

Building bridges between libraries: the creation of a Union Catalog with VuFind Open-source software and the role of patronizing bodies

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Abstract

Purpose – The purpose of this study is to show the implementation procedure and model of a Union Catalog in Bangladesh. It explores the collaborative effort of the supporting bodies. This paper will also show the possibilities of a Union Catalog in Bangladesh. In addition, this paper demonstrates how the union catalog improves the library resource visibility, interoperability and public access.

Design/methodology/approach – This paper is based on practical experience and study. The author used the qualitative case study method to conduct this research. The author also consulted many online resources for the analysis of the literature. He also consulted with UGC (University Grants Commission) members regarding the union catalog. The VuFind federated search engine is selected for developing a Union Catalog in this study. This paper will also motivate librarians to implement the Union Catalog in their countries where it has not yet been implemented.

Findings – Establishing a Union Catalog in Bangladesh is not particularly complicated or costly. It is possible with minimum effort and low cost. Supporting bodies play an essential role in funding and policy contributions, which are proven to be needed for the project's success. Library users can easily locate their required reading materials by using this catalog. It also reduces duplicate MARC 21 cataloging among the library professionals. The primary identified difficulties are metadata standardization and the qualified professionals that can be minimized with proper training and phase integration.

Practical implications – The results show VuFind's actual functions as a Union Catalog. Therefore, librarians will be motivated to participate in and use VuFind federated search. This research provides a practical guideline for worldwide library professionals to develop and implement a union catalog with the support of patronizing bodies and at a low cost.



Originality/value – No study has been conducted to establish a Union Catalog in Bangladesh using any Open-Source software. This study can serve as a model for the worldwide community to implement a scalable, sustainable Union Catalog in their countries.

Keywords Union Catalog, Resource sharing, Supporting bodies, Discovery search, Search engine, Inter-library loan, Koha, DSpace, Evergreen, ABCD, Integrated library system, Bangladesh

Paper type Research article

Introduction

It is a great regret that there is still no Online Union Catalog in Bangladesh. Though Bangladesh is a developing country, and its development in other sectors is excellent, in the library sector, development has not been, and is not, good. Most libraries in Bangladesh do not have an ILS (Integrated Library System) for regular operations. So that users are not getting proper services from the libraries. Some universities and research organizations have ILS for their regular activities. However, the author has taken the initiative to establish a Union Catalog in Bangladesh at a low cost and with minimal effort, thereby achieving maximum benefit. The author presents a model of a Union Catalog in a lecture organized by the Bangladesh Association of Librarians, Information Scientists and Documentalists (BALID). A union catalog is a collection of catalogs or sources. The sources may consist only of bibliographic information from library resources or databases. It works like a ‘one-stop shop’. It provides a single interface for searching resources from incorporated libraries. It also includes digital resources alongside physical library resources. The author used ten libraries that held data to prepare a Union Catalog model. He also emphasizes the role of the University Grant Commission (UGC) of Bangladesh for establishing the Union Catalog.

Before the Internet, it was in print. Nowadays, it is mainly available online as software. Many institutions have developed the Union catalog by using different software technologies. In addition, all are using the Internet for their Union catalogs. It integrates many catalogs’ resources. The resources may include bibliographic information for books and/or metadata for Institutional materials. After all, in one word, all the information about libraries. It provides a unique interface for searching a wide range of library materials/resources. After searching, users can locate library resources and the holding libraries of their required materials/resources. However, this research project used VuFind open-source software. This software provides the freedom of use, which is essential to this project. Open-source software grants users the right to modify its source code to meet their needs. Therefore, VuFind became the ideal Open-source software for developing the union catalog in Bangladesh. Anyone can change the source code of open-source software without considering the discrimination it may cause its users (VuFind®, 2025). This paper highlights the role of supporting bodies in establishing the Union Catalog using VuFind, an open-source software, in Bangladesh. It also identifies the potential benefits to Bangladesh through the collaborative efforts of UGC (University Grants Commission), BALID (Bangladesh Association of Librarians, Information Scientists and Documentalists), and LAB (Library Association of Bangladesh). This initiative can significantly contribute to the overall development of the information resources accessibility and discoverability in Bangladesh.

