Wikidata and Libraries: Facilitating Open Knowledge

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Introduction

Libraries and archives are increasingly embracing the value of contributing information to open knowledge projects. Users come to Wikipedia—one of the best-known open knowledge projects—to learn about a specific topic or for quick fact checking. Even more serious researchers use it as a starting point for finding links to external resources related to their topic of interest. Wikipedia is just one of the many projects under the umbrella of the Wikimedia Foundation, a nonprofit charitable organization. Wikidata, for its part, is a sister project to Wikipedia. It stores structured data that is then fed back to the other Wiki projects, including Wikipedia, thus providing users with the most up-to-date information.

This chapter focuses on Wikidata and its potential uses for libraries. We hope to inspire information professionals (librarians, archivists, library practitioners) to take the next step and start a conversation with their institutions and colleagues to free their data by contributing it to an open knowledge base like Wikidata.

What is Wikidata?

Wikidata is the newest project of the Wikimedia Foundation, launched on October 29, 2012 (Wikidata, 2017). It is a free knowledge base that can be read and edited by both humans and machines. Wikidata runs on an instance of MediaWiki, the software used to run all Wikimedia projects, which means that its content can be collaboratively added, modified, or deleted ("Wikidata:Glossary," 2017).

Wikidata was conceived as a means of addressing the need for a centralized repository to store structured and linked data. Having a central repository allows information to be updated in one place; all other Wikimedia projects that have decided to connect to Wikidata are updated automatically. Currently, there are 285 active language Wikipedias (such as the English Wikipedia, Spanish Wikipedia, German Wikipedia, and so on), which are all individual encyclopedias ("List of Wikipedias," 2017). Before Wikidata was created, there was not an easy way to update data across the different language Wikipedias. Changes made by editors to the structured data of one Wikipedia needed to be manually made in all other Wikipedias, which proved cumbersome. Now editors are able to make these changes in Wikidata, allowing all Wikimedia projects to use that structured data. For instance, Wikipedias can make use of Wikidata's data to maintain their infoboxes[1] with the most up-to-date information. Another advantage of using Wikidata's data to power infoboxes is that information will be displayed consistently across all language Wikipedias. An example of an article in the English Wikipedia that makes use of Wikidata's structured data to populate its infobox is the page for the South Pole Telescope. In its infobox, there is a pencil-like icon displaying next to some of the entries. When a user hovers over this icon, it shows a message suggesting that if changes need to be made, they should be made in Wikidata (see Figure 1). Once the icon is clicked, the Wikidata item opens up for the user to edit. Changes made in Wikidata would then be reflected not only in
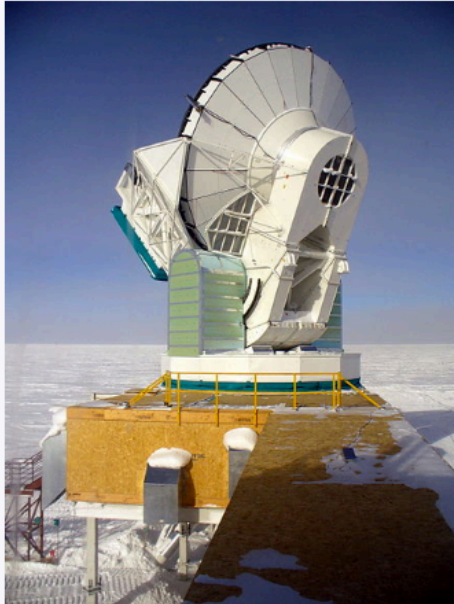
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[1] Infoboxes are templates that contain structured metadata about the subject being described. It usually displays on the right-hand side of a Wikipedia article for languages that read from left to right.

the English Wikipedia for this article, but also in any other language Wikipedia that is connected to the knowledge base.

Wikipedias that do not make use of Wikidata's structured data are missing the opportunity to access and display the most recent data available for a specific subject. For instance, by looking at the South Pole Telescope page in the Spanish Wikipedia (see Figure 2), we can begin to see noticeable differences in terms of content compared to its English counterpart since the Spanish version does not yet harness the power of Wikidata. Being able to access consistent structured and linked data in Wikidata provides humans and machines with the ability to traverse information and, programmatically, retrieve relevant pieces of information that often contain links to other data sources (Bartov, 2017).

