Overcoming Open Linking Bottlenecks: A Post-print Analysis of the KBART Digital Resource Standard

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Abstract

[Purpose/Significance] This study investigates the Knowledge Bases and Related Tools (KBART) Recommended Practice, aiming to promote in-depth understanding and wide application of KBART within China's library community, assist content providers in obtaining certification and fulfilling their commitment to providing high-quality digital resources, and enhance the digital resource usage environment for end users.

[Method/Process] By introducing the genesis, evolution, main content, and characteristics of the KBART standard, this paper summarizes its best practice guidelines, related educational materials, organizational activities, and network hub centers for knowledge base information. Building upon this, it investigates the current status of KBART application and practice in the field of electronic resources both domestically and internationally, and analyzes the development trends of KBART.

[Results/Conclusion] The KBART standard has gained recognition from numerous resource providers and been put into practice, promoting the standardized development and management of electronic resources both at home and abroad.

Full Text

Preamble

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Breaking Through the OpenURL Bottleneck: An Analysis of the KBART Digital Resource Standard

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Abstract

[**Purpose/Significance**] This study examines the Knowledge Bases and Related Tools (KBART) Recommended Practice to promote deeper understanding and broader implementation of KBART among Chinese libraries, assist content providers in achieving certification and fulfilling their commitment to delivering high-quality digital resources, and ultimately improve the digital resource environment for end users. [**Method/Process**] The paper introduces the origins, development, main content, and characteristics of the KBART standard, summarizes its best practice guidelines, educational materials, organizational activities, and information network hub for knowledge bases, and investigates the current application and implementation of KBART in electronic resources both domestically and internationally to analyze its development trends. [**Result/Conclusion**] The KBART standard has gained recognition from numerous resource providers and has been put into practice, promoting the standardized construction and management of electronic resources both in China and abroad.

Keywords: KBART, OpenURL, knowledge base, digital resource standard, metadata

1. Overview of KBART Project Development

1.1 Origins of KBART: Addressing OpenURL Effectiveness Issues

OpenURL, as a technical standard for digital resource system integration and interoperability, enables service providers (such as libraries) to dynamically generate links on relevant service webpages through link resolvers, helping library users access digital resource content. The OpenURL standard was jointly drafted by O. B. T. Arie of Ex Libris and H. Van de Sompel of Ghent University in Belgium in the late 1990s. In May 2005, the National Information Standards Organization (NISO) announced the "OpenURL Framework for Context-Sensitive Services" (NISO Z39.88-2004) as a new American national standard. This service provides users with comprehensive relevant resources based on context in user requests, greatly facilitating retrieval.

With the widespread application of OpenURL, concerns about its linking effectiveness emerged. In early 2006, the United Kingdom Serials Group (UKS) published the research report "Link Resolvers and the Serials Supply Chain,"

which identified and described a series of issues affecting OpenURL effectiveness and recommended establishing a working group to identify and promote "best practice" solutions across the industry to improve metadata exchange with knowledge bases. The KBART Working Group was formally established in December 2007, co-chaired by UKS and NISO.

1.2 Phase I Focus: Providing High-Quality Journal Metadata

The KBART Working Group invited representatives from all segments of the electronic resources supply chain to discuss the issues identified in the UKS research report, propose solutions, support KBART adopters, and achieve smoother interaction among knowledge base supply chain members. In its early stages, the Working Group focused on problems arising when data was supplied to knowledge bases in the information supply chain. By providing best practice guidelines, compiling educational materials, organizing relevant activities, and establishing an information network hub for knowledge bases, the group aimed to improve data supply for link resolvers and knowledge bases to enhance OpenURL linking efficiency and effectiveness. In January 2010, Phase I of the Recommended Practice (NISO RP-7-2010) was released, offering fundamental recommendations for journal metadata and benefiting both knowledge base providers and their clients (primarily university libraries) through high-quality data from content providers.

