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A Descriptive Review of ANSI-NISO Standards with Specific Reference to Their Implications for Digital Library Systems (2015-2023)

Lili Sahu*
Department of Library and Information Science, Sambalpur University, Odisha, India
E-mail: sahu.lili1995@gmail.com

Bulu Maharana
Department of Library and Information Science, Sambalpur University, Odisha, India
E-mail: bmaharana@suniv.ac.in

ABSTRACT

This paper provides a systematic review of American National Standards Institute-National Information Standards Organization (ANSI-NISO) standards that have been published or revised since 2015, and the aim of the paper is to review them in terms of thematic orientation, developmental patterns, and future implications to the digital library systems presently in use. In this study, 17 standards were grouped into five broad thematic clusters: content tagging and metadata standards, unique identifiers and addressing systems, guidelines and best practices, information interchange and communication standards, and contributor roles and peer-review terminology. The findings indicate a significant move toward extensible markup language based content structuring (especially journal article tag suite and standards tag suite), increased metadata interoperability, resource synchronization system, and transparency based academic communication standards like contributor roles taxonomy and standardized peer-review language. Together, these standards enhance fundamental digital library capabilities through enhanced metadata quality, the means to discover and exchange resources seamlessly, long-term digital preservation, and machine-actionable and interoperable workflows in the spirit of open science. The analysis also identifies that despite the adoption of individual standards, they are seldom studied as a structure to sustain digital library ecosystems. The results highlight the importance of integrating standards that facilitate the deployment of new technologies like linked data, artificial intelligence, and data-driven digital scholarship, and thus assist in making ANSI-NISO standards key to building sustainable and future-oriented digital library systems.

Keywords: library standards, interoperability, digital library, metadata, American National Standards Institute, National Information Standards Organization

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***Corresponding Author:** Lili Sahu
https://orcid.org/0009-0000-2810-8089
E-mail: sahu.lili1995@gmail.com

1. INTRODUCTION

The library is regarded as the core of academic and research systems since it is pivotal in both aspects. It serves as a knowledge reservoir and a forum of dialogue between people of different socioeconomic and educational levels (Riva et al., 2013). The library offers guidance on searching, organizing, accessing, choosing, and using information, communication, and sharing (Ranganathan, 1931; Rubin et al., 2020). To ensure that these activities are carried out efficiently, consistently, and are interoperable across systems and institutions, standardization emerges as a fundamental requirement governing all such processes in the field of library and information science (LIS). Adhering to the existing standards, libraries can ensure the consistency, quality, and reliability of their services and resources. Furthermore, they can contribute to the best practices in the field of LIS because they can facilitate the publication and dissemination of standards. This collaborative process not only improves libraries' operations but also enhances the activities of libraries, and also benefits the entire community by facilitating consistency and quality in management and access to information (Deegan & Tanner, 2002). There has been discussion on the application of these standards and best practices between different stakeholders in the information community (Lagace, 2015).

Standards increase efficiency for suppliers that support libraries, as well as for the libraries themselves. They enable information sharing among libraries and provide a consistency of products that is crucial for customers, along with efficiency in terms of time and cost (Gill et al., 2008; Weibel, 1997). Interoperability in libraries refers to how easily users can move from one library to another without needing to learn entirely new skills in bibliographic research. It also involves data exchange. The main organizations that provide library standards include the American Library Association (ALA), IFLA, NISO through the American National Standards Institute (ANSI), and United Nations Educational, Scientific and Cultural Organization (UNESCO) (ALA, 2025; UNESCO & IFLA, 2022).

1.1. ANSI–NISO Standards

The ANSI and the NISO play key roles in developing and sharing standards in the United States, especially in the fields of information and publishing.

1.1.1. American National Standards Institute

ANSI was established in 1918 as a non-profit organization that is private and which manages the development of voluntary consensus standards of products, services, processes, systems, and personnel in the United States. The institute grants accreditation to standards developed by other bodies to guarantee that they satisfy the consensus, due process, and openness in the standards (ANSI, n.d.). The accreditation process by ANSI helps the standards to be legitimate and acceptable by many. This promotes innovation, economic development, and safety for library users.

1.1.2. National Information Standards Organization

NISO is a non-profit organization that was founded on June 22, 1939, and that has the goal of developing, modifying, and publishing technical standards to be used in publishing, bibliographies, libraries, and other information industries. In 1983, it was incorporated in the United States as a non-profit educational organization and adopted its current name as the NISO in 1984. Being an ANSI-recognized organization, NISO can be relevant in developing formal United States national standards and recommended practices. Its standards guarantee uniform and trustworthy storage, retrieval, and exchange of information among various platforms and institutions (Lagace, 2015). The activities of NISO are critical in ensuring that information systems are maintained in their integrity and efficiency. It enhances the capacity of libraries and other information organizations in serving their communities (Deegan & Tanner, 2002). Additionally, NISO offers some training and education courses to enable information professionals to remain abreast of the latest standards and practices. Being able to foster collaboration between stakeholders and provide valuable resources and advice, both ANSI and NISO play a significant role in enhancing and normalizing practices in information and publishing industries (ANSI, n.d.). Their work enables libraries and other organizations to work at high standards of quality and reliability, which eventually helps people and information exchange throughout the world. Table 1 gives the list of standards at the time of the selected period.

1.2. Process of Creating Library Standards

The creation of a library standard is a complex process that involves cooperation. It starts with the decision to begin the need for standardization. Various professionals, developers, and stakeholders become engaged in determining the purpose, scope, and uses of the standard. They have a look at the existing standards and frameworks to formulate initial specifications. Then they receive feed-

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Table 1. List of standards during 2015-2023

Serial No.	ANSI/NISO	Description
1	ANSI/NISO Z39.102-2017	Standard tag suite (STS)
2	ANSI/NISO Z39.43-1993 (R2017)	Standard address number (SAN) for publishing industry
3	ANSI/NISO Z39.2-1994 (R2016)	Information interchange format
4	ANSI/NISO Z39.14-1997 (R2015)	Guidelines for abstracts
5	ANSI/NISO Z39.23-1997 (S2015)	Standard technical report number format and creation
6	ANSI/NISO Z39.41-1997 (S2015)	Placement guidelines for information on spines
7	ANSI/NISO Z39.87-2006 (R2017)	Data dictionary - technical metadata for digital still images
8	ANSI/NISO Z39.96-2015	Journal article tag suite (JATS)
9	ANSI/NISO Z39.99-2017	Resource Sync framework specification
10	ANSI/NISO Z39.96-2019	JATS version 1.2
11	ANSI/NISO/LBC Z39.78-2000 (R2018)	Library binding
12	ANSI/NISO Z39.104-2022	Contributor roles taxonomy
13	ANSI/NISO Z39.102-2022	STS
14	ANSI/NISO Z39.96-2021	ANSI/NISO JATS version 1.3
15	ANSI/NISO Z39.4-2021	Criteria for indexes
16	ANSI/NISO Z39.106-2023	Standard terminology for peer review
17	ANSI/NISO Z39.105-2023	Content profile/linked document

ANSI, American National Standards Institute; NISO, National Information Standards Organization.

back from the community to improve and make the design better. The usability and reliability of the standard is guaranteed by documentation, testing, and reference implementation. Recognition bodies are used to attain formal legitimacy. Adoption and continuous improvement are encouraged by community participation. The standard is updated on a regular basis to be relevant to the changes in technology. Process inclusion in this paper presupposes transparency, the involvement of stakeholders, and credibility. This helps the reader to understand how standards develop as well as the strength and application of good practices. This is what ultimately brings about trust, and it spurs more acceptance (Fig. 1) (NISO, n.d.).

The changing nature of digital library infrastructure, open science practice, and interoperable metadata frameworks have added a huge strategic value to information standards. Although ANSI-NISO standards play a foundational role in enabling interoperability, resource discovery, preservation, and scholarly communication, existing studies largely examine these standards in isolation. As a result, there is limited understanding of their collective development and functional orientation, particularly during the period 2015-2023, which coincides with major technological and conceptual shifts in digital librarianship. This paper fills this gap through a systematic documentation and synthesis of standards issued or revised in the ANSI-NISO standards over the given period, and seeks to explain the subject matter of the standards and the implication of this for digital library systems. By placing these standards in the context of modern digital library necessities, this study demonstrates its importance as a combined system that contributes to sustainable, interoperable digital library infrastructures.