South Pole Telescope

The South Pole Telescope in November 2009

Named after	South Pole
Observatory	Amundsen–Scott South Pole Station
Location(s)	Amundsen–Scott South Pole Station, Antarctica
Coordinates	90°S 0°E
Altitude	2.8 km (9,200 ft) [1]
Built	November 2006– February 2007[2]
First light	16 February 2007
Telescope style	Gregorian telescope
	Edit this on Wikidata
Diameter	10.0 m (32 ft 10 in)[3]
Secondary diameter	1 m (3 ft 3 in)
Mass	280 t (280,000 kg) [1]
Angular resolution	1 minute of arc
Collecting area	78.5 m^2 (845 sq ft)
Mounting	Altazimuth mount
Website	pole.uchicago.edu

Figure 1. Screenshot of the South Pole Telescope infobox in the English Wikipedia.

Telescopio del Polo Sur	
Organización	Universidad de Chicago Universidad de California en Berkeley Case Western Reserve University Universidad de Illinois en Urbana-Champaign Smithsonian Astrophysical Observatory Universidad de Colorado en Boulder Universidad McGill Financiado por la National Science Foundation
Ubicación	Base Amundsen-Scott, Polo Sur
Coordenadas	🌐 90°S 0°E
Fecha de construcción	entre 2006 y 2007
Primera observación	marzo de 2007
Diámetro	10 m
Sitio web	SPT en la Universidad de Chicago⬚

Figure 2. Screenshot of the South Pole Telescope infobox in the Spanish Wikipedia.

Wikidata data model

Wikidata contains a collection of entities, which are "the basic elements of the knowledge base" and which can be either properties or items ("Wikibase/DataModel/Primer," 2017). All properties and items have their individual namespaces and their own Wikidata page with their respective label, description, and aliases in different languages. The label is the actual name that aids in identifying an entity. The meaning of the label can be clarified further in the description field. For instance, if we search for "Havana" in Wikidata we get multiple items matching our search: entries for the capital city in Cuba, cities in Mason County, Illinois and Gadsden County, Florida, an entry for a romantic movie, among others. Because of the information entered in the description, we are able to quickly disambiguate these entries that have the same label ("Wikidata:Glossary," 2017). In the same way that we can have multiple items with the same label, we can also have more than one item with the same description, since descriptions do not necessarily have to be unique. However, there cannot be more than one item with the same combination of label and description. Items in Wikidata are the equivalent of a Wikipedia article in that they contain data about a single concept. It is also useful to list under aliases all alternative names by which an entity is known. This is helpful in cases where a search is made for a name that is not the one assigned to the label. For instance, the item Q65, with the label "Los Angeles," has the following aliases: L.A., LA, Pink City, The town of Our Lady the Queen of the Angels of the Little Portion, and Los Angeles, California. Having this additional information added to entities facilitates discoverability.

All properties and items are assigned unique identifiers, which are formed using the letter P for properties and Q for items, followed by a sequential number. For instance, building on the previous example of Havana, the capital city of Cuba, we have Q1563 as the unique identifier for

its item, while property P1082 is used to record its population. Due to the multilingual nature of Wikidata, having a unique identifier is needed to differentiate entries, since names are not unique and can change over time. Having a canonical identifier assigned to an item means that regardless of whether there are multiple items with the same name or whether the name changes, the integrity and uniqueness of the item will remain intact.

Properties are similar to cataloging/metadata fields in that they are used to better record metadata values. The Wikidata community has the ability to propose properties, which are documented on the property proposal page ("Wikidata:Property proposal," 2017). Proposals receive open discussion and debate within the Wikidata community. After discussion, the community votes. If the majority agrees to include the property, it is added to the knowledge base. Once included, it can be used with any item in Wikidata.