1.3 Phase II Focus: Promoting Effective and Efficient Metadata Transmission and Exchange

In February 2010, NISO launched Phase II of KBART. To better improve the user experience with knowledge bases and link resolvers, the KBART Working Group adjusted its membership and further examined issues discussed in Phase I, focusing on more specific and complex problems affecting metadata supply. The group revised metadata supply transmission standards, conducted in-depth investigations of user needs, improved knowledge base data supply, clarified provider cooperation frameworks, established an information portal, carried out promotional activities, and provided comprehensive information resources. In April 2014, the Phase II Recommended Practice (NISO RP-9-2014) draft revision was released, with key revisions including metadata standards related to consortia, open access publications, e-books, and conference proceedings, as well as methods, frequency, formats, and descriptions for data exchange and transmission.

2. Current Application Status of KBART

2.1 KBART Standard Gains Recognition from Resource and Knowledge Base Providers

Since the KBART support process includes a certification framework that enables content providers to achieve accreditation and publicly demonstrate their

commitment to supplying high-quality metadata to the supply chain, content provider recognition of the standard is critical to KBART adoption. According to the KBART website, 48 resource providers have currently achieved KBART certification, including prominent organizations such as EBSCO Information Services, Emerald Group Publishing, Cambridge University Press, OCLC, IEEE, and Royal Society Publishing.

Many commercial link resolver products in the international market comply with KBART standards, including OCLC's WorldCat Local, Ex Libris's SFX and Alma UResolver, Serials Solutions' 360 Link, Innovative Interfaces Inc.'s Web-Bridge, and EBSCO Information Services' Full Text Finder. Additionally, some open-source link resolvers such as CUFTS and Umlaut also adhere to KBART specifications.

KBART outlines three ways for knowledge base providers to utilize KBART documentation: (1) **KBART Title Lists**: Accredited content providers supply title lists in KBART-certified formats to the industry, with links provided on the KBART registry website. (2) **KB+** (www.kbplus.ac.uk/kbplus/): Operated by Jisc Collections, KB+ is a community-shared knowledge base for managing electronic resources for UK academic libraries, providing accurate and up-to-date data on publishing, licensing, and subscription information that is compatible with KBART Recommended Practice. KB+-related documents are available on its website and are used by institutions and link resolver providers such as EBSCO, Ex Libris, OCLC, and ProQuest (Serials Solutions). (3) **Global Open Knowledgebase (GOKb)** (gokb.org/): An international collaborative project operated by Kuali OLE and Jisc, GOKb is an open, community-managed knowledge base supporting library electronic resource management, including global authoritative data on packages, titles, platforms, organizations, and licenses.

2.2 KBART Standard Begins Practical Implementation in the Industry

In the industry, the NISO ERM Data Standards & Best Practices Review's 2012 white paper "Future Standards Needs for Electronic Resource Management Systems" identified link resolver and knowledge base standards as one of five major categories of standards related to electronic resource management. KBART enables resource acquisition and information changes, facilitates interaction among supply chain members, and its data elements fully align with the functions of the Electronic Resource Management Initiative (ERMI), whose data elements can incorporate portions of KBART.

When developing its OpenERMS electronic resource management system in 2011, Shenzhen University Library emphasized compliance with standards such as OpenURL and KBART to improve the accuracy of electronic resource discovery, linking, and management, and to facilitate maintenance and updates. Between 2013-2014, after experiencing budget deficits, Queens College Library faced the potential cancellation of numerous electronic journal subscriptions.

Using tools such as Ex Libris SFX and Microsoft Excel, the library worked to optimize KBART guidelines to analyze perpetual access license terms. By processing and analyzing data according to KBART specifications, the library effectively identified its perpetual access journal list. Because the generated data followed KBART format, it could be migrated to knowledge bases to enhance content discovery services.

At the 31st NASIG Annual Conference in June 2016, S. Mears, M. Van Balliego, and K. Wilson presented "Deep Dive into KBART," sharing with the publishing and library communities an overview of KBART, metadata exchange methods, KBART specifications for journals and monographs, methods for constructing title lists compliant with knowledge base and related tool recommendations, and discussions of common issues in KBART Recommended Practice.

Although Shenzhen University has considered KBART application in its electronic resource management system development, domestic research on KBART standards has not been thorough, and relatively unified standards are lacking in digital resource description and management. As a hub for resource construction, management, and use, libraries should consider applying KBART standards in future cooperation to break through digital resource standardization bottlenecks, identify resource development problems, and improve resource standards and services.