2. OBJECTIVES OF THE STUDY

The main objective of this study is to examine ANSI-NISO library standards published or revised between 2015 and 2023 to analyze their thematic focus, developmental trends, and implications for digital library systems. Accordingly, the specific objectives of this study are as follows:

1. To enumerate and to add up all published or revised ANSI-NISO standards published or revised during 2015-2023, based on verified ANSI-NISO sites.

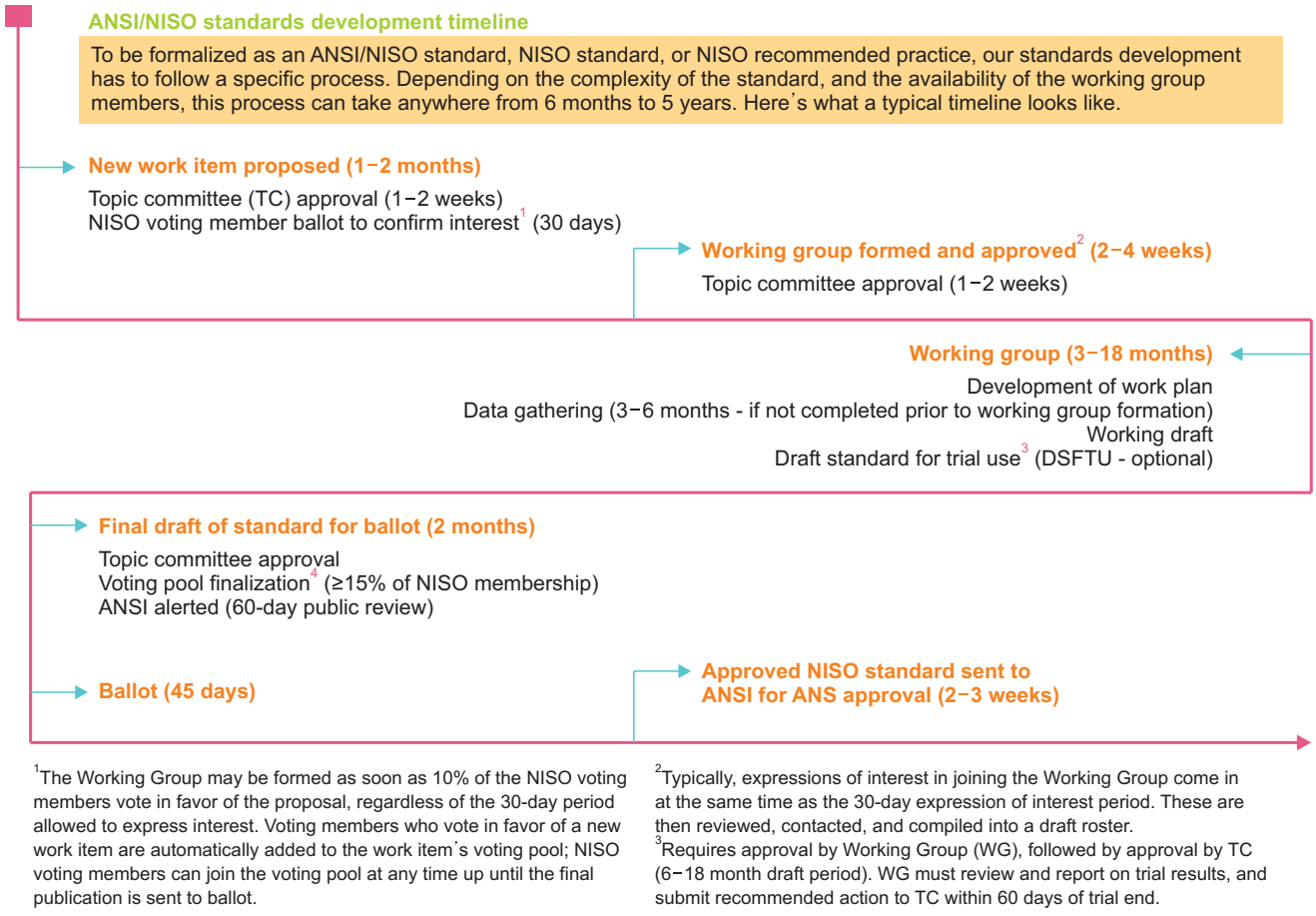

Fig. 1. Timeline for formalizing a NISO standard. Adapted from NISO (n.d.) (https://www.niso.org/standards-timeline). ANSI, American National Standards Institute; NISO, National Information Standards Organization.

2. To discuss the structural, functional, and thematic characteristics of such standards with the help of qualitative content analysis.

3. To structure the standards into useful thematic groups using a systematic coding framework depending on their scope and purpose.

4. To explore the aspects of changes and evolutionary patterns of the development and revision of ANSI-NISO standards during the research period.

5. To extract the practical and theoretical significance of ANSI-NISO's standards in the improvement of digital library infrastructure and in establishing the direction towards the adoption of the standard in the future.

3. LITERATURE REVIEW

In reference to library and information technology systems, standards have traditionally been seen as supporting data organization, retrieval, and exchange. Different bodies ensure that guidelines are maintained for the purpose of ensuring interoperability and uniformity in diverse information systems. These organizations include the ANSI and the NISO. NISO, accredited by ANSI, has promulgated standards and recommended practices for cataloguing, metadata creation, digital preservation, indexing, and discovery services (Carpenter, 2020).

3.1. Evolution of ANSI-NISO Standards in the Digital Age

In the early phases, the ANSI/NISO standards revolved around bibliographic control and information retrieval. According to Moen and McClure (1994), the Government Information Locator Services exploited the ANSI/NISO Z39.50 standard to enable access to distributed government information through searchable network locators. In the 1990s, the Z39.50 protocol was being widely used to create online public access catalogues that allowed different systems to talk to each other and enabling federated

searches.

Likewise, Milstead (1998) analyzed the ANSI/NISO Z39.19 standard for thesaurus construction, which aims to build controlled vocabularies for subject indexing and retrieval with precision. However, he described that this standard existed before the advent of full-text search and web-based retrieval, losing pertinence as far as the emerging digital environments are concerned. Noguera-Iso et al. (2005) sought further to propose some mapping mechanisms between cataloguing activities and Z39.50-based information retrieval services, thus cementing their role as standards in catalogue interface design.

NISO has also, beyond retrieval, contributed to resource identification. Amenu-Kpodo (2008) discussed the roles of NISO and ANSI in the production of identifiers like international standard book number and international standard serial number, which laid the foundation for worldwide bibliographic interoperability. Dingley (2003) analyzed the ANSI/NISO Z39.20-1999 standard, which specifies indexes for the prices of library resources, and demonstrated the influence of NISO on economic data gathering in the information industry. Similarly, NISO influenced the standards for link resolvers, such as OpenURL (Z39.88) and its offshoots (knowledge bases and related tools, improving openURL through analytics), which further refined cross-platform linking and access management, according to McQuillan (2012).

In the mid-2010s, major changes happened in the field of information management, due to the advent of digital repositories, open-access publishing, and standardization movements in the fields of metadata. NISO (2007) remarks that, nowadays, ANSI-NISO standards have become the primary method for organizing and preserving print and digital resources in libraries. Fedotov et al. (2016) cited this perspective when he re-analyzed Z39.19:2005 and agreed with the view that automatic thesaurus control and consistent metadata serve as two essential mechanisms for digital collection management.

NISO has created several standards since 2015 in response to technological changes and changes in scholarly communication. One major change has been the NISO standards tag suite (STS; ANSI/NISO Z39.102-2017), which offers a standard extensible markup language (XML) structure for representing standards documents to ensure that they are easily accessible, reusable, and interoperable (Usdin & Lapeyre, 2018). Another important innovation was the contributor roles taxonomy (CRediT; ANSI/NISO Z39.104-2022), which defines a standard representation of author contributions to encourage transparency in scholarly publishing (Blickhan et al., 2022). NISO further published Peer Review Terminology (Z39.106-2023), which defines a controlled vocabulary for peer review processes to promote data sharing and metadata exchange in open-science settings.