Items can contain statements to describe a concept in more detail. There can be multiple statements for both items and properties. The main part of a statement is a property-value pair. Statements can also contain qualifiers and references. For instance, as seen on Figure 3, the English writer Douglas Adams has the property *educated at* (P69), and its value is *St John's College* (Q691283). We can then enrich statements with the use of qualifiers. Qualifiers also contain a property-value pair and are used to refine metadata values ("Wikibase/DataModel/Primer," 2017). Looking again at Figure 3, we can tell the period of time when Douglas Adams attended college (*start time: 1971, end time: 1974*) as well as his academic major (*English literature)* and academic degree (*Bachelor of Arts)*. Each statement can be supported by a reference to indicate where a particular claim was made, when the source was published and retrieved, its language, URL, and so on. A reference can include anything from websites and scientific papers to datasets.
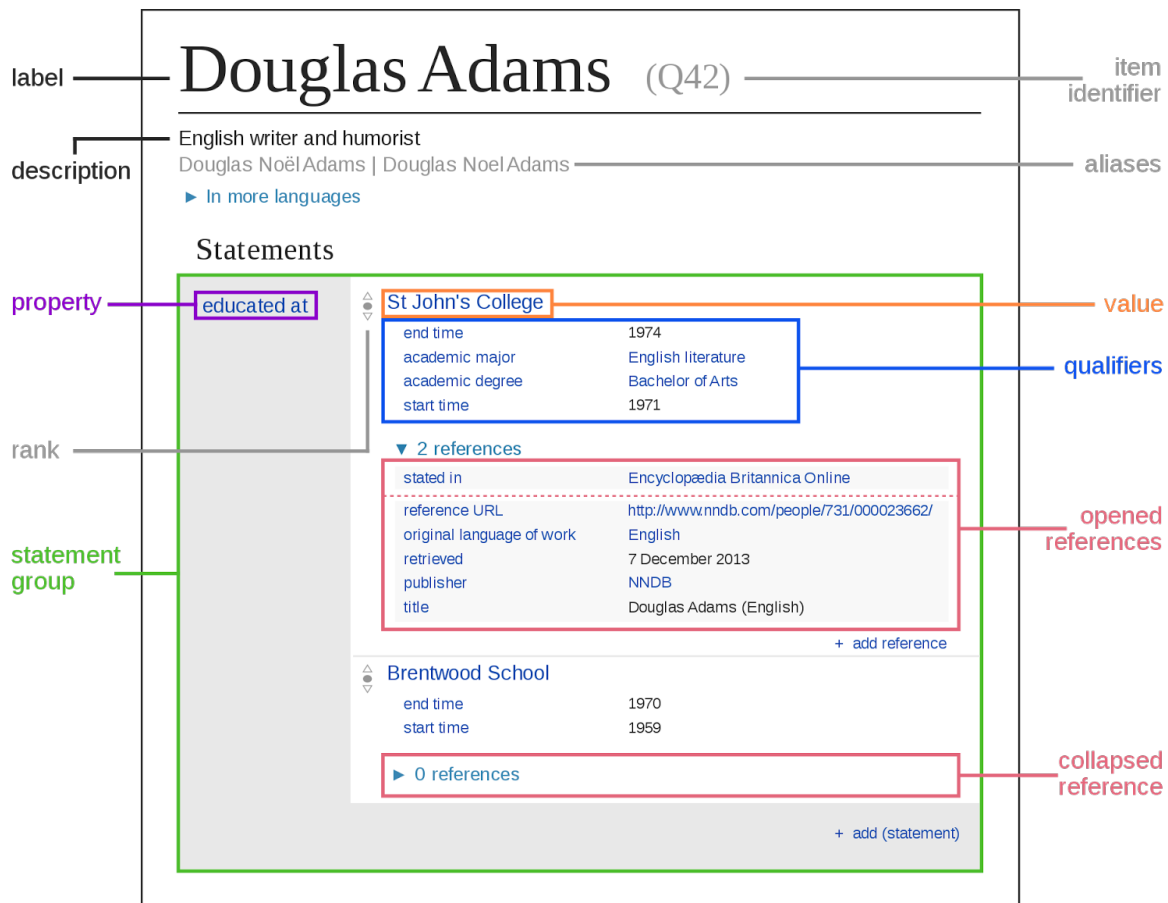
Figure 3. Data model in Wikidata by Charlie Kritschmar (WMDE) (Own work) [CC0], via Wikimedia Commons.

