

Research on the Standard and Specification System for Open Resource Construction

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Abstract

[Purpose/Significance] From the perspective of business processes in open resource construction, this study proposes a standard system framework and offers recommendations on issues emerging during standard formulation and application, with the aim of providing reference and guidance for China to build a more comprehensive and systematic standard framework for open resource construction. [Process/Method] In an open access environment, the types and quantities of open resources are continuously increasing, and open resource construction is gradually becoming an important component of daily work in information resource construction. [Results/Conclusion] Currently, no relevant standards or specifications have been formulated domestically or internationally for the workflow of open resource construction. This study proceeds from domestic and international practices of open resource construction, systematically reviewing and summarizing existing standards from aspects including resource selection and evaluation, organization, interoperability, and reuse.

Full Text

Preamble

Research on the Standard System for Open Resource Construction

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Abstract

[Purpose/Significance] This study proposes a standard system framework from the perspective of open resource construction business processes and offers recommendations on potential issues in standard formulation and application, aiming to provide reference for developing a more comprehensive and systematic standard framework for open resource construction in China. **[Process/Method]** In the open access environment, the types and quantities of open resources continue to increase, making open resource construction an increasingly important component of daily information resource management. **[Results/Conclusion]** Currently, no relevant standards or specifications have been established for open resource construction workflows either domestically or internationally. This study examines practical open resource construction efforts worldwide, systematically reviewing and summarizing existing standards and specifications from the perspectives of resource selection and evaluation, organization, interoperability, and reuse.

Keywords: open resource; resource construction; standard system

1. Introduction

In recent years, the Open Access (OA) movement has gained tremendous momentum, gradually becoming a focal point of attention, while the scope of open resource types has continuously expanded to encompass journals, books, dissertations, conference papers, reports, courseware, videos, images, datasets, and various other formats. Influenced by the OA movement, publishers have introduced open access publishing workflows alongside traditional publishing models, causing the volume of open resources to surge exponentially year by year. Taking Chinese journal articles as an example, statistics from the Web of Science Core Collection over the past decade reveal [Figure 1: see original paper] that as of June 3, 2017, the number of open access journal articles increased from 1,985 (representing 1.04% of the total) in 2007 to 45,764 (23.93% of the total) in 2016. However, this rapid growth has brought to the forefront numerous obstacles in resource construction and utilization, including inconsistent quality, unclear usage rights, and ambiguous reuse conditions during the selection, evaluation, organization, description, and reuse of open resources. There is an urgent need to establish appropriate standards and specifications to address these challenges and support the rational and standardized development of open resource construction.

Numerous standards development and management organizations, both domestic and international—such as the International Organization for Standardization (ISO), the International Federation of Library Associations and Institutions (IFLA), the National Information Standards Organization (NISO), the National Information and Documentation Standardization Technical Committee, and the National Library Standardization Technical Committee—have developed various standards, specifications, and guidelines related to information resources, cover-

ing organization, description, processing, preservation, and protection. However, content specifically addressing open resource construction standards remains relatively scarce. Currently, open resource construction primarily relies on adapting traditional resource construction standards, reusing more universal and mature standards and protocols, or having individual institutions independently modify relevant specifications according to their needs. While these approaches offer some reference value, they lack systematic coordination.

Through extensive investigation of open resource construction for books, journals, courseware, images, and datasets worldwide, this study finds that open journals have developed relatively well in recent years with more comprehensive standards and specifications across various construction stages. In contrast, other types of open resources lack standardized content in most stages. Therefore, this paper focuses on open journals as the primary research subject and example, summarizing and 梳理 ing the intersections between standards, specifications, protocols, and guidelines developed for different types of open resources and those applicable to open journals. Simultaneously, it compiles and supplements content not covered by open journal specifications. Combined with key elements in the open resource construction workflow, this study attempts to propose a foundational and universally applicable standard system framework for open resource construction, aiming to further improve standardization across OA processes, provide reference for resource construction practitioners and relevant institutions, and promote the sustainable development of open resources.