Some standards maintained by NISO since its inception include the continued revisions of older standards, such as the standardized usage statistics harvesting initiative, also known as Z39.93, and COUNTER for harvesting and reporting usage data in electronic resources management (Rieger & Schonfeld, 2023). These revisions are the outcome of NISO's efforts to keep data and reporting standards updated to meet the challenge of growing volumes of digital data, machine-learning-based analytics, and open-access workflows.

3.2. Scholarly Analysis and Identified Gaps

While this transformation is crucial, almost all scholarly work in this area focuses on individual standards, rather than considering the NISO standards as a group. The works exhibit this trait. For instance, Milstead (1998) and McQuillan (2012) circumscribe their analyses to just one narrow sphere: thesaurus construction and link-resolution, respectively, so that they can provide more detailed insights into a single standard but less into cross standards. Also, some studies that focus on metadata standards for preservation and discovery (Mosha & Ngulube, 2023) hardly ever incorporate the NISO standards into a whole framework that covers bibliographic control, data exchange, and scholarly communication simultaneously. There is a range of active standards projects, as documented by Carpenter (2020) and the Information Standards Quarterly of NISO, but they lack an in-depth, comparative assessment of their collective influence over time.

Thus, the literature demonstrates a well-established historical basis for ANSI-NISO standards as well as clear documentation of an individual standard's purpose and evolution. Thus arises a gap wherein no systematic evaluation or critical synthesis of the application of ANSI-NISO standards developed or revised between 2015 and 2023 exists, especially concerning their functionality and interoperability with digital libraries and scholarly communication. The current studies mostly address individual standards and largely reflect the earlier context, thus they are unable to capture the implications of linked data, open science, and artificial intelligence on modern information systems. Therefore, a comprehensive, time-bound examination of multiple ANSI-NISO standards is needed to understand their collective evolution and place in the

advancement of digital library praxis, something also currently lacking in the comparative analyses mapping the trajectory of ANSI-NISO standards development and thematic focus over the past ten years.

3.3. Statement of the Research Problem

The standards of ANSI-NISO have become a backbone for publishers and libraries and provide improved standards for information systems in adding directives on developing metadata, retaining digital copies, finding resources, and system integration. Despite wide adoption, comprehensive research needs to be done on their development, applicability, and/or implications, particularly between 2015 and 2023. That era constitutes a transitional phase as it had greater influence and proliferation of technologies such as artificial intelligence, semantic web, big data, and cloud computing into the creation and establishment of library practice-cum-user expectations.

The fact that ANSI-NISO standards have not been reviewed in a unified manner at this critical time is a gap in the knowledge of how the standards reflect the current issues, how they have been applied to practice, and how effective they are in responding to emerging needs. In this way, this research will fill this gap by reviewing all the ANSI-NISO standards issued and updated since 2015 to the present to analyze their principal themes, actuality in technology, and practices. Through it, the research aims to provide information about the role of standards in the development of the digital library systems, interoperability, and user-centric services in the environment of the rapidly evolving digital reality.

4. RESEARCH METHODOLOGY

ANSI-NISO standards are pivotal in establishing a unified framework for the organization and exchange of information. They serve as a benchmark for ensuring quality, interoperability, and consistency across diverse library systems and digital repositories. These standards address various issues, such as metadata, content management, data exchange, and preservation. This research incorporates the methods of a systematic descriptive review to explore the ANSI-NISO standards that were published or updated since 2015 to 2023 and evaluate their implications to digital library systems. The approach is also descriptive by design.

4.1. Data Source and Selection Criteria

The ANSI-NISO organization has a wide range of publications. The publication area covers standards, technical papers, recommended practices, primers, and other documents. The study comprises 17 ANSI-NISO standards that were published or updated in the years 2015-2023. These standards were recognized after a systematic review of the official NISO website (https://www.niso.org/publications/standards). To keep it consistent and within scope, draft documents, technical reports, and recommended practices were omitted. All the chosen individual standards were downloaded and analyzed separately. Each full-text document was broken down into descriptive information, including:

1. Date of publication or revision
2. Purpose and scope
3. Functional domain
4. Main technical or conceptual focus
5. Applicability to digital library systems

4.2. Analytical Approach

The analysis is based on systematic thematic organization and comparative description. All of the 17 standards were classified into five groups based on their content type, such as:

1. Content Tagging and Metadata Standards
2. Unique Identifier and Addressing Standards
3. Guidelines and Best Practices
4. Information Interchange and Communication Standards
5. Contributor Roles and Peer Review Standards

Each group has been analyzed based on its respective standards, with a comparative analysis presented in tabular format. The first group, Content Tagging and Metadata Standards, includes seven standards. The second group, Unique Identifier and Addressing Standards, comprises two standards. The third group, Guidelines and Best Practices, encompasses four standards, while the fourth and fifth groups contain two standards each. These standards cover various aspects such as guidelines for abstracts, criteria for indexes, library binding, information interchange formats, and more during the specified period (Fig. 2).

This period is chosen by the researcher due to the inclusion of a period of high technological development in the information community. Semantic web and linked data technologies improve the interoperability of data and its integration. Open access and open science have been on the rise, backed by transparent peer review and digital

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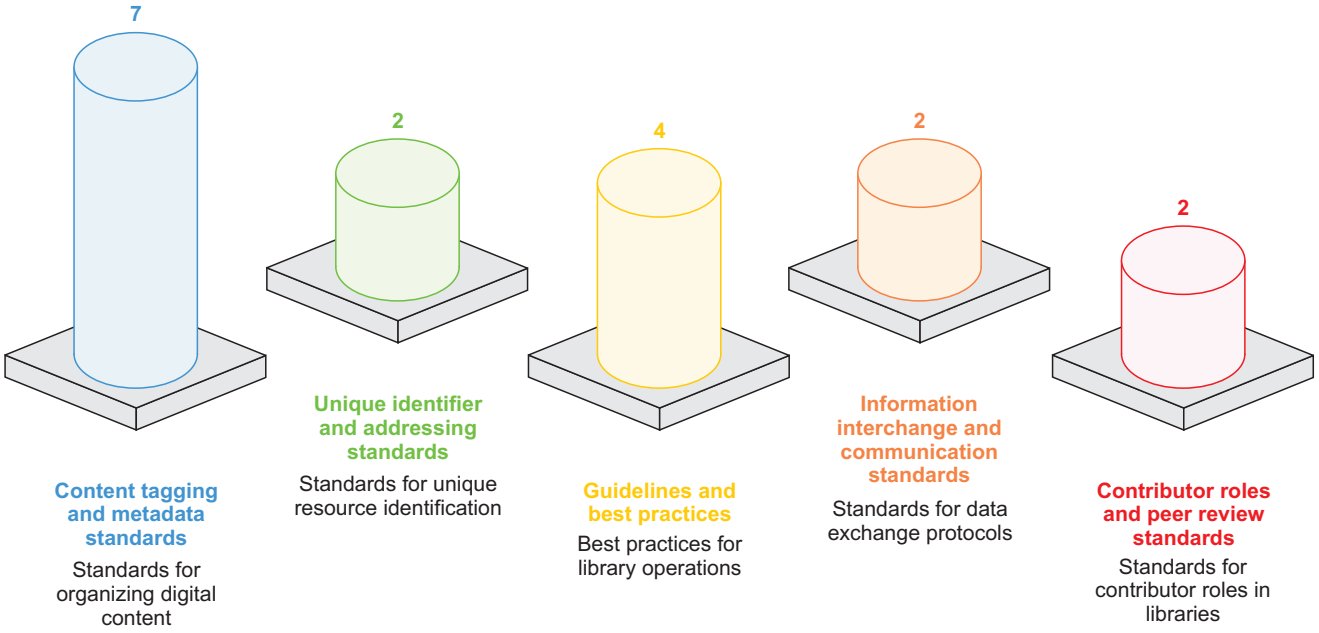

Fig. 2. Distribution of standards in various groups.

repositories. Another observation made by the researcher was that the level of standards being developed in the information community was also on the rise during this period. Standards are needed to make sure that various technological systems and processes are well compatible and effective with one another. The increase in standards can be due to a growing industry, more cooperation between stakeholders, and more emphasis on quality and uniformity in information practices.

