A Strategy for Integrating Printed Catalog Cards from Three Cuban Libraries into the Open Linked Data Space

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Abstract

This article summarizes the main aspects of the strategy created as the result of the project to integrate printed catalogs into Cuban digital library spaces and the internet in general. It also describes the status of the initiative and offers reflections on the relationship between the ongoing parallel development of online catalogs, digital libraries, and digital repositories of cultural patrimony, highlighting opportunities to make use of linked data techniques for these purposes.

Introduction

Since 2000 many Cuban libraries have had online catalogs covering all or most of their collections. This is thanks to two trends. The first has been the increased use of MicroIsis, a free bibliographic database software distributed by UNESCO. The computer version of CD/ISIS was introduced and promoted in Cuba and the rest of Latin America beginning in the late 1980s as the result of the support for the UNESCO Information for All Programme (Ugobono 2011). The second has been the adoption in recent years of open library software for online catalogs. However, even as recently as 2014, many or all items in the three most important Cuban libraries were still only findable using physical card catalogs. At that time, the José Martí National Library and the Central Library of the University of Havana (UH) were using physical cards for all items acquired before 1996. The Library of the Cuban History Institute was using physical cards for its entire collection. These three institutions were selected for developing a printed catalog digitization project as part of an initiative under the Directorate of Computerization of the University of Havana, under the supervision of the author of this article.

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The National Library's physical cards covered more than 50 percent of its holdings. The UH Central Library's physical cards covered more than 60 percent of its holdings. Processing all these items anew in order to create entries in an online catalog was not feasible. In the case of the National Library and the UH Central Library, this situation existed alongside the use of automated library-management systems, held bibliographic records of only a small portion of their holdings. For this reason, the work of retrospective conversion of printed catalog entries in these institutions was an ongoing, unresolved need, resulting in limitations on holdings management and duplication of functions in document management and user services. Because these institutions contain important national collections with printed bibliographic descriptions of high quality created over time, the option of proceeding with a project to recreate the catalogs was discarded. Because of the size of the collections, reprocessing them in their entirety was simply not a viable option. In addition, the volume and complexity of this task, as well as the limited resources available, had resulted in a delay of many years in the search for a solution. This background context justified the proposal of a project for developing a test system that would make use of digitization processes and the search for new strategies. The purpose was to prioritize the inclusion of this information, once digitized, into an online system.

The vision of a José Martí National Digital Library of Cuba, or Biblioteca Nacional Digital de Cuba José Martí, was conditioned in part by this reality. (See Biblioteca Nacional de Cuba "José Martí" [2013] for details about this digital library and its creation.) This justified the decision of the selected libraries, in collaboration with the Directorate of Computerization of the University of Havana, to develop a project to utilize the resources available at participating institutions to design a strategy for completing the conversion of the printed catalogs of these libraries. The project began with a review of state-of-the-art technology in this field, an evaluation of the experiences of other libraries that had developed this type of process in prior decades, an assessment of the peculiarities of the Cuban environment, and a survey of new opportunities derived from technological advances and methodologies in this field. The goals of the catalog migration project aligned with the principles used in the construction of the José Martí National Digital Library of Cuba (Biblioteca Nacional de Cuba "José Martí" 2013).

Conversion of Printed Catalogs in a New Environment

In past decades, libraries have dedicated significant efforts to the retrospective conversion of printed catalogs. This entailed migrating entire catalogs of huge institutions onto computers, mainly by typewriting the bibliographic cards and standardizing the bibliographic record for computer processing. The result was full digital bibliographic records represented

in a standard way, readable by machines. This process was closely related to the history of the Machine Readable Cataloging (MARC) system lead by the Library of Congress in the United States and other national libraries (Avram 1975). This resulted in a set of experiences, tools, and knowledge that constituted an antecedent for further effort in this direction (Chapman 1996; Harrison 1985; Hsueh 1992). However, the stage and strategies for these processes had to be adjusted to new realities that included, most significantly, the generalized use of the internet and in particular the internet as a platform for access to information, in addition to growth in the availability of standardized bibliographic data in national and international library catalogs, such as the OCLC's WorldCat and the authoritative records associated with them (Loesch 2011; Yang and Hofmann 2010).

