. For example, some EBSCO articles are not within the publisher's authorization scope due to author copyright restrictions; databases fail to configure relevant access settings when new subscription periods begin; or overall access problems caused by unstable or faulty database platforms. Therefore, further construction of an overall problem workflow from procurement to revelation is needed.

Furthermore, in Tsinghua University Library's "Shui Mu Search," VIP, CNKI, and Wanfang databases can all serve as full-text acquisition platforms after resource discovery. Compared with foreign language resources, Chinese resources have strong particularities, manifested in non-standardized data, lack of linking standards, and monopolistic situations caused by interest disputes among the three major Chinese resource providers [21]. Issues such as linking failures caused by journals without standard numbers and confusion at article and journal levels caused by multiple journals sharing one number result in 60% of access problems received by the library originating from Chinese databases. Driven by the discovery system environment, Chinese database vendors need to strengthen cooperation and sharing with platform service providers to improve data quality.

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#### **Author Contributions:**

Wu Lina: Conceived research questions, proposed paper structure, wrote the paper;

Jia Yanxia: Revised the paper;

Dou Tianfang: Revised the paper;

Lv Xiaohua: Revised the paper;

Zhao Yang: Revised the paper.

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### **The Practice and Research of Electronic Resources Access Problems in New Library Service Platform**

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**Abstract:** [Purpose/significance] Electronic resources access problems are increasingly obvious because of the launch of new service platform ALMA and PRIMO, which confuses the librarians and affects users' experience. Library should pay more attention to it. [Method/process] The paper reviewed the literature on electronic resources troubleshooting, analyzed the flowchart of electronic resources access in discovery system and also investigated examples of commonly encountered access problems. [Result/conclusion] Summarizing the research progress on electronic resources access issues and outline the access process. Major reasons of access trouble are examined from 3 aspects: meta-data quality and configuration in Primo Central Index and ALMA, information change of electronic resources themselves. Some suggestions for solving access problems are put forward.

**Keywords:** ALMA; Primo; discovery system; electronic resources; access problems

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

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