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Standards Collections: Considerations for the Future

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STANDARDS COLLECTIONS: CONSIDERATIONS FOR THE FUTURE

ABSTRACT

Technical standards are a form of grey literature that describe consensus for a wide variety of applications. They promote safety, quality, and interchangeability of parts. In academic libraries, standards have largely been associated with engineering collections, despite having connections to many disciplines. Engineering and technology accreditation bodies and employers continue to expect graduates to have knowledge and experience with standards upon graduation.

This paper provides a brief history of standards collection development in academic libraries, discusses the challenges of standards collections, shares a case study of standards information literacy curricula integration, and offers considerations for the future of standards collections.

Keywords: *technical standards, industry standards, academic libraries, engineering, technology, collection development, standards education*

INTRODUCTION

According to the Merriam-Webster online dictionary (as of September 20, 2018), the term “standard,” has several definitions, including “something established by authority, custom, or general consent as a model or example,” and “something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality.” The word broadly implies agreement and consensus, whether that happens by formal or informal means, is enforced, recommended, or merely common practice. From a collections perspective, libraries have traditionally been interested in standards that are formally published by recognized standards bodies (e.g., the International Organization for Standardization (ISO), ASTM

International). These standards are termed “de jure,” an expression that means “according to law,” but with regard to standards, it signifies the documents are formally published by standards organizations, but not necessarily required by law. This is in contrast to other types of standards, such as company standards that are created for internal use only (Thompson 2011), and de facto standards that are widely accepted as common practice, but considered “informal,” typically representing only a single company’s approach, or the practice of a private industry alliance, known as a standards consortia (Katusic et al. 2017). Broadly, “de jure” standards may also be referred to as voluntary consensus standards (although compliance is mandatory if a standard is referenced in federal, state, or local regulations), technical, engineering, or industry standards. Standards are important for many reasons, including to promote safety, provide quality assurance to consumers, and to facilitate the interoperability of products and components (Thompson 2011). It has been reported that more than 93% of global trade has direct ties to standards and technical regulations (Okun-Kozlowicki 2016), signifying their broad applicability and wide appeal.

Many types of libraries, including public, corporate, and academic, collect standards, which is evident by standards guides on library websites. Members of the public may be interested in standards for a variety of reasons, including learning about standards applicable to their product purchases, for the construction of their residences, and for entrepreneurship endeavors. Likewise, professionals, and students preparing to be professionals, need to be aware of standards that affect their current and future work. While standards are applicable to many fields, they are vital to the work of engineers and technologists, who design and maintain many of our society’s products, systems, and its infrastructure. According to Osif

(2014), standards play a crucial role in the engineering design process, in considering “issues of safety, legal constraints, and/or professional standards for performance interoperability.”

ABET, the organization that accredits engineering programs, stresses the importance of standards education in its Engineering Accreditation Commission (EAC) and Engineering Technology Accreditation Commission (ETAC) accreditation criteria. The 2018-19 EAC criterion 5d states, “students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and *incorporating appropriate engineering standards* and multiple realistic constraints (ABET 2017a).” Additionally, the 2018-19 ETAC criteria requires the student outcomes of “an ability to conduct *standard* tests and measurements” (3.c) and an “an ability to...identify and use appropriate technical literature” (3.f) (ABET 2017b). Also, the ETAC Mechanical Engineering Technology program criteria requires “basic familiarity and use of industry codes, specifications, and *standards*,” (e) and the Electrical Engineering Technology program criteria, the “application of...*engineering standards*” (a) (ABET 2017b). All of these references to standards have been maintained in the proposed changes to the EAC (ABET 2017a) and ETAC (ABET 2017b) criteria for 2019-20 (approved in 2017), indicating standards education continues to be a priority for future graduates of engineering and technology programs.