3. Main Content and Characteristics of KBART Recommended Practice

3.1 Refined Metadata Standards

Building on Phase I's resolution of journal title-level metadata standardization and transmission issues, Phase II of the KBART Recommended Practice uses consortium metadata, open access publication metadata, and e-book and conference proceedings metadata transmission as specific entry points to refine the description of recommended metadata standards. For consortium metadata, it explicitly lists specific situations requiring consortium documentation and naming conventions, and indicates when separate documents should be listed. For open access publications, it emphasizes the importance of link resolver technology while explaining why content providers need to supply metadata for open access and free content to link resolvers. Although the definition of open access continues to evolve, the KBART Working Group does not distinguish between open access and free content on publisher platforms. For e-books and conference proceedings, associating bibliographic metadata with specific books remains critical, and the evolution of bibliographic metadata standards has considered e-book formats. Link resolver knowledge base providers require minimal library effort to configure continuously transmitted data from content providers, facilitating e-book content discovery and access.

Another challenge addressed in Phase II involves resolving title changes in se-

rial publications, including journals and conference proceedings. Many serials change titles during their lifecycle, sometimes multiple times. Phase I did not include a field linking various titles in a publication's history (still available online). Many librarians reported difficulties in finding and maintaining relationships between old and new serial titles. This issue is further described in the NISO Recommended Practice "Presentation and Identification of E-Journals" (NISO RP-16-2013).

3.2 Emphasis on User Needs

The revision of the KBART Recommended Practice places greater emphasis on user needs. In January 2012, the KBART Working Group conducted a library and library consortium KBART questionnaire survey via SurveyMonkey to explore the importance of delivering KBART documents to consortia and member libraries, and to collect opinions on using consortium title lists and metadata for open access publications. The survey collected over 200 responses, including 20 from consortium representatives serving nearly 2,000 libraries, and 180 from individual libraries. Regarding open access metadata, responses reflected the complexity and importance of the open access field, with 70% indicating that identifying open access and free content at both the journal and article level would be useful. The vast majority considered it important or somewhat important to indicate in the user interface whether a journal or article is open access or free. In Phase II, the Working Group delved deeper into the needs of different users based on survey questions and responses. While unable to immediately address all issues raised, the group recommended focusing on and continuously addressing metadata issues related to open access and free content.

3.3 Establishment of KBART Information Hub

To better present information related to KBART work, the KBART Working Group established a KBART information hub on the NISO website (www.niso.org/workrooms/kbart), providing information beyond the KBART Recommended Practice, including: (1) a glossary of KBART terms (already available on UKS and NISO websites during Phase I); (2) an introduction to OpenURL, its purpose, methods, and value (included in Phase I Recommended Practice); (3) descriptions of roles, needs, responsibilities, and values of participants in the knowledge base supply chain (included in Phase I); (4) a recognition framework for content and knowledge base providers; (5) best practice guidelines, including knowledge base formats and terminology; (6) comparison charts with other standards/initiatives/technologies, such as ONIX Serials Online Holdings (SOH); and (7) a contact registration page to locate metadata webpages and technical support contacts provided by content and knowledge base providers.

3.4 Clear Cooperation and Recognition Framework

The KBART Recommended Practice optimizes metadata transmission from content providers to link resolver knowledge bases by providing a standardized document format, a set of common metadata fields with defined data formats, and a fixed field order. KBART document standardization makes document transmission and knowledge base updates easier to manage. KBART cooperation involves different stakeholders, with content providers achieving certification through the recognition framework and publicly committing to supply high-quality metadata to the supply chain. After certification, stakeholders can trust and utilize this metadata. Following the Phase II release, it replaced Phase I. All new content providers can confirm their systems can process KBART-format documents to endorse Phase II. Knowledge base providers in the KBART Working Group verify sample documents from content providers seeking recognition. Phase I recognized providers need updated certification for Phase II, involving resubmission of document samples for verification by knowledge base providers in the Working Group. Additionally, some library consortia expect to use KBART-compliant documents for their knowledge bases and have incorporated this requirement into their contracts with content providers.