2. Standards and Specifications in Open Resource Construction Practice

Open resource construction primarily unfolds across four dimensions: collection, organization, preservation, and utilization. Given the wide distribution and massive volume of open resources, coupled with issues such as unclear rights and inconsistent standards in practical usage, numerous relevant institutions have developed normative documents. For instance, in resource collection, institutions and platforms have established selection and evaluation criteria to clarify resource availability. To facilitate retrieval and utilization, different institutions have developed their own metadata specifications according to their needs. For resource sharing, research institutions, libraries, and publishers have proposed various interoperability protocols to share data resources and serve users. In terms of resource reuse, activities are carried out orderly based on open knowledge sharing protocols.

2.1 Selection and Evaluation Standards

(1) Foreign Open Resource Selection Standards

Both domestic and foreign institutions have established relevant selection and evaluation mechanisms primarily for Open Access Journals (OA journals) and Open Access Books (OA books). Internationally, institutions mainly follow the

review standards proposed by the Directory of Open Access Journals (DOAJ) based at Lund University in Switzerland, with some additionally referencing indexing status in the Ulrichsweb database for further evaluation [1]. DOAJ has established OA journal evaluation principles that primarily follow the “Principles of Transparency and Best Practice in Scholarly Publishing” jointly issued by the Committee on Publication Ethics (COPE), DOAJ, the Open Access Scholarly Publishers Association (OASPA), and the World Association of Medical Editors (WAME) [2]. These principles outline basic conditions for reviewing and indexing OA journals, evaluating them from perspectives such as research scope, access rights, quality, and journal identifiers to reduce issues arising from non-standard journal practices (detailed criteria are shown in Table 1).

Table 1. DOAJ Journal Review Standards

- **Subject:** Covers all disciplines, reusing the Library of Congress Classification system
- **Type:** Academic journals publishing full-text research or review articles
- **Source:** Academic, governmental, commercial, non-profit, and private institutions are all acceptable
- **Audience:** Original target audience should be researchers
- **Content:** Journals should primarily consist of research papers, with all content available in full text
- **Language:** All languages are acceptable
- All full texts must be freely accessible upon publication
- Online user registration is only permitted when journals have appropriate privacy policies and comply with data protection regulations, and user information must not be distributed without permission
- Journals must have a peer review mechanism
- Journals must have editorial boards with institutional information listed for board members
- Journals must have at least one ISSN number
- Print ISSN and electronic ISSN numbers should generally be provided separately

(2) Domestic Open Resource Selection Standards

Domestically, the GoOA project team from the National Science Library of the Chinese Academy of Sciences was the first to propose open journal selection standards, followed by the National Science and Technology Library (NSTL), which also developed relevant evaluation indicators. These standards evaluate OA journals from perspectives such as impact, authority, and openness, with specific indicators including: (1) examining whether the OA journal’s publisher is a member of OASPA or COPE, and whether it appears in Beall’s list of predatory publishers (this blacklist’s official website has ceased updates, so this indicator is no longer in use); (2) checking whether the OA journal is indexed in DOAJ; (3) using impact factors, H5-index, and SCImago as indicators of OA journal impact; (4) examining indexing status to assess journal authority, primarily based on Ulrichsweb’s inclusion of OA journals, supplemented by indexing information from journal websites; and (5) assessing openness through

Creative Commons (CC) license reuse permissions, machine readability, and repository policies. Weights are assigned to each indicator for comprehensive scoring to evaluate OA journal quality.

For OA book selection, the open resource construction team at the National Science Library of the Chinese Academy of Sciences has also proposed preliminary evaluation standards. These use book identifiers (DOI and ISBN numbers) as basic indicators and conduct more specific and systematic assessments through the book's publisher, peer review information, copyright statements, and usage licenses.