Additionally, employers expect new graduates to be familiar with finding and applying standards upon hire. In a survey of employers, Harding and Mcpherson (2010) found that 58% of respondents “agree that there is a need for engineers who possess the fundamentals of standards development and the knowledge to find and apply standards prior to employment.” Likewise, both Jeffryes and Lafferty (2012) and Napp (2017) found that

engineers (co-op students and professionals, respectively) reported needing to use standards in their on-the-job experiences more frequently than any other resource type.

Given the continued emphasis placed by ABET and industry on the importance of standards education for engineering and technology graduates, it is clear that academic libraries need to plan for the future of their standards collections. To lay a foundation for this topic, this paper first provides a brief history of standards development in the United States and standards collections development in academic libraries. Next, the author discusses the uniqueness and challenges of standards collections compared to other resources, and shares a case where Purdue University Libraries received federal funding from the National Institute of Standards and Technology (NIST) to develop openly available curricular materials to promote the integration of standards collections into engineering and technology undergraduate programs. Lastly, the author discusses considerations for the next generation of academic libraries standards collections.

STANDARDS DEVELOPMENT IN THE UNITED STATES

In the United States formal standards development began the early 1900's, largely in response to needs for standardization in the railroad and manufacturing industries during the late nineteenth century (Russell 2005). In 1901, the United States Congress approved the formation of the National Bureau of Standards (NBS) as a national laboratory for domestic measurement standardization. The NBS was renamed the National Institute of Standards and Technology (NIST) in 1988 (NIST 2001) and continues to operate today. Also in the early 1900's, many engineering societies (e.g., American Society of Civil Engineers (ASCE), the American Society of Mechanical Engineers (ASME)) were formed to meet industry needs for professional development, communication, and standards development. In 1918 five

engineering societies, along with the U. S. Departments of Commerce, Navy, and War, came to together to found the American Engineering Standards Committee (AESC) (Russell 2005), as “an impartial national body to coordinate standards development, approve national consensus standards, and halt user confusion on acceptability” (ANSI 2018a). AESC was reorganized and renamed numerous times and became known by its current name, the American National Standards Institute (ANSI), in 1969 (ANSI 2018a). ANSI continues to operate as a private, non-profit organization, coordinating domestic voluntary consensus standards development and representing the United States to two international standards organizations (ISO and the International Electrotechnical Commission (IEC)) (ANSI 2018b). According to ANSI, “in the U.S. today there are hundreds of “traditional” standards developing organizations [SDOs] - with the 20 largest SDOs producing 90% of the standards - and hundreds more “non-traditional” standards development bodies, such as consortia.”

STANDARDS COLLECTIONS IN ACADEMIC LIBRARIES

Standards collections have largely been associated with academic engineering libraries, despite having connections to many other disciplines, including business, economics, and law. Engineering subject libraries began emerging at academic institutions in the United States in the early 20th century (White 2016). Early engineering library literature discusses collecting textbooks (White 2016), books, and periodicals, with periodicals emerging as a preferred source for engineers due to the currency of information on scientific and technological developments (Hyde 1948). While it’s not clear if standards were part of the library’s collections, Budington (1951) describes teaching a for-credit library course to engineering undergraduates at Columbia University that included standards as a topic. Additionally,

Dowell (2005) discusses how Iowa State University began documenting the acquisition of standards in 1950 and formally obtained a subscription to ANSI approved standards in 1982.

Musser (1990) wrote one of the earliest articles dedicated to standards collections in academic libraries, discussing the general importance of standards and the challenges of trying to build a standards collection, many of which still exist today, including high costs, the vast numbers of standards in existence, and the lack of a comprehensive index to the standards literature. Additionally, Musser (1990) highlighted the *Union List of Technical Reports, Standards, and Patents in Engineering Libraries*, an American Society of Engineering Education (ASEE) Engineering Libraries Division (ELD) publication that contained lists of member library holdings materials that were difficult to find to facilitate inter-library lending (Byers 1986). According to OCLC Worldcat, four editions of the Union List were published from 1986-1999. Since Musser's (1990) article, several case studies have been published describing various aspects of standards collections at individual institutions (Taylor 1999; Matylonek and Peasley 2001; Melgoza 2002; Papin-Ramcharan, Dolland, and Dawe 2011; Murphy, Strong, and Sewerin 2011; Kozak 2014; Dunn and Xie 2017). Additionally, both Pellack (2005) and Matthews (2006) conducted surveys of academic libraries standards collection practices, with Pellack focusing mainly on ARL libraries with an engineering collection and Matthews on libraries of top engineering schools, as ranked by America's Best Graduate Schools in 2004. Matthews' (2006) work also involved reviewing library websites for standards user guides and policies, as well as investigating librarian responses to a reference question about standards.