4.3. Evolution of NISO Standards During 2015-2023

The information shows clear patterns in the number of standards introduced annually between 2015 and 2023. The years 2015 and 2017 stand out with the highest activity, each producing four standards, suggesting a period of focused standardization efforts or the culmination of long-term projects. In contrast, the year 2020 recorded no new standards. From 2018 onward, the number of standards introduced remained relatively steady, ranging between one and two per year, indicating a more consistent but subdued pace of activity. The consistent output in 2021, 2022, and 2023 suggests renewed efforts in standardization, albeit at a moderate pace. This timeline highlights both the dynamic nature of standards development and the potential influence of external factors on these processes (Fig. 3).

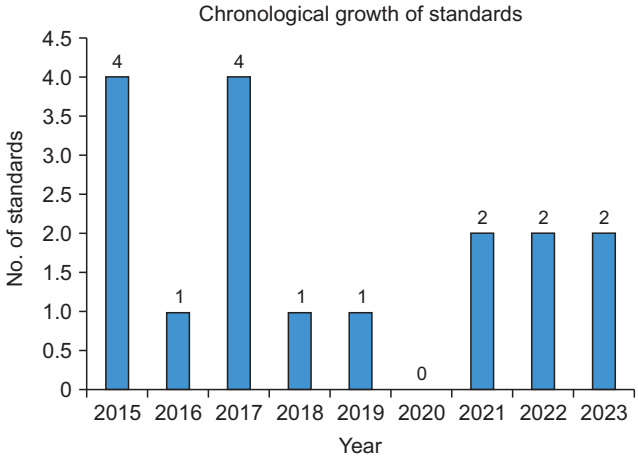

Fig. 3. Chronological growth of standards.

4.4. Classification of Standards Based on Their Content

4.4.1. Group 1: Content Tagging and Metadata Standards

4.4.1.1. ANSI/NISO Z39.102-2017 for Standard Tag Suite.

The published normative standards documents' full text, as well as their metadata, are described by the STS's predefined elements and attributes. The STS offers a unified XML format for standard developers, publishers, and

distributors, including national standards bodies, regional standards organizations, and international standards organizations. Organizations may also use this to publish and exchange common metadata as well as full-text content. The NISO STS standard intends to provide a set of XML elements and attributes that describe the full-text content and metadata of standards, and is designed to safeguard the intellectual property included in those standards, regardless of how data was initially communicated. Without imitating any certain sequence or textual format, it is feasible to capture the structural and semantic components of material using the Tag Suite. The use of NISO STS for non-normative materials is not prohibited, but work has not been done to support them because Tag Suite will only consider normative documents. The Tag Suite will not consider previous or back-content standards; only current content/standards is considered. This standard is concerned with the specifications for published documents rather than the requirements for XML authoring or production. ANSI/NISO Z39.102-2017 significantly enhances library operations by providing a consistent XML-based framework for encoding standards documents. This standard improves metadata management, enabling accurate and efficient cataloguing and retrieval.

This standard enhances the user access and discovery with searchable digital records, and supports standardization across libraries for promoting interoperability and resource sharing. STS also aids in the long-term preservation and archiving of standards documents, ensuring they remain accessible over a long period of time. Libraries can seamlessly integrate STS-compatible documents into digital archives and content management systems, facilitating better management and preservation with other digital resources. Additionally, STS supports digital publishing and

Table 2. Grouping of standards according to different content types

Serial No.	Category	Standard	Description
1.	Content Tagging and Metadata Standards	ANSI/NISO Z39.102-2017, ANSI/NISO Z39.102-2022	Standards tag suite for tagging and structuring content in standards publications
		ANSI/NISO Z39.96-2015, ANSI/NISO Z39.96-2019, ANSI/NISO Z39.96-2021	Journal article tag suite for structuring metadata and content in journal articles
		ANSI/NISO Z39.87-2006 (R2017)	Data dictionary standard for technical metadata for digital still images
		ANSI/NISO Z39.99-2017	Resource Sync framework for synchronizing and sharing metadata and resources
2.	Unique Identifiers and Addressing Standards	ANSI/NISO Z39.43-1993 (R2017)	Standard address number for uniquely identifying organizations in the publishing industry
		ANSI/NISO Z39.23-1997 (S2015)	Standard technical report number format for creating and managing identifiers for technical reports
3.	Guidelines and Best Practices	ANSI/NISO Z39.14-1997 (R2015)	Guidelines for writing abstracts to improve clarity and consistency
		ANSI/NISO Z39.41-1997 (S2015)	Placement guidelines for information on book spines to ensure consistency
		ANSI/NISO Z39.4-2021	Criteria for indexes to improve their quality and usability
		ANSI/NISO/LBC Z39.78-2000 (R2018)	Library binding guidelines for durability and usability of bound materials
4.	Information Interchange and Communication Standards	ANSI/NISO Z39.2-1994 (R2016)	Information interchange format, primarily for bibliographic data sharing
		ANSI/NISO Z39.105-2023	Content profile/linked document standard for describing content relationships and profiles
5.	Contributor Roles and Peer Review	ANSI/NISO Z39.104-2022	Contributor roles taxonomy for identifying and categorizing contributor roles
		ANSI/NISO Z39.106-2023	Standard terminology for peer review processes

ANSI, American National Standards Institute; NISO, National Information Standards Organization.

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enhances user interaction with rich media and interactive elements. Adopting STS leads to improved metadata management, user experience, and operational efficiency in libraries (https://www.niso.org/publications/z39102-2017-sts) (Table 2).

4.4.1.2. ANSI/NISO Z39.102-2022 for Standards Tag Suite.

Full-text content and metadata of standards in the STS, a widespread XML format, are published and shared by information professionals such as developers, publishers, distributors of standards, and standards development organizations. STS offers guidelines on the adoption of standards and similar documents that are developed by the standards bodies. This standard contains the material of normative and non-normative standards. It is based on ANSI/NISO Z39.96 (journal article tag suite; JATS). The latest release of this standard is NISO STS 1.2, and ISO STS version 1.1 and 1.0 are also completely backwards compatible. The suite has two implementations of this standard, the Interchange Tag Set and the Extended Tag Set. These sets of tags are constructed based on the elements and properties designated in the suite and are designed to be used as the templates on which the publishing standards and interoperability can be achieved.

The NISO STS Tag Sets are not fixed but can be modified to the requirements of projects. Examples of non-normative supportive data would be schemas, descriptions of usage, XML-tagged examples, information about Mathematical Markup Language and Organization for the Advancement of Structured Information Standards XML Exchange table model, and TermBase eXchange. NISO STS/NISO JATS has specifications of XHTML-inspired elements and characteristics tables that are provided in STS Tag Library. The STS has significant effects on the running of libraries since it enhances easier management and availability of standards and technical documentation. This standard provides a unified XML platform to tag and share standards that guarantee the similarity of metadata and content structure. In the case of libraries, STS facilitates cataloguing, retrieval, and interoperability of documents. Through the adoption of STS, libraries will be able to improve their digital processes and operations, improve the search and resource discovery process, and provide long-term preservation (https://www.niso.org/publications/z39102-2022-sts).