Use of external identifiers

Wikidata also allows for the integration of external identifiers. These identifiers, which were created and reside in outside sources, are reconciled in Wikidata. There are currently 1,746 external identifiers in Wikidata, some of which are familiar to the library community because information professionals have direct involvement in facilitating the creation of their corresponding authority/archival records. These include the Virtual International Authority File (VIAF ID: P214), Library of Congress Control Number (LC/NACO Authority File ID: P244), and the recently added Social Networks and Archival Context ID (P3430). Adding these external

identifiers to Wikidata items provides links that point to another set of data residing elsewhere, which aids in establishing connections and providing additional information about the items.

Contributors & contributions

Wikidata's content is represented in over 300 languages. The Wikidata community plays an important role in the contribution of data to the knowledge base, as reflected in Table 1. Wikidata has over 2.8 million registered contributors, of which only about 18,000 are active contributors (an active contributor is one who has had some activity in the last 30 days). The Wikidata community is also involved in the creation and use of tools and bots to make actionable edits to Wikidata. The statistics in this table reflect the dedication and commitment of the community to making Wikidata a successful project.

Registered contributors	~2,8 Million
Active contributors	~18,000
Languages represented	over 300
Items	over 26 Million
Labels	over 140 Million
Aliases	over 14 Million
Descriptions	over 210 Million
Properties	3475
Statements	~158 Million
Page edits	~512 Million

Table 1. Wikidata statistics.

What makes Wikidata special?

As a free collaborative knowledge base, Wikidata is evolving with its community members and their needs. The global community creates, edits, and maintains the structured data in Wikidata. One can access, copy, modify, and/or distribute all the content of Wikidata because its data is published under the Creative Commons Public Domain Dedication 1.0, which allows free use ("Wikidata:Data access," 2017). The community also contributes to the creation of documentation that serves as a guide for prospective contributors.

Wikidata was conceived as a central place where data created by people from different cultures and languages can coexist. It is designed to deal with the complexity of the world that we live in. This means that it accommodates multiple, even conflicting, data points about a topic, which eliminates the need for contributors to be in agreement with the contributed information. These contributions can then be qualified with additional information to specify, for example, where a certain belief is held. All of these qualifying statements can be supplemented with references. The references, in turn, provide users with information that indicates where the data is coming from—a valuable feature for deciding which data point to employ for their use case.

Wikidata also recognizes that those who do not speak or read English have access to limited information online compared to those who are fluent in English. Wikidata provides all of its data in hundreds of languages, all in a single site. This means that its editors work on the same data regardless of their language expertise, which benefits those who speak and read less well-represented languages. This also facilitates making changes to a smaller Wikipedia (which usually have smaller communities of contributors) more quickly and effectively, and ensures that information is accurate across all Wikipedias connected to Wikidata. Although Wikidata has not been in existence for long, it has already shown tremendous potential for storing high-quality and

reliable information. This is due, in part, to the multilingual nature of the knowledge base and the fact that information is stored in one central location for everyone to access, enhance, and validate. Being transparent about sources of information and providing reliable data is important because it demonstrates the viability of the knowledge base.

Wikidata and libraries

Why should libraries get involved with Wikidata?

Anyone can contribute to Wikidata, but why is it important for information professionals to use their expertise to contribute to a project like Wikidata? In the library community, we collect, describe, organize, preserve, and provide access to physical and digital materials. Information professionals have long created and contributed authority records to help disambiguate personal, corporate, and jurisdictional names by providing a standardized form for them. For example, in the United States, authority file contributions are made through the Name Authority Cooperative (NACO) program, which allows institutions to either contribute directly to the Library of Congress Name Authority File (LCNAF) or to contribute through a NACO Funnel. As part of this work, the library community has had the opportunity to participate in the development and implementation of standards and rules used in the creation of authority files, which has led to a deep appreciation and understanding of the value of creating structured metadata.