CHALLENGES OF STANDARDS COLLECTIONS

Reviewing the literature on standards collections makes it apparent standards are unique resources and impose significant discovery and access challenges for academic libraries.

With regard to discovery, Musser (1990) described the vast numbers of standards in existence and the lack of a comprehensive index to the standards literature as challenges. Thompson (2001) noted in November 2000 that 14,650 ANSI approved standards and 12,524 ISO standards were in effect. Today, ANSI reports 22% fewer approved standards (11,500 ((ANSI 2018b)), but ISO reports on its website (as of September 24, 2018) 22,336 standards, an increase of 78%. Additionally, one standards aggregator website, ANSI Webstore, reports over 540,000 U.S. and international standards available from over 140 publishers (as of September 24, 2018), which includes some historical documents, redline versions, and equivalent standards issued by different SDOs. Another complication, many times there are competing or overlapping standards in existence, making it challenging to identify which standards are the most applicable for a library's collection or a patron's need. For example, Witherell and Lu (2017) describe how between 2014-2016 seven SDO's had committees focusing on additive manufacturing (also described as "3D printing") standards, creating a potential for redundant and dissonant publications.

Indexing for standards has improved over time, but indexing practices still pose challenges for library collections. The International Classification for Standards (ICS) is a comprehensive standards index developed by ISO in the early 1990's, now in its seventh edition. It is "intended to serve as a structure for catalogues of international, regional and national standards and other normative documents...(ISO 2015)." ICS use in standards databases and search engines is sporadic. Some databases with standards content, including IEEEExplore and IHS Engineering Workbench, use ICS indexing; however, many databases

do not. Even databases that use ICS indexing do not necessarily do so for all of the standards content in their databases. Most freely available standards search engines do not use this index.

Another issue with standards discovery in academic libraries is cataloging practices. Item records for individual standards are not available from typical sources, like OCLC (Erdmann 2010). Series records are available for some groups of print standards, such as those published in the *Annual Book of ASTM Standards*. As a result, many libraries opt to not catalog individual standards and develop alternative databases listing the standards in their print collections, which are not tied to library catalogs, but provide for precise standards discovery by users (Erdmann 2010; Kozak 2014).

To improve standards discovery and access for users, many libraries have moved at least portions of their collections online. For simplicity, many obtain full or customized collections of standards from aggregator services, namely IHS and TechStreet. It is widely known that obtaining collections from aggregators often results in higher prices than subscribing directly to publisher platforms, but aggregators streamline access for users in having to go to fewer places to locate a library's standards collections. Additionally, aggregators offer librarian mediated and user direct on-demand purchasing of standards, which can provide nearly instantaneous access for users needing standards outside of their library's standing subscriptions. Standards aggregator platforms currently do not work with link resolver technology, complicating access to standards that users may "discover" through aggregators, but their libraries subscribe through individual vendor platforms. Engineering Village recently announced on its blog that its database Compendex, which is compatible with link resolver technology to publisher collections, now indexes ASTM and IEEE standards.

This is a significant improvement to standards discovery and access for libraries that subscribe to both Compendex, through the Engineering Village platform, and the individual ASTM and IEEE standards publisher collections.