4.4.1.3. Journal Article Tag Suite – ANSI/NISO Z39.96-2015.

ANSI/NISO developed this standard to define a list of XML elements and attributes used to describe the content and metadata of journal articles. These include different types of research articles, non-research articles, letters, editorial, book reviews, and product reviews. Because of this, publishers and archives will be able to share the content of the journal in a standard manner. The implementations of the suite whose implementations are referred to as Tag Sets in the standard are also covered. These sets of tags are used as templates in the development and publication, as well as preservation of journal articles. These tags are based on the elements and features mentioned in the suite. This standard basically defines the characteristics of the whole content and metadata of the scientific journal articles. The entire collection of aspects and features listed in the standard is called the Tag Suite. Further, the standard defines three types of articles, or Tag Sets: The Article Authoring Tag Set, the Journal Publishing Tag Set, and the Journal Archive and Interchange Tag Set. JATS enhances the accessibility, interoperability, and preservation of scholarly content. JATS provides a universal XML pattern of tagging of journal articles, guaranteeing that metadata and full-text content are always organized. Such consistency accelerates the management and sharing of digital content across platforms and systems by libraries. Implementing JATS will assist libraries in enhancing their digital contents management, which means that scholarly materials are readily available, are reliably maintained, and can be easily distributed to the academic community (https://www.niso.org/publications/z3996-2015-jats).

4.4.1.4. ANSI/NISO Z39.96-2019 of Journal Article Tag Suite, version 1.2.

This standard is designed to specify a collection of XML elements and attributes describing the text and metadata of journal articles, research and non-research articles, letters, editorials, book reviews, and other forms of publications. The Tag Suite is aimed at maintaining the intellectual content of a publication regardless of the means of delivery used originally. The suite defines three Tag Sets in the standard. These sets of tags were developed based on the elements and attributes outlined in the Suite to give examples on how the contents of journal articles should be produced, published, and preserved. The JATS identifies the characteristics of the entire text and metadata of research journal articles. The Tag Suite is the whole set of the elements and characteristics mentioned in the

standard.

Along with these descriptions, the standard defines three types of articles or Tag Sets: the Article Authoring Tag Set, the Journal Publishing Tag Set, and the Journal Archive and Interchange Tag Set. ANSI/NISO Z39.96-2019 helps library operations to enhance the management, preservation, and sharing of scholarly material. This standard is a flexible and standardized XML format to tag journal articles that promote interoperability and data exchange among various systems and platforms used by libraries. With the introduction of JATS, libraries can achieve a high level of metadata quality and consistency, which is extremely important in the process of cataloguing and indexing scholarly articles. JATS enhances the access and discoverability of journal content as well, and allows libraries to provide more efficient search and discovery capabilities to their researchers and patrons (https://www.niso.org/publications/z3996-2019-jats).

4.4.1.5. ANSI/NISO Z39.96/2021 ANSI/NISO Journal Article Tag Suite 1.3.

Journal articles are characterized by the information or content contained within them, which is defined as the NISO JATS, a set of XML elements and attributes. The Journal Archiving and Interchange Tag Suite is the product of the National Library of Medicine (NLM) that was developed as part of the National Center for Biotechnology Information/NLM PubMed Central project to archive life science publications of different sources. Three implementations, known as Tag Sets, are created using the elements and features that have been offered by the suite. Such implementations are used in the creation and sharing, as well as preservation of journal articles material. It offers three models of the article: The Journal Publishing, The Journal Archive Tag Set, and The Article Authoring Tag Set. Tag sets can be developed using the components and attributes of the Tag Suite. The sets of tags may contain other structures, though these are not said to be conforming to the standard. The NISO JATS Tag Suite is based on XHTML as the default table model. JATS 1.3 enhanced the management, accessibility, and interoperability of scholarly content. This standard is known to offer an all-inclusive XML encoding format of journal material, which assists in enriching the uniformity of data depiction and interchange. The advantages for libraries are improved metadata accuracy and enhanced discoverability, which results in a more efficient cataloguing and retrieval of journal articles. The standard also promotes the interoperability of various systems and platforms and can be easily integrated with institutional repositories, digital archives, and discovery tools (https://www.niso.org/publications/z3996-2021-jats).

4.4.1.6. ANSI/NISO Z39.87-2006 (R2017) of Data Dictionary – Technical Metadata of Digital Still Images.

As a standard set of metadata elements of raster images, NISO developed a standard data dictionary. This standard is only limited to the case of a static raster (bitmap) image. It does not involve animated raster, vector, and motion picture formats. The standard also enumerates the technical information required to deal with digital still photographs. Former versions of this standard frequently mentioned images stored in the tagged image file format. The last revision has been extended to define other file formats of images. Also, this standard laid emphasis on master image file documentation during format development. This standard is set to make it easier to come up with software capable of verifying, handling, migrating, and processing long-term master image file values. A Data Dictionary - Technical Metadata of Digital Still Photographs category would go a long way in influencing the operations of a library because it offers a methodical manner of describing and controlling digital photographs. This standard is used to bring about consistency and interoperability between various systems and institutions, which is significant to the effective management of digital assets. Adhering to this standard, libraries will be able to catalogue and access digital images more effectively, and access to the latter will be increased by users and the discoverability of digital collections will increase. The standard also assists in preserving the digital images in the long term by proposing the necessary technical metadata components that aid in ensuring that the digital assets stay intact and useful as time goes by (https://www.niso.org/publications/ansiniso-z3987-2006-r2017-data-dictionary-technical-metadata-digital-still-images).

4.4.1.7. ANSI/NISO Z39.99-2017 of Resource Sync Framework Specification.

This Resource Sync standard outlines several simple features that a server can provide. These are features that help remote systems to monitor its evolving resources in a better manner. It also defines the way a server is expected to advertise its resources. The features will offer a different synchronization option, such as a list of resources that the server has or a list of the resources recently changed. It describes the types of changes carried out, including

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creation, update, and deletion, and all these features are based on the document formats defined by the sitemap protocol.

This Resource Sync also provides a universal method of synchronization, which simplifies implementation and reuse of resources. Resource Sync Framework enhances effectiveness and accuracy of resources synchronization between digital repositories. This standard provides a straightforward mechanism by which resources can be synchronized effectively, which means that library systems can update their collections with the newest information in a reliable and automatic manner. Through such a framework, libraries can reduce the amount of manual work and minimize the chances of errors associated with old or erratic information. It facilitates effective collaboration between various digital repositories and this enables libraries to share and update resources efficiently (https://www.niso.org/publications/z3999-2017-resourcesync).

Here is a concise comparison of the seven standards (Table 3):

4.4.2. Group 2: Unique Identifiers and Addressing Standards

4.4.2.1. ANSI/NISO Z39.43-1993 (R2017) for Standard Address Number for the Publishing Industry.

The aim of this standard is that numeric identifiers will be assigned to and used by book and journal publishers in the United States, as well as booksellers, book wholesalers, subscription agents and distributors, printers, binders, and other manufacturing suppliers to the publishing industry;

Table 3. Analysis of standards in content tagging and metadata standards group

Standard	Description	Key features	Library benefits
ANSI/NISO Z39.102-2017	Standards tag suite (STS) for normative standards documents	Unified extensible markup language (XML) format for standards' metadata and full-text	Enhanced metadata management, interoperability, and long-term preservation of standards
ANSI/NISO Z39.102-2022	Updated STS with broader support for normative and non-normative materials	Backward-compatible XML framework with interchange and extended tag sets	Improved tagging, accessibility, and interoperability for technical documents
ANSI/NISO Z39.96-2015	Journal article tag suite (JATS) for scholarly journal articles	XML elements and attributes for tagging article content and metadata	Consistent content structure, efficient digital content management, and enhanced scholarly accessibility
ANSI/NISO Z39.96-2019	JATS version 1.2 for academic journal articles	Refined XML framework with focus on interoperability and metadata uniformity	Better metadata quality, preservation, and improved discoverability of journal content
ANSI/NISO Z39.96-2021	JATS version 1.3 for archiving and interoperable scholarly articles	Advanced XML features including Mathematical Markup Language and Organization for the Advancement of Structured Information Standards XML Exchange table components	Seamless integration with repositories, accurate metadata, and enhanced cataloguing and retrieval
ANSI/NISO Z39.87-2006 (R2017)	Data dictionary provides a standardized set of metadata elements for digital still images	Metadata for image file formats such as tagged image file format, focusing on technical and master image files	Supports consistent cataloguing, retrieval, and preservation of digital images, ensuring long-term usability and integrity of digital assets
ANSI/NISO Z39.99-2017	Resource Sync Framework Specification provides capabilities for synchronizing resources between servers and remote systems	Enables synchronization of resources with change tracking (create, update, delete) using Sitemap protocol	Enhances resource synchronization accuracy and efficiency between digital repositories, reducing manual efforts and errors, and supporting seamless data sharing and updating across library systems

ANSI, American National Standards Institute; NISO, National Information Standards Organization.

other stakeholders include college and university bookshops, library systems, elementary and secondary schools, and school systems. The purpose of this standard is to establish an identification code system that will allow each address in the publishing sector to be given a unique code that can be used for positive identification in all transactions involving the purchase and sale of books and journals.