A partnership between library institutions and Wikidata seems appropriate given that we have a common interest in documenting and preserving our heritage and history, and providing access to knowledge. The library community can make a significant impact in improving the reliability and augmenting the size of this knowledge base, as well as enhancing the quality of the data already contributed to it. Additionally, information professionals have the experience and

necessary skills to join efforts in exploring how to model FRBR (Functional Requirements for Bibliographic Records)-like concepts for all types of bibliographic materials in Wikidata. For instance, both communities could collaborate in finding a solution to better represent expressions (translations) and manifestations (editions) of the works in the knowledge base. There is a critical need to address this issue in order to more accurately model resources in Wikidata; and the library community has the expertise to make a substantial and much needed contribution in this area.

Despite the fact that many libraries are able to make use and take advantage of systems like OCLC Connexion—a client that allows users to create bibliographic and authority records— there are still many institutions that are unable to do so. Even in instances where they are able to contribute bibliographic records, not all of them are NACO participants, which means that they are not able to create authority records. As an alternative, those institutions could make use of Wikidata's data to extract relevant information to be imported into their databases. Similarly, they could use Wikidata as a solution for creating authority records for underrepresented creators and organizations. It would be useful for the library community to actively participate in the development and documentation of the Wikidata knowledge base because there is much potential for future use and information integration.

Library implementation: use cases

Libraries are starting to invest time and resources in continuing to build a comprehensive Wikidata knowledge base. An example of an institution that has taken a leading role contributing to Wikidata is the National Library of Wales, which had the vision to bring a Wikidata specialist on board in 2016 as its first Wikidata Visiting Scholar ("Our Wikidata visiting scholar," 2016). The visiting scholar has been working with metadata from the Welsh Landscape Collection as

part of the Linking Landscapes project. The idea behind this project is to provide a presence in Wikidata for all the prints in the collection and to explore opportunities for future work with the structured data ("Life and times," 2016). Another institution that has been actively contributing to Wikidata is the Department of Digital Preservation at Yale University Library. They hired a CLIR (Council on Library and Information Resources) Postdoctoral Fellow in Data Curation to focus on digital preservation for software curation. As part of this project, they are building a "digital preservation model in Wikidata" to be able to describe the software available in their library's collection. For instance, they have been adding statements for items related to digital preservation and proposing properties to be able to describe file formats, hardware, emulated environments, etc. (Thornton & Cochrane, 2016). These two examples demonstrate that there is interest in our community to not only contribute data to the knowledge base, but also to participate in the development of models to be able to more accurately describe and represent artifacts and materials in Wikidata.

How to access and retrieve Wikidata's data?

All the data stored in Wikidata can be easily accessed using the Wikidata application programming interface (API). Another way to access the data is by querying it. Wikidata offers the Wikidata Query Service (https://query.wikidata.org/), which is powered by SPARQL, an RDF query language for triplestores. Using the SPARQL endpoint, users are able to query using a combination of triples to obtain everything that Wikidata knows about a subject ("Wikidata:Data access," 2017). The SPARQL endpoint is currently receiving over 7 million requests per day. The Wikidata Query Service offers a list of examples that can be used and modified as needed. For instance, one of the examples allow users to run a complex query to find out which American universities were founded before the states where they are located in were

created (see Figure 4). This query asks Wikidata to retrieve only 10 results. The limit can be adjusted as needed.

```
1  #American universities founded before the states they reside in were created
2  #added before 2016-10
3    SELECT ?uLabel ?founded ?stateLabel ?stateStart
4  WHERE
5  {
6      ?u wdt:P31/wdt:P279* wd:Q3918 .
7      ?u wdt:P131+ ?state .
8      ?state wdt:P31 wd:Q35657 .
9      ?state wdt:P571 ?stateStart .
10     ?u wdt:P571 ?founded .
11     FILTER (?founded < ?stateStart) .
12     SERVICE wikibase:label {
13         bd:serviceParam wikibase:language "en" .
14     }
15 }
16 LIMIT 10
```

Figure 4. SPARQL query from the Wikidata Query Service.