It is well established in the literature that developing standards collections in academic libraries is challenging from a cost perspective (Musser 1990; Schlembach 2000; Melgoza 2002; Pellack 2005; Murphy, Strong, and Sewerin 2011; Dunn and Xie 2017). Dunn and Xie (2017) describe how a working group, comprised of several librarians, is dedicated solely to evaluating and making decisions about standards collection development, suggesting how complex standards collections can be compared to other resource types. Standards are publications that are updated frequently with revisions. As users often need the “latest” version, this can lead to libraries purchasing multiple copies of different versions of standards in short time spans. To minimize costs, many libraries have adopted hybrid collection models, where they obtain subscriptions to some frequently used collections electronically, and purchase additional individual standards when needed outside of these subscriptions, either electronically or in print. With purchasing electronic standards, librarians must consider how many users need access to the standard. Most often .pdf copies of standards are licensed for a single user only and may even have digital rights management (DRM) restrictions that require a special plug-in to open the document and prevent it from being shared with other users. Libraries that utilize standards aggregators can evaluate the cost-effectiveness of adding single standards to their platforms to allow multiple users at the institution access to individually purchased standards.

In the past, interlibrary loan (ILL) was considered a good option for obtaining standards not owned in library collections (Musser 1990). However, over time ILL has

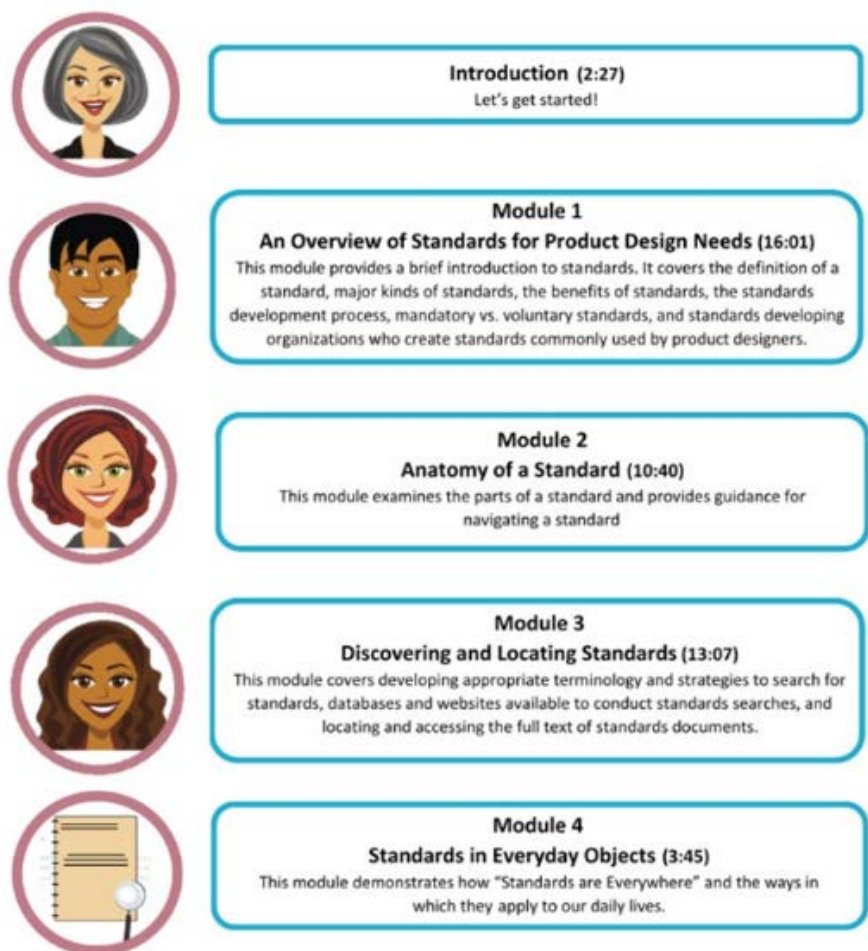
become a much less feasible option for standards access. Similar to other resources types, with the increasing shift to electronic access, libraries are often not permitted to lend standards to other libraries. Additionally, copyright restrictions may limit libraries to only being able to loan portions of print standards. Although it is widely known ILL is not often a successful option, many libraries still try this method, especially for older standards.