The momentum of OA publishing continues to expand, with many publishers gradually embracing OA publishing principles and numerous pure OA journal publishers emerging, including well-known examples such as PLoS, Hindawi, and J-STAGE. PLoS ONE, in particular, represents a mega-journal. Therefore, establishing a comprehensive evaluation indicator system for open resources (especially open journals) is essential during the resource collection stage. While domestic and international OA journal evaluation indicators differ, they primarily focus on three aspects: first, assessing the journal's research field, review mechanism, and whether it has unique identifiers; second, referencing inclusion in high-impact platforms; and third, evaluating usage restrictions and openness. Based on the formulation and practice of domestic and international OA journal selection rules, foreign evaluations tend to be relatively singular, mostly using DOAJ and Ulrichsweb as the two primary indicators. China's evaluation of open journals considers multiple indicators comprehensively, resulting in a relatively more complete evaluation system that can provide valuable reference for establishing an open resource construction standard system.

2.2 Resource Organization Standards

The organization and processing of open resources is a prerequisite for storage, retrieval, and utilization. When research institutions, universities, and even national governments establish open access repositories, their primary task is to organize, process, and integrally store their national and institutional open resources, creating and modifying certain standards and specifications to facilitate resource management and use.

Dublin Core Metadata (DC) has been widely applied in information organization, defining universal core standards that all web resources should follow. Consequently, many metadata standards, especially for electronic resources, have been developed with reference to and extension of DC. In 2015, the National Information Standards Organization (NISO) introduced the JATS (Journal Article Tag Suite) metadata standard (ANSI/NISO Z39.96-2015). Due to its comprehensive descriptive fields, this standard is also suitable for open access journal metadata description. For example, the open access paper discovery platform GoOA (<http://gooa.las.ac.cn>) reuses relevant metadata fields from this standard for resource organization. The UK RIOXX (RIOXX Metadata Applica-

tion Profile) project has also proposed metadata guidelines for UK institutional repositories (IRs), with resources including journals, reports, and presentation documents annotated according to these guidelines. Based on the DC element set, the RIOXX guidelines add two metadata elements—project number (or grant number) and funder name—enabling accurate retrieval between IRs while allowing project funders to access relevant papers from funded projects. In January 2015, NISO released the “Access License and Indicators” report (NISO RP-22-2015) on open resources, proposing the addition of two rights fields: Free-to-read and license-reference [3]. The RIOXX guidelines have incorporated these two fields to enrich their metadata description content. Additionally, the guidelines provide usage recommendations for their open resource metadata set, categorizing elements as optional, recommended, or mandatory (see Table 2) [4].

Table 2. UK RIOXX Project Metadata Guidelines

Open Resource Metadata Elements

- dc:coverage (Coverage)
- dc:description (Description)
- dc:format (Article storage format)
- dc:identifier (Identifier)
- dc:language (Language)
- dc:publisher (Publisher)
- dc:relation (Link address)
- dc:source (Source)
- dc:subject (Subject)
- dcterms:dateAccepted (Acceptance date) (ISO 8601, post-2004 versions)
- rioxxterms:apc (Article processing charge)
- rioxxterms:author (Author)
- rioxxterms:contributor (Other contributors)
- rioxxterms:project (Project ID)
- rioxxterms:publication_date (Publication date)
- rioxxterms:type (Resource type: book, journal, conference proceedings, etc.)
- rioxxterms:version (Version)
- rioxxterms:version_of_record (Version of record)
- ali:free_to_read (Free to read)
- ali:license_ref (License reference)

Element Set Usage Recommendations

When developing metadata standards for open resource organization, consideration should be given to both technical encoding metadata and resource description metadata to propose a universal metadata set applicable to all types of open resources. Additionally, reference can be made to the RIOXX project’s categorization of metadata usage, dividing open metadata sets into mandatory, recommended, and optional sets. By comparing differences among various element sets, standard development work can be gradually improved.

2.3 Interoperability Protocols

Before resource publication, content typically requires structural, relational, and semantic formatting specifications, using structured machine-readable formats to represent content and support its utilization. Today, in OA repository construction, most works are provided for reading in PDF and HTML formats, for download in XML format, and are uniformly managed through constructing associations between information structure contexts, papers and data, citation relationships, and knowledge units. Various interoperability protocols are applied to promote open resource retrieval and delivery.