4. Reflections on KBART Application for Breaking Through Digital Resource Standardization Bottlenecks

4.1 Further Development of KBART Standards

After the release of Phase II, the project was transferred to a NISO standing committee responsible for education and promotion, with necessary updates and modifications made to the KBART standard as needed. KBART provides detailed specifications for metadata exchange and transmission methods, frequency, and formats. If widely and specifically implemented, all parties in the data resource supply chain would benefit immensely. However, based on questionnaire surveys and practice, implementation efforts across the industry still fall short. This relates to the need for content providers, knowledge base providers, and libraries to better understand the relationship between data exchange standardization and effective discovery and use of digital resources, as well as to the fact that NISO standards themselves are not mandatory and the effectiveness of implementation measures remains uncertain.

To more effectively promote Phase II, NISO recently undertook two initiatives: First, in May 2017, it conducted a questionnaire survey of content providers regarding KBART adoption to identify barriers to KBART recognition and develop training materials to help more content providers effectively adopt and certify KBART. Second, in early 2017, it launched a KBART Automation Working Group to explore and expand the KBART standard format to support automated management of knowledge base content and library holdings metadata, including automatic extraction and exchange of KBART documents, using KBART documents to record individual library licensing rights for subscribed

journals and e-books, and automatically appending harvested COUNTER usage data with library-related rights. Meanwhile, NISO also seeks cross-project collaboration with other NISO electronic resource standards and initiatives, such as cooperation with the Open Discovery Initiative (ODI, NISO RP-19-2014).

Current KBART standards are primarily applied to journals and monographs, with certain limitations for other content types. For example, KBART has not yet addressed metadata for recently emerging non-text electronic resources such as audio-visual materials and images, nor social media content like blogs. There is also insufficient understanding of metadata standard needs for non-Roman script content. These areas await further KBART development.

4.2 Urgent Need for Consortium Cooperation and Consortium Metadata Standards

The rise of library consortia has promoted extensive cooperation among libraries and between libraries and data content providers, system platform providers, and others. Consortia often purchase unique resource packages for member libraries through group procurement. Based on past experience, libraries, consortia, and link providers have struggled to obtain accurate title lists, coverage dates, access URLs, and other details from content providers for these non-standard packages. Some providers could only supply minimal title data for consortium packages, similar to marketing lists (e.g., titles and ISSN numbers), while others could not provide any data. Consortium representatives consider accurate title lists for consortium packages extremely important. The KBART Working Group recommends that content providers should strive to provide resource data for specific consortium packages whenever possible. This brings good news to China's digital resource group procurement efforts. The Digital Resource Acquisition Alliance of Chinese Academic Libraries (DRAA) has over 600 member libraries, spending more than 1.5 billion RMB annually on over 140 foreign databases. Despite considerable effort, member libraries have achieved minimal results in managing metadata for their purchased digital resources. KBART application and practice will have important practical reference significance for the standardized management and application of digital resources for Chinese library consortia and their member libraries.

4.3 How International Standards Can Address Chinese Realities

China's library and information science field continues to transform in the new information environment, but there remains a certain gap between its standardization research and international levels. Even when new standards can be quickly introduced to China, domestic application and promotion require considerable time and effort. This article aims to guide domestic resource providers and knowledge base providers to jointly emphasize KBART application as a knowledge base metadata format standard, integrating international standards into domestic knowledge base construction and development: First, domestic resource providers and knowledge base providers should confirm their systems

can process KBART-format files to support KBART standards, enabling library discovery and management products to provide better user experiences. Second, after review and approval of file formats and content from domestic providers, their information will be publicly listed, contributing to domestic knowledge base construction and playing a positive role in promoting international integration.

With increasingly rapid global knowledge and resource growth and updates, particularly in the burgeoning open access academic environment, international cooperation has become essential for libraries to maintain progress and continuous learning. CALIS and DRAA have long been committed to promoting joint resource construction among university libraries, emphasizing resource sharing and international cooperation. DRAA established a standardization working group in 2015 to research resource construction standards. The introduction of standards such as KBART facilitates complementary advantages in international resource cooperation, bringing new technologies, methods, and ideas to the domestic standardization system and enabling more internationalized and standardized electronic resource management.

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Author Contributions

Yao Xiaoxia: Responsible for outlining the paper, introducing relevant background, and writing, revising, and reviewing the manuscript.
Liu Juanjuan: Responsible for research framework design, data collection, and manuscript writing.
Deng Shi: Responsible for manuscript review and proofreading.
Xue Yan: Responsible for manuscript review and proofreading.

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