CASE STUDY OF STANDARDS EDUCATION INTEGRATION

Despite the challenges, many academic libraries value the importance of standards collections and strive to not only provide access, but to actively work to integrate standards collections into engineering and technology curricula (Phillips and McPherson 2016; Leachman and Pezeshki 2015). In collaboration with a mechanical engineering technology faculty member and a librarian colleague, the author received federal funding from NIST (award #70NANB16H261) to develop open educational resources (OERs) to foster the integration of standards education into engineering and technology undergraduate programs (Phillips, Fosmire, and McPherson 2018). To inform the development of the materials, the researchers first consulted the literature on standards and standardization, finding books by Thompson (2011) and Hunter (2009) particularly useful. Additionally, the researchers conducted stakeholder interviews with five faculty members (two engineering librarians, two engineering technology professors, and one engineering professor) who work with standards in the classroom to gain insights about where they see students struggle with standards, and what content is most valuable to include in an introductory standards program for undergraduate engineering and technology students.

The standards OER materials, which are available to view and download at: https://guides.lib.purdue.edu/NIST_standards, consist of a set of four interactive tutorial

modules (see Figure 1), a database of student produced standards case studies, and a badging system, complete with integrated assignments and assessments that allow students to earn and display micro-credentials of their standards competence to potential employers. The badges are compliant with the Open Badge Initiative (OBI) and can be displayed on websites and through various platforms, such as LinkedIn and Facebook, where potential employers can link to view the work the student completed to earn the micro-credential.



Viewing Note: If you have trouble viewing any of the modules please try another browser or clearing your cache and browser history.

Figure 1: OER Tutorial Modules

The OER materials are currently being integrated into a required undergraduate mechanical engineering technology (MET) course at Purdue University that is taken by approximately 200-300 students per year. Additionally, the researchers have conducted three workshops for 79 librarians and engineering and technology educators at more than 35 different institutions to promote standards education and use of the OER materials.

To initially assess the modules, the researchers surveyed the workshop attendees and conducted a usability study with engineering and technology students. Overall, the results indicate the modules cover valuable content, and are engaging and easy to navigate. The researchers are in the process of implementing minor improvements based upon workshop attendee and student feedback. Additionally, the researchers plan to assess students' standards knowledge and abilities to identify and locate relevant standards pre and post intervention by examining student performance on assignments in the MET course. By reviewing student bibliographies for open-ended design projects in this course, and other courses students take later in the MET program, the authors will gain valuable insight into the frequency and types of standards used to inform collection development.

FUTURE CONSIDERATIONS

The future of technical standards collections in academic libraries will continue to be challenging in many respects, but also has the potential to be exciting and value-added for both librarians and library users.

Access to formally published standards will continue to be costly and complicated and require librarians to consider carefully the options available to make the best choices for their libraries and users. DRM restrictions, which are in place now on many electronic standards, may become more widespread and extend further than standards in .pdf format (Petosa 2013).

There is discussion in the standardization community to move beyond the .pdf to make standards themselves more interoperable, and enable conceptual linking between referenced and related documents, to lessen the burden on standards users. At times, users may need to access hundreds of related and inter-connected standards for their work (Saunders 2018). These advances will likely lead to further cost increases and complicate collections decisions for academic librarians.

Librarians and other academics need to voice their concerns to vendors about costs and access and discovery limitations. One improvement standards aggregators could implement is to index their content with the various discovery layers and other link resolver products to enable libraries to provide streamlined access to full text content. Additionally, while many standards publishers provide free or low-cost access to standards for educational purposes (Phillips and Huber 2017), many providers do not. Advocacy is needed to encourage providers to offer more affordable educational pricing for standards. This would be mutually beneficial, as recent graduates are more likely to request their employers to subscribe to products they utilized and found valuable during their academic programs. This would also enable more libraries that support ABET accredited engineering and technology programs to be able to provide standards for their users.