The resulting data provides the names of the universities, the dates when they were founded, the names of the states and the dates when the states were created (see Figure 5). These are the kinds of questions that we can ask Wikidata and expect to get results. The resulting data can be downloaded in various formats, including XML, JSON, TSV, and CSV. The completeness and accuracy of the results depend on the data that is stored in Wikidata, which is why it is so imperative to contribute to the knowledge base.

uLabel	founded	stateLabel	stateStart
University of Utah	Jan 1, 1850	Utah	Jan 4, 1896
University of Hawaii	Jan 1, 1907	Hawaii	Aug 21, 1959
University of Minnesota	Jan 1, 1851	Minnesota	May 11, 1858
Brigham Young University	Jan 1, 1875	Utah	Jan 4, 1896
University of Denver	Jan 1, 1864	Colorado	Aug 1, 1876
Transylvania University	Jan 1, 1780	Kentucky	Jun 1, 1792
Utah State University	Jan 1, 1888	Utah	Jan 4, 1896
New Mexico Institute of Mining and Technology	Jan 1, 1889	New Mexico	Jan 6, 1912
Carroll University	Jan 1, 1846	Wisconsin	May 29, 1848
University of Delaware	Jan 1, 1743	Delaware	Dec 7, 1787

Figure 5. Query results from the Wikidata Query Service.

How can information professionals contribute to Wikidata?

The first step toward contributing to Wikidata is to set up an account. Users that have an account from other Wikimedia projects can use it to contribute data to Wikidata. In cases where an account needs to be created, a pseudonym can be used as username if that is the user's preference. However, users should not include information that describes their institution because accounts are meant to be personal. Being registered with Wikidata ensures that edits are made under the user's account. Otherwise, edits are recorded under the user's IP address and that information is made publicly available. When contributing to Wikidata as part of one's job, it is recommended to add a conflict of interest statement to one's User Page to indicate any institutional affiliation. New users will benefit from consulting Wikidata's interactive tutorials to become familiar with the knowledge base ("Wikidata:Tours," 2017). An important aspect of contributing data to Wikidata is to determine the "notability" of a subject. One of the criteria that Wikidata requires for entries to be considered notable is to have one sitelink from any other Wikimedia project, such as Wikipedia, Wikivoyage, Wikisource, Wikibooks, etc. added to the items ("Wikidata:Notability," 2017).

A Wikidata entry features all information pertaining to a specific entity, a history page, and a discussion page for communicating about issues related to the entry. On the history page, users are able to see when an edit was made (specific date and time), the username of the user who made the edit, and the size (in bytes) of the contribution. Because changes are always recorded, they can be reverted to a previous version, if needed.

Information professionals can make a significant impact in shaping Wikidata. One way in which they can contribute to Wikidata is by adding references to statements. There has been a strong interest in bridging the citation gap in Wikipedia as part of the #1lib1ref global campaign. Since it first launched last year, libraries around the world have recognized the importance of backing up statements in Wikipedia with reliable sources and have actively participated in this effort as shown in the Wikipedia social search page.[2] With the support of library institutions, a similar campaign could be devised to address citation gaps in Wikidata. Of equal importance is to get involved with initiatives like WikiCite, which is aiming to build a repository of sources from all applicable Wiki projects to store them in Wikidata.

Another area in which informational professionals can help is by making sure their archival collections are represented in the Wikidata knowledge base. Once that is done, it would also be useful to have those collections attributed to the institution that holds them. For instance, Wikidata has property P485 labeled as *archives at*, which is used to indicate the name of the institution that holds an archival collection. Until 2014, this property (P485) was one of the least

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[2]The Wikidata social search page (http://tools.wmflabs.org/hashtags/search/1lib1ref) allows users to search for hashtags present in Wikipedia edit summaries and displays specific information about the contributions

used in Wikidata, with only 133 uses (Vrandecić & Krötzsch, 2014). However, as of June 2017, it has already been used 5,063 times showing a steady increase in usage ("Property talk:P485," 2017). Inputting values in this field would allow for a more accurate representation of institutional archival holdings, and libraries and archives are well positioned to continue carrying out this task. It could be accomplished by either contributing data via manual editing (one item at a time) or through the use of tools or bots (to make repetitive tasks without human intervention). Wikidata editors can submit bot requests if there are none already available for the specific task they want to accomplish. A justification for the need to create a bot should be shared to provide the community with all the necessary information needed to make an informed decision ("Wikidata:Bot requests," 2017).