(1) OAI Protocol

The primary interoperability standards adopted by domestic and international organizations for open resources include the Open Archival Information System (OAIS) reference model and the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) [5]. Chinese institutional repositories primarily follow the OAI-PMH protocol when enabling open resources to be indexed by professional search engines and expanding resource retrieval pathways. Indexing and inclusion of open resources by search engines helps improve their visibility and discoverability, serving as a means to disseminate research findings in a highly visible manner and promoting broader sharing. Therefore, open resources generally provide OAI-PMH services or retrieval interfaces to facilitate metadata harvesting and reuse. Some OA journals, in addition to providing standard interfaces for metadata acquisition, also support full-text batch downloads via FTP or OAI services to maximize open sharing, while providing machine-readable XML format full texts to facilitate machine analysis and mining. OA repositories, however, generally do not provide batch downloads of full texts or data.

(2) API Protocol

The Application Program Interface (API) protocol was created at the end of 1999 by Hewlett-Packard, Intel, IBM, Motorola, Lucent, Sun, Cadence, and Mentor Graphics to establish standard specifications for communication between computer software applications. The API protocol provides a common set of data functions to enable data exchange between platforms. Currently, the API functions provided by OA journals are increasingly rich. Beyond basic search interfaces, BMC (BioMed Central) offers APIs for latest articles, editor's choice articles, and article permission verification, while PLOS provides the Article-Level Metrics (ALM) API for analyzing article impact and value.

(3) SWORD Protocol [7]

The SWORD (Simple Web-service Offering Repository Deposit) protocol supports the automatic posting of papers to relevant institutional or disciplinary repositories, ensuring timely storage of OA papers in commonly used open repositories (such as PMC, PubMed Central) while also addressing researchers' duplicate submission issues.

(4) Metadata Encoding and Transmission Standard (METS) [8]

The METS schema is a standard for encoding descriptive, administrative, and

structural metadata related to resources/digital objects, expressed using XML schema language. This standard is maintained by the Library of Congress Network Development and MARC Standards Office and is being developed as an initiative of the Digital Library Federation.

(5) SUSHI Protocol (ANSI/NISO Z39.93-2014)

The Standardized Usage Statistics Harvesting Initiative (SUSHI) protocol (ANSI/NISO Z39.93-2014) is a standard protocol for data collection and delivery. It integrates resource types at the descriptive layer of OA repositories, enabling more efficient and convenient acquisition of usage statistics on open resource types and quantities, while making the obtained usage data more comparable, reliable, and consistent.

In resource retrieval, linking, and delivery by domestic and international institutional repositories, the OAI interoperability protocol is widely used. However, many foreign open resources also provide API protocols for data acquisition and exchange. Meanwhile, SWORD, RSS/Atom feeds [9], Shibboleth [10], LDAP [11]/Active Directory [12], and other protocols are all mentioned in various institutional guidelines. Therefore, it is necessary to identify differences among these normative protocols based on application scenarios to establish unified technical standards. This would facilitate the creation of standardized resource sharing alliances across different regions, countries, and institutions, enabling multiple data exchanges and supporting unified cross-repository retrieval to provide users with comprehensive digital services. Such standardization would also significantly control construction investment, promote standardization in institutional repository development, unify resource formats, and enable timely identification of problems during construction.

2.4 Reuse Licensing

The widely used guidance document for open resource reuse both domestically and internationally is the Creative Commons (CC) license. Based on different usage permissions in CC licenses, article content can be reorganized, adapted, and reused. In addition to CC licenses, open resource usage licenses include Founder's Copyright, Sampling Plus, Noncommercial Sampling Plus, Public Domain Dedication and License (PDDL), Open Data Commons Attribution License (ODC-BY), and others. Among these, the Open Data Protocol (OData) is a web protocol for querying and updating data, displaying data stored in applications. Other licenses include the Open Publication License and Open Content License. In the open content domain, there are the EFF Open Audio License and Ethymonics Free Music License.