To the above must be added the development of new focuses and techniques for data management. Particularly important is the maturity and increased use of linked data techniques by the library community and other cultural-heritage institutions (Moulaison and Million 2014). Linked data, a concept proposed by the creator of the World Wide Web, Tim Berners-Lee, is a practical approach to align web resources with the vision of a semantic web where computers can "understand" its content, using standardized metadata describing the content of those resources, thus linking them into what he calls a Giant Global Graph.

All this offers the possibility of liberating the bibliographic data from the traditional card catalog system and integrating its content to the global web of data (Alemu et al. 2012, 549). The most recent International Federation of Library Associations and Institutions (2015) guide for national bibliographies dedicates a special section to the use of linked data techniques. In addition, the OCLC and a significant group of national libraries have begun to share their bibliographic data in accordance with these guidelines. The Library of Congress of the United States has launched the BIBFRAME initiative, which involves a fundamental change in library collection cataloging strategies. This initiative recognizes linked data as an opportunity for revitalizing library functions in the internet age (Kroeger 2013, 2015, 2016; Zapounidou, Sfakakis, and Papatheodorou 2013, 2017).

Another factor to take into consideration as part of the context for the library catalog conversion processes is the appearance and development of initiatives for constructing digital libraries and digital repositories. Today, almost all countries in the Latin American and Caribbean region have developed projects of this type (Gómez-Acebo and Sánchez Nogales 2013). However, with some exceptions, there are a considerable number of partial and incomplete collections, and the heritage data continue to be disconnected and held in different collections. High-quality catalogs continue to be scarce. While the availability of digital copies of documents produced in Latin American and Caribbean countries has grown as documents have been added to shared repositories, significant collections of

treasures are held locally, with the resulting loss of cultural and historical contextual information and loss of traces of the social life reflected in these documents. This situation exists in every country and region; see, for example, Gregory and Williams (2014).

This coexists with an offensive on the part of the business sector to appropriate the benefits generated by using the information accumulated in library document holdings. This highlights the importance of these holdings, not only in scientific and cultural terms, but also as economic assets and as a platform for the development of many services (Rieger 2008). The renewed European Strategy for developing the European Library is an example of a focus on rescuing and reinforcing the proactive role of libraries and other heritage institutions for the protection of public goods of a cultural nature, and a focus on making them available for the benefit of the community (Poole, Racine, and Cousins 2014.)

The initiatives of libraries and digital repositories must be more than disconnected actions. Instead, they must form part of an articulated integration effort associated with the defense of cultural identity as a basis for better relationships between peoples and nations. One example of existing efforts to rescue, preserve, and disseminate cultural patrimony is provided by the UNESCO Memory of the World Program and its corresponding regional, subregional, and national initiatives (Abid 1995; Sloggett 2005).

Theoretical and Practical Foundations

To guide the activity of the Cuban National Digital Library initiative, an effort was made to take advantage of the knowledge gained during the retrospective conversion of printed catalogs. This was combined with an in-depth review of the available bibliography as well as interviews with experts and focus groups to identify the special characteristics of the Cuban environment, as well as practical and experience-based factors. The basic conclusion was that Cuban conditions require an adaptive strategy that considers the special characteristics of the national context.

A study of the strengths, opportunities, dangers, and weaknesses resulted in the identification of a unique situation that is marked by limited internet access, a lack of equipment and financial resources, and restrictions on access to services and international databases. These factors coexist with a legacy of systematically developed catalogs of high quality in the collections, as well as the existence of unique and rare documents, the availability of a qualified workforce, prior experience in processes of computerization, systems development, and the urgent need for new technical paradigms and possibilities so as to offer a space for innovation and learning.