Standard address number (SAN) significantly enhances library operations by providing a unique identifier for addresses in the publishing industry. This standard streamlines acquisitions and cataloguing by reducing errors and administrative burdens, improves inventory management through accurate tracking of shipments, and facilitates interlibrary loan processes by ensuring precise identification of institutions. It simplifies communication with vendors and publishers, supports the generation of consistent and accurate reports, and enhances data consistency and integration across library systems. Additionally, SANs enable efficient electronic data interchange by providing a standardized identifier for electronic transactions (https://www.niso.org/publications/z3943-1993-r2017).

4.4.2.2. ANSI/NISO Z39.23-1997 (S2015) for Standard Technical Report Number Format and Creation.

This standard provides a format of a standard technical report number (STRN) that will enhance access to technical reports as well as organize and standardize the reports. The STRN includes two sets of characters; the first one is the organization that issues it, and has optional subdivisions or series. The second offers sequential number. This standard is meant to give a proper framework upon which different related technical report numbers can be developed. All technical reports, including non-print ones, must be accompanied by the STRN. Report number should also be evident in the upper right of the spine, title page, and cover in case of space availability. There are two other required components of a STRN: a report code and a sequential group. The name of the program must precede the number of the Standard Technical Report. The STRN provides a standard method of identifying and managing technical reports. It is due to this standard that technical reports are easily identifiable, retrievable, and differentiated among the other categories of documents. This aids in making cataloguing, storage, and retrieval of documents easier, thereby making technical information in libraries easier to organize and retrieve. This standard also facilitates the aspect of technical reports being integrated into digital library systems to enhance more resource sharing and co-operation between institutions. The adoption of the ANSI/NISO Z39.23-1997 (S2015) standard simplifies the work of libraries, enhances the user experience, and makes sure that the precious technical information stays intact and can be used in the future in research and reference (https://www.niso.org/publications/z39.23-1997-s2015) (Table 4).

4.4.3. Group 3: Guidelines and Best Practices

4.4.3.1. ANSI/NISO Z39.14-1997 (R2015) for Guidelines for Abstracts.

In this standard, an "abstract" refers to a succinct, impartial summary of the information contained in a primary document or an oral presentation. This guideline is intended to assist writers and access services staff members in creating abstracts that are as detailed as possible. The requirements of this standard apply to all abstracts, regardless of who wrote them and whether they were written by the document's author(s) or someone else, whether they were attached to the document, appeared in access publications or services, or were published separately as a representation of a formal oral presentation. The abstract, which offers a concise overview of the topic or argument, may make it easier to read the main paper in its entirety.

Table 4. Analysis of unique identifiers and addressing standards group

Standard	Description	Key features	Library benefits
ANSI/NISO Z39.43-1993 (R2017)	Standard address number for the publishing industry	Unique numeric identifiers for accurate address identification. Used in transactions across publishing sectors	Streamlines acquisitions and cataloguing. Enhances inventory management. Improves interlibrary loans. Supports electronic data interchange and consistent reporting
ANSI/NISO Z39.23-1997 (S2015)	Standard technical report number format and creation	Structured technical report numbering system. Identifiers for organizations and sequential numbering	Ensures easy identification, retrieval, and cataloguing of technical reports. Supports digital integration and resource sharing

ANSI, American National Standards Institute; NISO, National Information Standards Organization.

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Table 5. Word length of abstract

Document	Maximum length of abstract (words)
Papers, articles, portions of monographs	250
Notes, short communications	100
Editorials, letters to the editor	30
Monographs and theses	Single page, 300

The abstract writing tips are also intended to assist authors and editors of specific papers and publications, whether printed or electronic. Depending on the sort of document being abstracted and how it will be utilized, an abstract's length varies. The following lengths often work well if length is not specified (Table 5):

This standard, "Guidelines for Abstracts," significantly impacts library operations by providing a consistent framework for creating abstracts. This standard outlines the essential elements and best practices for abstracting, ensuring that abstracts are informative, concise, and useful to end-users. For libraries, this means that the abstracts included in their catalogues, databases, and other resources adhere to a recognized standard, which enhances the quality and reliability of the information they provide. In more detail, the implementation of this standard in library operations ensures that abstracts are clear, comprehensive, and consistent, thereby improving the user's ability to quickly ascertain the relevance of documents and resources. The use of ANSI/NISO Z39.14-1997 (R2015) supports the library's mission to provide high-quality, accessible, and reliable information services to their patrons (https://www.niso.org/publications/ansiniso-z3914-1997-r2015-guidelines-abstracts).

4.4.3.2. ANSI/NISO Z39.41-1997 (S2015) for Placement Guidelines for Information on Spines.

Basically, the spines means the section of a binder, container, or other protective enclosure that joins the enclosure's front and back parts, and this standard ensures that local data is placed in a consistent location on works with spines for libraries and other organizations. According to this standard, information on printed bindings, covers, containers, or other protective enclosures of a book must be presented in a specific way. This standard is applicable to both commercial works and content bound by libraries, businesses, or other organizations. This standard expressly disallows non-spine containing works, such as saddle-stitched journals and reports. In this way, information placed on a spine by a publisher or producer will not be obscured. This standard provides guidelines for the placement of information on book spines, significantly impacting library operations by standardizing the way bibliographic information is displayed. This standard ensures that essential details such as the title, author, and call number are consistently placed on the spine, facilitating efficient shelving, retrieval, and inventory management. In practice, adhering to ANSI/NISO Z39.41-1997 (S2015) enhances the user experience by making it easier for patrons to locate books quickly, thus improving overall accessibility. For library staff, the standardized spine information streamlines cataloguing and reshelving processes, reducing errors and saving time (https://www.niso.org/publications/ansiniso-z3941-1997-s2015).

4.4.3.3. ANSI/NISO Z39.4-2021 for Criteria for Indexes.

This standard outlines requirements for the structure, content, and visual display of indexes that are used to find documents and portions of documents. The three steps of comprehensive design, vocabulary management, and syntax are emphasized as being crucial for all indexes. For publications and papers that are often cited, like textbooks, indexes are crucial. This standard includes requirements for words in vocabulary management, as descriptors in non-displayed indexes, and in shown index headings.

This standard applies to all indexes, regardless of whether they are created using manual labor or computer assistance, whether they are browsed visually or electronically, and regardless of whether a single indexer or a team of indexers created them. The introduction, scope, normative references, definitions, function of an index, types of indexes, design of indexes, vocabulary, headings and locators, display of an index, alphabetical arrangement, glossary, appendices, additional resources, and bibliography are among the fourteen sections that make up the text. Headings, subheadings, and locators ought to direct readers to the text, communicate meaning, and be simple to use and understand. Index designers and editors must take care to avoid using terminology, definitions, or scope remarks that exclusively represent their own viewpoints. Successful vocabularies must represent the index's aim, match the subject, level of detail, and language of the documentary unit, group comparable information under a single heading, and include cross-references that point readers to both that heading and related headings. For comprehensive indexes, controlled vocabularies are

particularly crucial since they can reduce indexing dispersion. In library operations, this standard is pivotal in several ways. Firstly, it facilitates the development of high-quality indexes, which enhance the accessibility and discoverability of information within library catalogues and databases. Consistent and well-structured indexes enable users to efficiently locate relevant materials, thereby improving the user experience and satisfaction. Secondly, the standard supports interoperability among different library systems and databases by providing a uniform framework for index creation. This interoperability is crucial for resource sharing, collaborative cataloguing, and interlibrary loan services, ultimately broadening the range of available resources to library patrons (https://www.niso.org/publications/z394-2021-indexes).