From an open publishing perspective, CC licenses are the mainstream protocol adopted by publishing institutions, though some publishers have developed their own usage protocols, and works within the same journal may follow different licenses. For example, Wiley's copyright belongs to authors, and publishers provide CC licenses for authors to choose from based on article funding sources.

Elsevier offers CC BY 4.0, CC BY-NC-ND 4.0, and its self-developed User License. Copyright and licensing information is typically reflected in resource metadata, though publisher-provided metadata does not always fully include this data. In open publishing funding programs, the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3) stipulates that articles published in OA form have copyright belonging to authors and allow text mining and data mining of resources under the CC-BY license [13]. Papers funded wholly or partially by UK Research Councils and published in peer-reviewed journals and conference proceedings must be made immediately open access using the CC-BY license, authorizing anyone to reuse them, including commercial organizations [14].

Based on investigation results, many types of open resources have reuse protocols, with CC licenses being widely applied. From a resource construction perspective, whether open resources can be data mined is a key issue requiring discussion and clarification. Therefore, when constructing open resource usage standards, it is necessary to comprehensively consider multiple factors—including reading, downloading, adaptation of works, and data/text mining—while clearly defining intellectual property rights, particularly copyright limitations, to maximize user needs while respecting intellectual property rights.

3. Construction of the Open Resource Construction Standard System

Based on the investigation of standards and specifications in open resource construction practice, drawing on relevant domestic and international standards and experiences in standard system construction, and considering needs and ambiguities in open resource construction work, this study proposes a standard system framework for open resource construction centered on collection standards, organization standards, preservation standards, and utilization standards, following the business workflow of open resource construction (see Figure 2 [Figure 2: see original paper]).

Figure 2. Framework of the Open Resource Construction Standard System

3.1 Collection Standards

Collection standards form the foundation of the resource construction standard system, serving as an important guarantee for obtaining valuable, high-quality resources and a prerequisite for launching knowledge services. This component must first clarify whether bulk data downloading is permitted during open resource collection and whether web crawlers can be used to extract data from various open resource websites. If such operations are allowed, specifications must define limiting conditions, data usage purposes, and related content. Second, standards must address the selection and evaluation of collected resources. In current open resource construction practice, relatively complete normative

documents already exist for OA journal and OA book selection and evaluation mechanisms. When developing formal standards, these can be referenced to propose general evaluation standards for open resources, which can then be further refined and accurately categorized based on the characteristics of each resource type.

3.2 Organization Standards

Organization standards constitute a key component of the open resource construction standard system, addressing content, structure, and storage space to facilitate resource management, transmission, and sharing. This includes five modules: cataloging standards, metadata standards, data processing standards, open repository standards, and retrieval standards. Cataloging rules and metadata field descriptions are essential for convenient retrieval and use of open resources. The methods for organizing and processing data resources also require attention. Currently, organization standards for open resources focus primarily on metadata standards, with storage repositories and integrated platforms reusing or self-developing inconsistent resource description standards and varying resource retrieval conditions. In practice, user needs and experiences can serve as references for developing specific content of resource organization standards and specifications to realize a human-centered philosophy.

3.3 Preservation Standards

Preservation standards primarily address resource storage locations, version specifications, and document formats. Open resources are stored in numerous locations: open access books may be stored on publisher websites, social media platforms, authors' personal institutional repositories, or blogs; multiple open access journal integration platforms exist, built by individuals, enterprises, research institutions, or publishers; and open access conference papers are mostly concentrated on service platforms of conference organizers. In summary, whether following the gold OA or green OA implementation model, open resources can be deposited in some form of "repository," making it necessary to standardize resource storage policies for such open repository platforms. Open resources have the right and characteristic of preprint publication, and different versions of the same resource can hinder system organization and interlinking. Version standardization helps resolve difficulties in organization processes and facilitates cataloging, management, and widespread use.