As has been indicated, the catalog pilot program was incorporated into a global strategic framework for developing the Cuban National Digital

Library, in alignment with concurrent regional and global strategies along the same lines. It is also part of the process of learning while doing and building.

The catalog work was approached as a problem of integrating these resources into shared bibliographic data spaces, and not as a classic problem of retrospective conversion, which is what dominates in the literature and the accumulated practice on this topic (Malmsten 2008). Instead of conducting a process of bibliographic registry conversion in order to obtain MARC records as a direct goal, an iterative process was adopted, one that allows progressive incorporation of the data in these catalogs into the web, thus achieving their interrelationship with existing information on the web. The possibility of obtaining regularized representations of the bibliographic descriptions in MARC format, so as to incorporate them into the library-management systems of each institution, was not abandoned, but priority was given to the digitization of catalog records and their inclusion in a database so as to make them available electronically on the internet and to conduct ongoing adaptation processes using linked data techniques.

Card-image public access catalogs, or CIPACs, have been the usual approach here, as detailed by Oberhauser (2002, 2003, and 2007). CIPACs are online databases that show an image of each card alongside digitized text from each card (see fig. 1). Patrons can search a CIPAC across the internet or in the library, moving from virtual drawer to virtual drawer. The database mimics the wooden drawers that once held paper cards ordered by author, subject, or title. The purpose was the creation of virtual representations of printed catalogs by means of digital images of the entries, grouping them in a way that was nearly identical to how they might exist physically. Without changing the original organization of the catalogs, the bibliographic entries were captured and made available on the web without changing the original organization of the catalogs. Remote patrons can then use the same logic as a physical card catalog to search an online catalog. This serves many previously unreachable patrons.

CIPACs first appeared in the 1990s. They were an alternative to and sometime an interim step toward the costly process of total retrospective conversion. Today they are still the only way to consult many significant collections at a distance. A directory of CIPACs across thirty-one countries can be found at http://cipacs.vfi-online.org/. CIPACS are also image repositories. They preserve documentary memory and safeguard traces of how libraries have functioned.

Some of these catalogs, because of their unique characteristics, their age, and their level of conservation, constitute the library patrimony of the country and are a testimony to the historic evolution of technical processes and systematic institutional work, as well as to periods of abundance and scarcity, all of which are reflected in the characteristics of the entries,

Figure 1. A Record in the CIPAC Catalog of the Czech National Library. Available at https://retris.nkp.cz/.

whether imported or created locally. Interesting factors include the quality of the typeface, print clarity, the extent of notations, and other aspects that invite research within the field.

A description of the catalogs was therefore one of the initial steps in the process. These descriptions were based on on-site study of catalogs, interviews with persons responsible for them, and interviews with those associated with safeguarding the catalogs and their history. The technical, material, and sociocultural factors associated with them, as well as their importance within library collections, were considered. In the case of the National Library, management and specialized personnel within the institution decided to conduct a pilot program using the nineteenth-century Cuban collection. This selection was made due to the value of the collection and because of its relatively small size (approximately 130 drawers) as compared to the main collection (more than 700 drawers). In the case of the Central Library of the University of Havana, a decision was made to begin with the official catalog of the general collection in order to have a manageable size (92 drawers). This collection is also in a relatively good state of conservation. In the case of the History Institute, the catalog selected was the only one available that was in a good state of conservation and that was of a manageable size (50 drawers).

The CIPAC construction experience, combined with the application of cross-data techniques, was seen, therefore, as the most promising alternative, given the Cuban environment. This decision was presented to and discussed with experts as well as in workshops at the institutions involved. The decision was made to move forward with a pilot program, evaluate viability, and learn from the process.

The solution proposed involved mass digitization techniques, optical

character recognition (OCR), online annotation, and the use of natural language processing techniques. The printed catalogs were then converted into digitized objects, given their value as a record of the historic creation of bibliographic collections and as tools for advancing the connections between the bibliographic data in the collections and linked data holdings.