4.4.3.4. ANSI/NISO/LBC Z39.78-2000 (R2018) for Library Binding.

This standard is for binding books and periodicals, making them strong and durable enough to be used in libraries. The following are the guidelines used in binding books by this standard: Paperbound books need to be bound in hardcover, and hardcover volumes need rebinding. The same can be said of binding periodicals. Serial volumes in hardcover need to be rebound and serial issues with paper covers should be initially bound in hardcover. Volumes should be classified as per this standard. The binder must ensure that the binding color, stamp foil color, and spine lettering style match those of the other volumes of the same title. This standard is applied to multivolume monographs as magazines. Standard binding in libraries is very important in the operation of libraries as it offers specifications involving the robust and enduring binding of the library materials. This standard aids in making sure that books and other bound materials can withstand heavy usage, environmental factors, and time, which is critical in maintaining the collection of the library. With such a practice, libraries will be able to save a huge amount of money on repair and replacement costs and save their funds to better allocate financial and material resources. The standard also assists in ensuring the standard appearance and quality of bound materials, which increases the satisfaction and trustworthiness of users about the collections of the library (https://www.niso.org/publications/z3978-2000-r2018) (Table 6).

4.4.4. Group 4: Information Interchange and Communication Standards

4.4.4.1. ANSI/NISO Z39.2-1994 (R2016) for Information Interchange Format.

This standard defines the need for a standard format of the information transmission that can process various data types. This entails bibliographic description of vari-

Table 6. Analysis of guidelines and best practices group

Standard	Description	Key features	Library benefits
ANSI/NISO Z39.14-1997 (R2015)	Guidelines for abstracts provides guidelines for writing concise, impartial summaries of primary documents or presentations	Defines abstract lengths for different document types, from 30 to 300 words, ensuring clarity and conciseness	Improves cataloguing and searchability of resources by ensuring standardized, clear, and consistent abstracts, facilitating quicker user access to relevant information
ANSI/NISO Z39.41-1997 (S2015)	Placement guidelines for Information on Spines standardizes the placement of bibliographic information	Ensures consistent placement of essential details (title, author, call number) on spines for easy identification	Enhances book shelving, retrieval, and inventory management, saving time and improving accessibility for both library staff and users
ANSI/NISO Z39.4-2021	Criteria for Indexes provides best practices for creating and structuring indexes to facilitate efficient information retrieval	Focuses on vocabulary management, index design, and clarity of headings and locators	Supports better information retrieval within library catalogues and databases, enhancing user experience and facilitating resource sharing among institutions
ANSI/NISO/LBC Z39.78-2000 (R2018)	Library binding is for the durable and robust binding of library materials, such as books and periodicals	Guidelines for binding both new and rebound materials to ensure durability and long-term use	Ensures materials are durable enough to withstand frequent use, reducing repair costs and preserving library collections for longer periods, which enhances overall resource management

ANSI, American National Standards Institute; NISO, National Information Standards Organization.

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ous pieces of work and the associated information, such as authority, holdings, and circulation. The standard does not prescribe the content of a record, and tags, indicators, and data element identifiers do not usually carry specific meanings. This enables one to explain or define an entity, either independent or relative to others. The standard describes a structure with a general arrangement that primarily is used to transfer data between the systems of processing, but it is also used as a processing structure in the systems themselves.

Information Interchange Format provides representation in the interchange of bibliographic information where there are consistency and compatibility. This standard defines the format of the bibliographic data, and this allows the various library systems and databases to communicate with ease. Through this standard, libraries can share records regarding the cataloguing. This saves time to enter the same data more than once, and minimizes the probability of mistakes. The standard enhances the collaboration of the various library management systems and enhances the discoverability and accessibility of the resources. It also makes the incorporation of library collections into larger networks, e.g. consortia or national catalogues, simpler. This assists in increasing the accessibility and coverage of library services to more people (https://www.niso.org/publications/ansiniso-z392-1994-r2016).

4.4.4.2. ANSI/NISO Z39.105-2023- Content Profile/ Linked Document.

This standard provides a clear approach to scholarly publishing where HyperText Markup Language and JavaScript Object Notation for Linked Data (JSON-LD) are used to establish a relationship between content and data elements. It facilitates the creation of self-describing content that can be automatically interpreted and processed by machines. The goal is to enhance sharing and re-use of scholarly research information. The document explains salient details of linked documents (LD) and content profiles (CP). Such profiles will be able to modify specifications of various applications without substituting the available journals, books, or datasets. The integration of different content types and data semantics are facilitated in new strategies in this standard. This approach aims to simplify content interoperability across different platforms by using a common format that works well for search and display.

The primary purpose of the CP/LD standard is to offer a versatile framework that enhances the level of discoverability and sharing of research outputs. The standard highlights the importance of having a robust framework which keeps up with the changing technology but still makes users aware by developing a connected system where various information resources can co-exist and be easily shared. Current development of CP will be based on popular ontologies and schemas to remain relevant and pursue best practices in scholarly communication. The format and CP requirements of scholarly articles are such that it enhances access and interoperability of academic documents using a standard format. Every LD must contain a manifest of the publication that outlines the parts of the document, including metadata of the kind of work, authorship, and reading sequence, structured in JSON-LD format. This profile demonstrates the significance of the presence of both narrative and data aspects in each article so that the main details could be represented properly. It demands compliance to the set vocabularies such as the schema.org to get a wider comprehension and states further and specific terms are to be specified using resource description framework. Moreover, the association between the document and associated datasets will be enhanced by the

Table 7. Analysis of information interchange and communication standards group

Standard	Description	Key features	Library benefits
ANSI/NISO Z39.2-1994 (R2016)	Information Interchange Format provides a format for transmitting bibliographic and related data, ensuring system compatibility	Specifies a flexible structure for data exchange, facilitating uniformity and interoperability across different library systems	Facilitates data exchange, reducing manual entry and errors. Promotes sharing of cataloguing records and integration into consortia or national databases
ANSI/NISO Z39.105-2023	Content profile/linked document framework for linking content and data using HyperText Markup Language and JavaScript Object Notation for Linked Data for improved content interoperability	Introduces semantic interconnections among content elements, creating machine-actionable content for better data exchange and reuse	Enhances the discoverability and accessibility of research outputs, supporting seamless integration across platforms

ANSI, American National Standards Institute; NISO, National Information Standards Organization.

incorporation of research data using permanent identifiers, such as DOIs.

The guidelines also describe how these documents can be created and managed while considering the discovery and validation of CP. A variety of ways of connecting information and content are proposed, such as using external identifiers to give the document a context. The validation process is needed with both CP/LD standards and any CP schema. The quality and consistency of the documents will rely on making sure that the documents can meet these criteria. Through these standards, the CP can provide an easy-going experience to the users of academic contents and facilitate a standardized frameworks of scholarly communication (https://www.niso.org/publications/z39105-2023-cpld) (Table 7).

4.4.5. Group 5: Contributor Roles and Peer Review

4.4.5.1. ANSI/NISO Z39.104-2022 for Contributor Roles Taxonomy.

CRediT has been approved by the ANSI. This is the standard set by the NISO. It makes it possible to record various forms of contributions made to publish academic work in a clear and systematic way. CRediT has been broadly embraced by many publications to enhance access and visibility of different contributions to research outputs. It helps in grant funding, assists in the reduction of conflicts of authors, assists in compliance with the policy of authorship, and underlines the contributions of the researchers, identifies peer reviewers and their skills, and informs meta-research as a way of enhance science education. CRediT being recognized on this level will offer more assistance to users and implementers in their academic endeavors.

The CRediT taxonomy consists of four categories, namely methodology, resources, tools, and project management overseer. It provides a model of explaining the roles and responsibilities of the contributors of research published. CRediT also aids in the operations of libraries by making it easier to attribute contributions in a piece of scholarly work. The standard offers a specific means to provide credit for different roles in research, thereby facilitating transparency and accountability. This clarity is useful in academic libraries as it assists in indexing, cataloguing, and locating academic material. CRediT can also be used to empower libraries to capture a comprehensive range of contributions by authors and researchers in their metadata to enhance metadata discoverability and citation behaviors (https://www.niso.org/publications/z39104-2022-credit).