Pellack (2005) and Matthews' (2006) surveys of academic libraries standards collection practices focused largely on ARL libraries with an engineering collection and libraries of top engineering schools (as ranked by America's Best Graduate Schools in 2004), respectively. Combined, they received responses from 93 libraries, of which there is likely some overlap. As Erdmann (2010) notes, the responses to these surveys are not representative of libraries at smaller institutions that primarily support undergraduate programs. According

to data extracted from the ABET website (as of September 28, 2018), there are currently 561 institutions in the United States that offer academic programs accredited by either ABET EAC or ABET ETAC. It is reasonable to assume that if ARL and libraries at top engineering schools have budget challenges with providing standards for users; libraries at smaller institutions have even greater struggles. More research is needed to gain wider, current understandings of academic libraries' standards collections practices and challenges.

One future trend in standards development that is beneficial to all academic libraries, from a cost perspective, is the move towards increased use of “de facto” standards (Katusic et al. 2017), which are often openly available on the developer’s website. Formal “de jure” standards can take significant time to develop. According to ISO’s website (as of September 28, 2018), it typically takes three years for a standard to be created. In today’s world, with technology changing rapidly, standards are often needed more quickly than the formal “de jure” process allows. Companies and standards consortia can move faster to develop “de facto” standards at the point of need, which can complement the “de jure” process (Katusic et al. 2017). However, “de facto” standards can pose challenges for discovery, since they are not included in aggregator indexes. This calls for academic liaison librarians to stay current with standardization happenings in their disciplines.

Librarians can keep up with standards news in many ways, including monitoring headlines, social media posts, and freely available publications from ANSI, ISO, and the individual SDO’s most relevant to their disciplines, and by joining SES – the Society for Standards Professionals. SES is a professional society that has members from government, industry, and academia interested in the topics of standardization and conformity assessment. The society holds an annual conference, offers many webinars on current topics, and

publishes a monthly journal, titled *Standards Engineering*, which regularly includes case studies of standards integrations into undergraduate and graduate curricula. Additionally, librarians can subscribe to the International Cooperation for Education about Standardization (ICES) mailing list. ICES is an international standards education organization that also holds annual meetings, occasionally jointly with SES.

Concerning standards education, going into the future academic librarians are well positioned to be leaders on their campuses with standards curricula integrations. Although standards education is required by ABET (ABET 2017a; ABET 2017b) and industry expects graduates to have standards knowledge and experience upon hire (Harding and McPherson 2010), standards are still not well integrated into all engineering and engineering technology programs. Khan, Karim, and McClain's (2013) survey of engineering and engineering technology faculty members found that nearly 30% of respondents do not teach standards and regulations, and 34% report that senior design students in their programs do not incorporate standards into their projects. As for reasons why, their survey reported 49% of respondents indicated “lack of faculty expertise on application of standards” and 42% “lack of access to technical standards documents” as barriers. Librarians can propose solutions to these obstacles. Regarding costs, librarians can promote the use of relevant “de facto” standards that are freely available, as well as free and low cost options for obtaining standards for educational use (Phillips and Huber 2017). Concerning expertise, librarians can connect faculty to openly available standards resources (Phillips and Huber 2017, Phillips, Fosmire, and McPherson 2018), as well as case studies and relevant literature focused on other academics in their disciplines integrating standards into curricula. Librarians can also develop standards lesson plans that align with the *ACRL Framework for Information Literacy for*

Higher Education (ACRL 2016), in areas such as “searching as strategic exploration,” “information creation as a process,” and “information has value,” to better prepare students for the workplace, where they will need to locate and use standards, and potentially participate in the standards creation process.

The future of standards in academic libraries is challenging and exciting. Traditionally, it has been engineering librarians associated with standards collections, even though their applications extend across many disciplines (Katusic et al. 2017). To expand the role of standards in libraries and truly become campus leaders in standards integration, engineering librarians need to engage librarians from other disciplines, notably business, since standards have significant impacts on company decision-making and operations. As a result, students from many disciplines will be better prepared to enter the workforce.

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