Results

From the beginnings of the Cuban National Digital Library project, the interventions performed focused more on developing local skill sets and have been making innovative and rational use of the resources available. These principles guided the realization of the pilot project. What follows are the actions taken that illustrate the results along these lines.

1. Library Personnel Directly Associated with the Collections Perform the Work, Supported by Others.

In the case of the pilot program, the work was performed by the personnel with the most experience in the technical processes of the library; in the case of the National Library, tasks were completed by the staff associated with the Cuban collection. Personnel from other departments, such as technology and digitization, would support the process and receive training, but the work would be controlled and led by the department responsible for the collection and its catalogs. Practical training programs were provided, and the persons associated with the three institutions were connected so as to encourage mutual support and peer training.

Specialized support was provided by experienced personnel, and oversight and quality control were central to the process. Most of the annotations, transcriptions, and textual reviews resulting from the OCR processing of the entries were performed by personnel from the participating libraries, with significant participation from the University librarians. In this case, given the relatively poor quality of the OCR file images, low-quality results were obtained; this was compensated for by the large-scale transcription of entries by specialists.

2. Emphasize the Use of Available Technical and Material Resources and Cooperating with Other Departments.

Local resources were identified that could be used to perform digitization tasks, such as the computers on hand. Only in the case of the National Library was a brand-new computer used exclusively for the process of digitizing material. In other institutions, machine time was shared. The pilot program led to innovations such as the simple digital-capture workstations that facilitated the digitization of the entries and that took their formats into account (see fig. 2). These workstations were designed so that a standard commercial digital camera with certain specifications could be used, and the only criteria were that it should be able to produce images that

Figure 2. Project Librarian Using the Digital Entry Capture Workstation. (Photo courtesy of the author.)

later could be viewed correctly and that would be suitable for OCR processing. Given the characteristics of the entries, their size and relative uniformity, different alternatives were subject to experimentation and evaluation until a prototype with a capacity of more than 100,000 entries was developed. When the computer and communications infrastructure was not available, participants sought out support at other institutions within the broader National Digital Library project. All the catalogs already online are housed in one of the project's collaborating institutions. (Hosting the online system supporting the CIPACs was helped by Infomed, the Cuban National Medical Library Science Center, http://www.sld.cu/, an institution that has been a key participant in the project.) In addition, every institution has copies of the work on its local network, which is regularly synced with the main server.

Once the heavy work of image capture of the catalog entries was completed, thanks to the solution described above, it became possible to make use of a scanner with a feeder and adequate OCR resolution. This increased entry-capture process efficiency and allowed the optical character-recognition process to work much more efficiently.

3. Combine Advanced Techniques and Methodologies with Traditional Methods, Depending on the Objective.

An internet-accessible system was planned and designed for managing the CIPACs—just one example of the blending of advanced and traditional methodologies. The system was developed incrementally as an ongoing beta system for sharing catalogs and the progressive addition of annota-

Figure 3. Screen Showing the Online CIPAC Developed by the Author.

tions. The system was programmed in Python by the author. It is available at http://bnjm.sld.cu/.

The upper part of figure 3 shows the browsing and search capabilities. The drawers are grouped alphabetically as they are presented in the real catalog. In the left center, the image of the printed card and a navigation menu in the drawer is shown. In the right side, there is a form to edit the content of the text seen at left where authorized people can work. If a link with WorldCat exists, it is presented as a hyperlink.

A statistical sample of the works represented in the official catalog of the Cuban collection was selected by means of the sample of groups (drawers) in two stages, making use of a systematic selection in the second stage (the entries) to study the catalog and estimate the number of entries held in the bibliographic registries in the form of data linked to WorldCat. This resulted in a figure of 48 percent. This justified the strategy of linking the entry notations with the database in order to facilitate completion of the process later.[1]

Techniques for managing data were studied and incorporated in order to design a strategy for displaying data on the internet and developing a web app for accessing the data. The result of the work stage integrating the catalog data into linked data spaces is a web app, Restful, which uses a serial RDF database on JSON-LD (Lanthaler and Gütl 2012). Data was selected using BIBFRAME 1.0 terminology proposed by the Library of Congress of the United States as a basic vocabulary set for representing the data. ("Description of the Category View," n.d.)