3.4 Utilization Standards

Resource utilization is the ultimate goal of resource construction and the most significant indicator of meeting user needs. Therefore, the principle for constructing resource utilization standards should be to maximize usage permissions to serve the public while remaining within the scope of reasonable use defined by copyright. This study preliminarily envisions this component including four parts: interoperability standards, content usage license specifications,

standards for using work attachments (cover images, charts, datasets, etc.), and text/data mining standards. Numerous interoperability protocols have emerged from internet file transmission, and those used in open resource sharing vary according to different resource providers' preferences. When standardizing interoperability standards, reference can be made to relatively mature protocols such as OAI and API, with overall standard content further improved based on different resources' sharing needs. Regarding content usage licenses for open resources, the Creative Commons (CC) protocol has become the mainstream usage license and is widely applied, providing a basis for establishing formal content usage licenses based on its content and practical feedback. Text/data mining standards represent an unknown and ambiguous area—whether open resources can undergo deep-level content processing, handling, and reuse has remained unclear. This highlights the importance and practical significance of discussing and establishing such standards.

4.1 Multi-stakeholder Participation in Standard Development

Given the diverse entities engaged in open resource construction both domestically and internationally, collaborative participation among various organizations in developing standard systems and specific standard content is advantageous for establishing more universal specifications. For public welfare open resource construction organizations such as libraries and research institutions, which have richer experience in resource collection and organization, standards can be developed based on their work content. For free/commercial open resource construction platforms, such as certain open dissertation integration platforms that understand market demands and supply-demand relationships in resource utilization, they can participate in planning open resource utilization standards while complying with intellectual property management regulations for knowledge works. Effective coordination mechanisms ensure orderly work among different stakeholder groups, facilitating the establishment of more specific and demand-oriented standard systems and content.

4.2 Establishing National-level Management and Review Mechanisms

Open resource standards essentially represent conscious regulation of the entire workflow of open resource construction, encompassing both horizontal and vertical dimensions. They must consider not only the comprehensiveness of standardization work across the entire scope but also its systematic nature. When developing open resource construction standards, reference can be made to IFLA' s standard development and management department' s specific processes, including standard proposals, review of existing standards, letters of intent for standard content, discussion meetings to collect opinions, and subsequent development, implementation, supervision, and revision [15]. When designing the standard system, principles of comprehensive systematicity, co-

ordinated consistency, prioritized standard benefits, and orderly change should be followed. After standard implementation, deficiencies or potential problems should be further reviewed and evaluated to address possible risks. This process can also refer to IFLA's relevant departmental practices, implementing a review system for standards, organizing standard committee members for regular discussions, collecting and organizing problems in management and usage, and making timely corrections when issues are identified. Standards closely related to technology should be reviewed irregularly according to actual conditions, while standards in stable use can have prescribed review periods and be maintained according to social development needs [16].

4.3 Standard System Extension

Although the open access movement has emerged and developed worldwide for nearly a decade, with open access forms and open resource types continuously increasing, current development trends suggest that open resource construction may require clarification and standardization of additional content in the future, indicating the possibility of further extending the standard system. The open resource construction standard system framework proposed in this study represents a preliminary concept that requires further supplementation and improvement in future OA development and open resource construction practice.

5. Conclusion

Currently, the open resource construction process has reused and modified many existing standards, involving multiple aspects of resource construction, but a truly complete standard system has yet to be established. The essence of constructing an open resource construction standard system is to consciously regulate the entire workflow of open resource construction, considering overall comprehensiveness and coverage of the entire process while emphasizing systematic principles in standard planning to form an effective review mechanism that adapts to potential issues after standard formation. Establishing open resource construction standards and specifications is a long-term and important task requiring continuous improvement of the standard system based on theoretical research and practical work. This study provides some ideas for standard development and management departments, but it still has certain limitations, such as not covering all categories of open resources, the standard system remaining in its preliminary stage without practical implementation, and uncertainty about standard sustainability. These issues require further in-depth discussion and research.

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