Information professionals can find many ways to build Wikidata, including adding value to the development, implementation and improvement of Wikidata properties, creating new items, adding references to existing items, contributing to the creation of data models, verifying the accuracy and completeness of existing data, and adding identifiers. Adding identifiers to items, some of which have been directly or indirectly created by library institutions, helps to validate and enrich the data, and facilitates connections with external sources. When libraries contribute data to the Wikidata knowledge base, they are building opportunities to ask more complex questions through the Wikidata Query Service about their collections—questions that would not otherwise be possible using a local integrated library system (ILS).

Beyond Wikidata

There are many tools, projects and applications that have been built using Wikidata's data. They have been created by the Wikidata community and are aimed at achieving very specific goals. Some are intended to aid users in reviewing and contributing data to the Wikidata knowledge

base, while others aim to provide new meaning to the data. Histropedia is one example of how the data can be used and presented in a more meaningful way. It aims to be a "new type of website" where a combination of data from Wikidata and Wikipedia is used to generate timelines. These timelines allow users to visualize history in dynamic ways, and can be used by institutions for educational purposes (Histropedia, 2014).

Another example of a tool that was built to display Wikidata's data is Reasonator. It acts as a "discovery interface" that brings together all the data available in Wikidata related to an item and includes images, audio, and maps. It can also display a timeline based on available data (Reasonator, n.d.). In contributing data to Wikidata we would not only enrich the knowledge base, but would potentially facilitate the discovery of library collections through the use of this tool and many other tools powered by Wikidata.

Another project to highlight is Inventaire. As its name suggests, it maintains an inventory of all its users' books. Inventaire draws from Wikidata and uses the Wikipedia links present in Wikidata items to build authors' biographies, which are displayed in a nicely formatted presentation. The code and data of this web application are open source. Inventaire allows users to keep an inventory of their favorite books, connect with the community, and check what materials are available to give, lend, or sell (Inventaire, n.d.). Users are able to specify their

location in order to see the availability of materials in their surroundings. Once they find materials in the area where they reside, they can be picked up in person or sometimes dropped in a box that the lender and borrower have agreed upon. This level of interaction adds a social component because users are able to meet others with similar interests. This prototype is yet another great example of what can be achieved by accessing and using open knowledge data.

A final open source application to showcase is Scholia. Scholia is hosted on the Wikimedia Tool Labs page, and its code can be found on GitHub. This application takes advantage of the richness of the data in Wikidata to effectively create and display scholarly profiles. The data is presented in what the application identifies as *aspects*, which can be an "author, work, organization, venue, series, publisher, sponsor and topic" (Nielsen, F. Å., Mietchen, D., & Willighagen, E., 2017).

Scholia has the potential to be used by library institutions because library practitioners could create profiles for notable faculty by contributing relevant personal and publication information to Wikidata. Scholia can then be used to search for an aspect, at which point the application queries Wikidata and displays all relevant information (Scholia, n.d.). Exploring the potential of giving new meaning to Wikidata's data through these web applications and tools might be useful in helping the library community to get a better sense of what can be achieved when using data from the knowledge base.

Conclusions

We encourage library institutions to embrace Wikidata as they have begun to embrace Wikipedia and to consider the benefits that a partnership would provide for both communities. Information professionals have the necessary skill set to undertake the task of contributing library and archival data to the Wikidata knowledge base. Establishing a connection between library institutions and their collections in Wikidata is just a small but crucial step in preparing the groundwork that would facilitate discovery and the potential for experimentation in current and future projects.

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