Figure 4 shows a graph representing the links between the subjects and

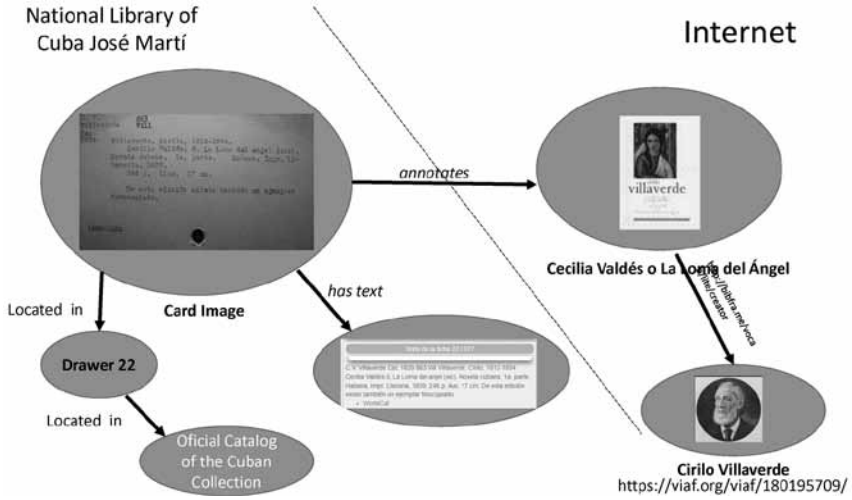

Figure 4. Indicative Representation of the Tri-part Basis of the Model.

the objects that are contained in the bibliographic record. This specific card image, for example, annotates the existence of the work *Cecilia Valdés* in the WorldCat catalog using the corresponding Internationalized Resource Identifier (IRI). This work is a book that is also connected to its author through the property "created by," which points to the Library of Congress authority record identified by its IRI. Metadata from the web integrates this specific card into open linked data. Figure 5 shows the content expressed in JSON-LD, one format for data that is to be stored.

It was necessary to design a workflow based on best practices adapted to the purposes of the project—digitization and processing of the entries—and so later to incorporate the text of the entries as annotations, making combined use of OCR techniques (in interactive batches), online annotation, and decentralized review. A web-based interface using desktop applications was integrated to perform OCR and to create annotations for each entry. The diagram below (fig. 6) represents the general flow used to digitize the card catalogs and convert its content to integrate to the web application.

A data harvester and search engine were set up, making use of Lucene/SOLR, to allow for processing the texts of each entry, which were then incorporated in the system database. This allows for searches of both the body of the text and the entries processed (Grainger and Potter 2014; Smiley et al. 2015). The search and navigation interface can be accessed at http://bnjm.sld.cu/.

```
{
  "@context": {
    "@base": "http://bnjm.sld.cu/bnjmsculyfof/",
    "@vocab": "http://bibframe.org/vocab/"
  },
  "@id": "./bnjmsculyfof001/bnjmsculyfof0010001.jsonld",
  "@type": "Annotation",
  "annotates": {
    "@id": "http://worldcat.org/entity/work/id/320445285",
    "@type": "Work"
  },
  "annotationAssertedBy": {
    "@id": "http://viaf.org/viaf/169775455",
    "@type": "Agent"
  },
  "annotationBody": {
    "@id": "./bnjmsculyfof001/bnjmsculyfof0010001.txt"
  },
  "catalogCardImage": {
    "@id": "./bnjmsculyfof001/images/bnjmsculyfof0010001.jpg"
  }
}
```

Figure 5. Example of a JSON-LD Entry with Cross-matched Data.