4.4.5.2. ANSI/NISO Z39.106-2023 - Standard Terminology for Peer Review.

The ANSI/NISO Z39.106-2023 standard suggests a homogenous vocabulary of peer review processes. It speculates specifically on the dynamic nature of open peer review patterns by publishers. Such an undertaking will improve the level of transparency of the peer-review of articles and journals since the terms used by various publishers are standardized. This will make the academic community able to measure and compare different practice reviews satisfactorily. The standard that has been made after consulting with a huge number of stakeholders in the publishing industry concerns significant areas of the publishing industry such as identity transparency, working with reviewers, and sharing of review information. This kind of adoption of terminologies will make it easier to peer review and will form a basis upon which these terminologies can be used in other publications in the future.

Table 8. Analysis of contributor roles and peer review group

Standard	Description	Key features	Library benefits
ANSI/NISO Z39.104-2022 (CRediT)	CRediT provides a structured taxonomy for recording contributor roles in academic research	Categorizes research contributions (methodology, resources, tools, management). Improves visibility of authors' roles. Supports grant making and peer review	Enhances transparency in authorship, improving cataloguing, indexing, and citation practices in libraries. Helps in the accurate attribution of scholarly contributions, improving discoverability
ANSI/NISO Z39.106-2023	Terminology for peer review establishes standardized terminology for peer review processes, supporting open peer review models	Standardizes peer review terminology. Focuses on open peer review and identity transparency	Improves the reliability and consistency of peer review information in academic content, enhancing the quality of scholarly resources in library collections

ANSI, American National Standards Institute; NISO, National Information Standards Organization; CRediT, contributor roles taxonomy.

This standard is managed by the NISO and it needs to go through extensive peer review and consensus-forming among its voting members, and finally approval by the ANSI. Although the terminology is primarily oriented towards the peer review of journal articles, it can also be adjusted to potential applications with other sources such as books and preprints. The standard encourages a culture of joint refinement by seeking feedback and suggestions on the constant improvement of the standard by stakeholders. Altogether, ANSI/NISO Z39.106-2023 is a valuable tool to be used by publishers and researchers who approach the challenges of peer review and enhances the reliability and credibility of scholarly communication (https://www.niso.org/publications/z39106-2023-peerreview) (Table 8).

5. SUMMARY OF KEY FINDINGS

1. The research found 17 ANSI-NISO standards published or updated since 2015 and confirmed by the authoritative sources of NISO. The following are significant specifications, which are JATS, STS, Resource Sync, CRediT, and peer-review terminology standards, which give a more current reference to recent standardization efforts in the digital information environment.

2. Descriptive review analysis demonstrates the significance of that structural design, such as XML schemas, frameworks, vocabularies, and guidelines, and functional goals include metadata management, interoperability, contributor transparency, and repository synchronization. Most of the standards use machine actionable, extensible models in line with modern digital processes.

3. With the help of a structured coding methodology, standards were grouped into five thematic clusters; such a categorization emphasizes the scope of the standardization program by NISO and its applicability to the various facets of operation of digital libraries.

4. Temporal analysis showed that standardization activity increased in the years 2015 and 2017, and there were significant changes in the digital scholarship, linked data, and repository architecture. The last ten years have seen a distinct movement to look beyond the traditional bibliographic frameworks to progressive metadata models, semantic precision, synchronization mechanisms, and open science-oriented practice.

5. The results revealed that the standards have a major impact on the digital library infrastructure by improving the interoperability, metadata quality, synchronization of resources, discoverability, and the transparency of scholarly communication. XML standards like JATS and STS enhance structured content management whereas Resource Sync enhances updates to the repositories. Peer review terminology and CRediT can help to make research ethical and transparent.

6. The analysis indicates that ANSI-NISO standards have practical and theoretical applications. In practice, they help to build sustainable, interoperable, and next generation digital library systems. This research indicates how the standardization develops according to technological, scholarly, and cultural shifts in the period 2015-2023 as a period of transformation in the development of NISO standards.

6. DISCUSSION AND IMPLICATIONS

The exploration of ANSI-NISO standards released since 2015 reveals that the role of standardization in the context of libraries has dramatically improved. During this time ANSI and NISO were quite open to technological developments, typically for the creation of digital repositories, semantic Web applications, artificial intelligence, and linked data infrastructures. XML-based standards such as the JATS and the STS are significant steps in the direction of more structured, interoperable, and machine actionable metadata structures, which are more efficient in resource discovery, exchanging, and long-term preservation of digital objects. Also, the resource synchronization standards additionally promote the trustworthiness of digitized collections that are published, as they enable automatic and frequent changes of repositories. In addition, the most recent standards, addressing the points of contributor roles (CRediT) and terminology of peer-review, represent a more mature interest in the ethical and transparent practices of scholarly communication. This is consistent with the international open science agendas that aim at promoting fairness, accountability, and transparency in the research processes.

Thematic classification of standards into five broad categories, such as content tagging and metadata, identifiers, guidelines and best practices, information interchange, and contributor roles represents a more holistic trend assumed by NISO. The diversity of emphasis demonstrates the multifunctional needs of the contemporary ecosystems of digital libraries, in which the integrity of data and user-centered access play a pivotal role. The clustering of new and updated standards during 2015 and 2017 are linked to the significant change in the field of scholarly communication and the fast-paced development of digital infrastructures on an international scale.

In addition, towards trend identification, the present study has several contributions towards professional practice and academic discourse. In terms of libraries, the results explain how the ANSI-NISO standards will improve consistency in metadata, facilitate the digital preservation process, and simplify the process of locating resources. To administrators and policymakers, the study has an evident base that can be used to design institutional strategies in resource allocation and the formulation of policies that follow best practices in the world. This study also highlights a gap in research publications, as it is the first comprehensive review of ANSI-NISO standards in the selected period characterized by a significant technological and conceptual transformation. It also offers a basis for further investigation into standard adoption, institutional implementation trends, and integration of recent technological developments of AI-based metadata creation and linked open data architecture.

7. LIMITATIONS OF THE STUDY

There are several limitations associated with this study. To begin with, regarding scope, the analysis is limited to the ANSI-NISO standards that were released or revised over the period of 2015-2023; hence, the previous underlying principles and the corresponding international standards that were created are not analyzed. Second, in terms of methodology, the paper uses a systematic descriptive review as opposed to an empirical or qualitative content analysis framework. Third, in terms of generalizability, the conclusions are only based on the context of ANSI-NISO standardization and might not be immediate transferrable to other national or international set-ups of standards. Regardless of such shortcomings, the study offers an organized and time-specific overview of the latest ANSI-NISO standards and offers a valuable foundation for empirical and comparative studies on the adoption of the standards and their impact on digital library systems.

8. CONCLUSION

This study examines the ANSI-NISO standards that have been issued and updated in 2015-2023, representing a period of significant change in digital information management. The results indicate that NISO standards have grown more than traditional bibliographic design has to include complex XML designs, interoperability standards, and codes of ethics in scholarly communication. The five thematic areas verified in the research highlight the multidimensionality of modern standardization endeavors. The 8-year period under consideration is a dramatic period where ANSI-NISO standards had to answer to the requirements of digital libraries, open-science projects, and new technology. They are at the heart of the creation of new digital library ecosystems due to their increased interest in metadata quality, resource synchronization, contributor transparency, and machine-actionable formats.

In the current context where libraries are already grappling with a rapidly changing technological environment such as artificial intelligence, big data analytics, linked open data, and blockchain preservation, the future viability of ANSI-NISO standards will rely on the ability to remain flexible and on cross sector collaborations.

Altogether, the 2015 to 2023 period is an important step in the modernization of ANSI-NISO standards, and this reflection has a prospective impact on digital library development. The relevance of these standards will have to be maintained by further adjustment to changing technology and by the constant interchange of standards bodies, libraries, system developers, and the rest of the scholarly community.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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