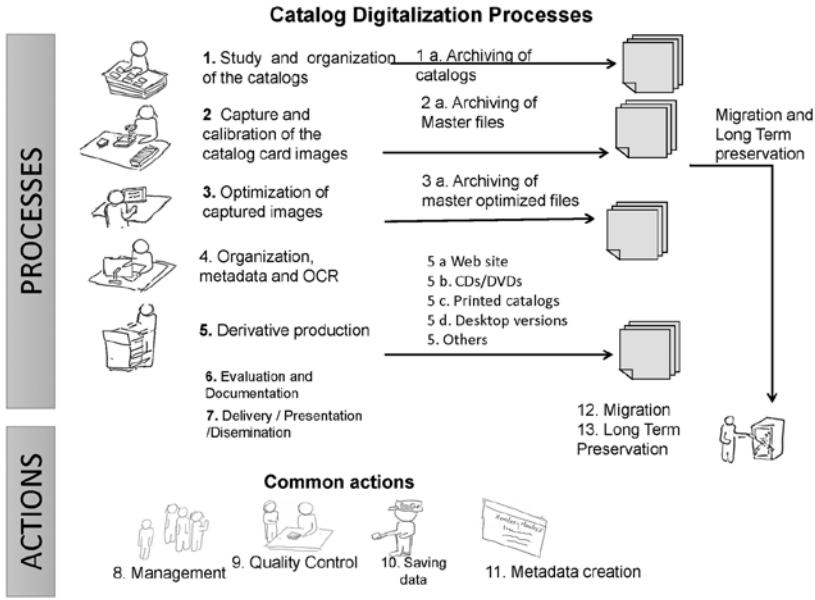

Figure 6. Workflow Diagram for Entry Digitization and Processing.

4. Start by Offering Products and Services of Direct Benefit to Users, Librarians, and Other Specialists.

One example of direct benefit to users is the project's provision of online versions of the catalogs; availability depends on advances in the capture process. Textual annotations are being performed using this online platform. In fact, the specialists performing the quality control processes do their work from their own internet connections. The people performing the capture, optimization, OCR, and annotation at the three institutions have access to the catalogs and are able to track progress as well as collaborate on the technology. At the same time, the process of digital capture of entries has resulted in the initial presentation of images online, first on the intranet and then on the internet, using an access portal for results within the catalog structures; additional personalized structures may be created by means of online annotations of the entries. On December 24, 2014, ten months after the first entries were captured, all the entries in the official catalog of the Cuban collection of the National Library were incorporated; since then, it has been possible to search for full text by means of the content of the entries described. In May 2017, a group of catalogs belonging to the National Library and the catalogs of the Central Library of the University of Havana and the Library of the Cuban History Institute became available on the portal created by this project (see http://bnjm.sld.cu/).

Figure 7 shows the integration of search capabilities into the system. The search is done consulting the Solr index generated by the processing of the full text of every card image and linking to WorldCat, if a record exists there.

An important aspect of this project has been the use of linked data techniques, which are an innovative and educational part of the process involving the integration of printed catalog data into an open online space, significantly, a cross-matched online space. In accordance with the progressive construction approach of the initiative, once the complete texts of the entries were subjected to OCR and manual review, they were initially treated as annotations existing within the corresponding libraries, in accordance with the BIBFRAME 1.0 model. Every entry was cross-matched with the corresponding bibliographic entry in WorldCat, and these data were indexed in JSON-LD. In this way a link was created with the open, cross-matched space, permitting the possibility of successive annotations and recuperation of normalized data for integration in the catalog system of local library management. Experimentation with emerging methodologies for international interoperability, known as IIIF, and the use of the recommendations of the WC3 Web Annotation Working Group have opened up new possibilities for the project. Work is progressing on the new version, which incorporates the totality of IIIF technical specifications and which intensively exploits the annotation recommendations

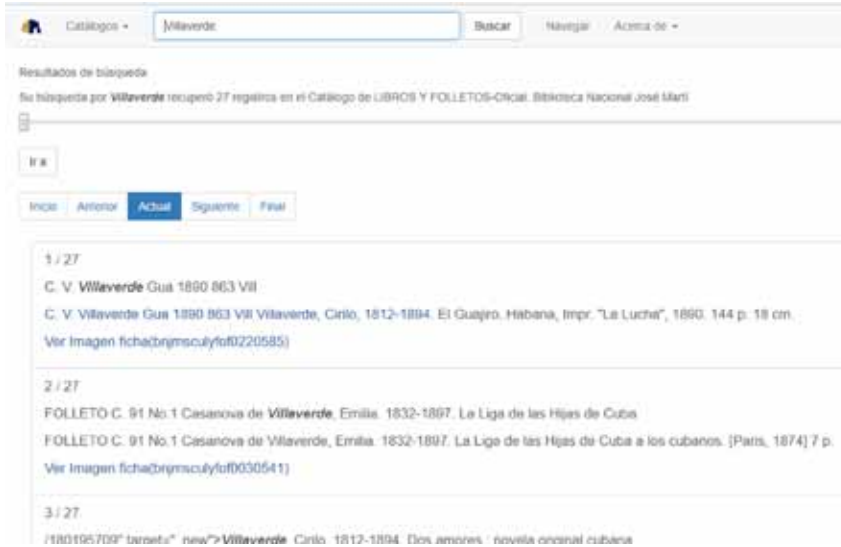

Figure 7. Example of a Search Result from One of the Three Catalogs Indexed Using Lucene/Solr.

mentioned (Crane 2017; Sanderson 2017; "International Image Interoperability Framework" 2018; Sironi 2017; McAulay 2017; Snydman, Sanderson, and Cramer 2015).

The strategy described above was adopted because of the complexity involved in the transformation of the independent records existing in the texts into a MARC21-type structure (Kroeger 2013). In the case of the official catalog of the Cuban collection, the sample allowed for an estimate that 48 percent of the entries now have an RDF-format entry in this database. This approach has reduced the number of entries requiring the manual addition of data to the local catalog. In the case of the official catalog of the Cuban collection of the National Library, this results in a reduction of almost half of the total number of entries. At the same time, the local annotations of the imported entries have been preserved. This opens possibilities for links with other resources, following in the footsteps of the links provided by high-quality centralized databases such as WorldCat. This approach also provides access to additional data, such as authoritative databases like the Virtual International Authorities File (http://viaf.org) and others. The identification of entries that also have entries in the WorldCat catalog was performed by means of automated techniques with human review.

Finally, as a part of a progressive view of database management, additional annotation tools have been developed. The experience gained from other linked data projects, and particularly the European, the Digital Pub-

lic Library of America, and the BBC, has been studied. One of the tools serves to "press" the text data in the entries so as to identify named entities and to be able to represent this data as "cross-matched data." The idea of a "data presser" in this context is a metaphor referring to procedures for extracting named entities from a text and converting them to cross-matched data. The BBC cross-matched data system is an innovative example along these lines (see Shearer 2013). It would allow for ongoing value added in the registries, and it provides the web app data results described above. In order to address this, a line of investigation has been opened by students in the School of Computer Sciences of the University of Havana. Their findings will be tested and published soon.

This experience incorporating cross-matched data techniques in repository-development processes and digital libraries has been and is a learning process, and it is presented as an opportunity for responding to the problem of the integration of printed catalogs with online spaces. Additional research will be required to evaluate its true impact in the medium and long term. In the short term, the state of the printed catalogs of three important Cuban libraries has changed, with a significant part of their bibliographic data now available online and gradually becoming available on open and linked internet locations.

Note

1. See, e.g., Catálogo de Libros y Folletos—Oficial, Fichas: 15817, Biblioteca Nacional José Marti, n.d., http://bnjm.sld.cu/cgi-bin/item.py?idficha=bnjmsculyfof0100175; and its corresponding record, http://bnjm.sld.cu/cgi-bin/record.py?idficha=bnjmsculyfof0100175.

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