The concept of union catalog

In simple words, A Union Catalog is a combined library catalog describing the collections of several libraries. Union catalogs have been created in a range of media, including book format, microform, cards and more recently, networked electronic databases. Print union catalogs are typically arranged by title, author or subject (often employing a controlled vocabulary); electronic versions typically support keyword and Boolean queries. (Wikipedia, 2024)” It is a significant gadget for both library users and librarians to fulfill their needs. It is also a basic library resource-sharing tool. The Library of Congress developed the First Union Catalog.

“The Library of Congress began its union catalog project in 1901 in an attempt to locate and note the location of a copy of every important book in the United States. With financial assistance from John D. Rockefeller Jr., the collection grew to over 11 million cards. Copies of these cards were distributed to some libraries around the country. Eventually, the cards for all materials cataloged by the cooperating libraries were reproduced and issued serially in printed volumes as part of the National Union Catalog, supplementing the Library of Congress Catalog of Printed Books. Monthly NUC catalogs were cumulated quarterly, annually, and multi-annually. To simplify research, it was decided in the 1960s to collect and publish all of the references to pre-1956 imprints in a single alphabetical listing. Mansell Information/Publishing Ltd., the company that created the British Museum library catalog, won the contract to publish the proposed union catalog. Over the next 14 years, about 600-page volumes were published each month until the NUC of Pre-1956 Imprints was completed, largely superseding the older Library of Congress Catalog of Printed Books (Wikipedia, 2024). Before the Internet, it was in print. Nowadays, it is mainly available online as software. Many institutions have developed the Union catalog by using different software technologies. However, all are using the Internet for their Union catalogs. It integrates many catalogs’ resources. The resources may include bibliographic information for books and/or metadata for Institutional materials. After all, in one word, all the information about libraries. It provides a unique interface for searching a wide range of library materials/resources. After searching, users can locate library resources and the holding libraries of their required materials/resources.

To facilitate interlibrary loan services, Union Catalogs provide a centralized platform where libraries can list their holdings. This simplification in discovering where materials are stored is not just practical for users, to say the least, but it also establishes collaboration and resource sharing among libraries. It is the basic condition for enhancing the accessibility of information. An example of this is the Hellenic Libraries Union Catalog (HLUC). The concept provides a means for national projects to promote collaboration between libraries and thereby increase access to resources for users throughout Greece, both quantitatively and qualitatively (Apostolaki *et al.*, 2019). In addition to simply helping users locate materials, Union Catalogs also play an extensive role in managing library collections – a role that cannot be ignored. While using Union Catalogs to study inter-library loan patterns and use statistics, libraries can make sensible decisions about purchase and allocation of resources. For instance, a study which analyzed interlibrary loan use during the COVID-19 pandemic showed that libraries readjusted their services to meet changing user needs. By using Union Catalogs, they were able not just track but also find gaps in resource availability (Bakker *et al.*, 2023). Union Catalogs help democratize access to information. By using the Union Catalogue, small libraries can get the same facilities as the big libraries. It is very important for those areas where libraries do not have better funding due to their regional economic situation. With the facilities of the Union Catalogue, these types of libraries can get equitable access to the information for their library users (Anishchuk, 2024). The functionalities of the union catalogue have developed through the development of technology. Now user can easily locate their required resource materials with the help of the modern Union Catalogue. For example, now the library users can get loan services from other libraries with the integration of interlibrary loan services in their library catalogue (Scott and Barton, 2018). For providing better library services to the library users, this type of integration is very important.

The Union catalogue not only enhances access to the physical library materials but also improves access to the digital resources of the participating libraries. Nowadays, libraries are increasing their digital information resources so that the union catalogue becomes more vital for the present information explosion age. The demand for digital information resources has increased due to the remote access facilities and online learning and education. For fulfilling this demand, Union Catalogue plays a greater role. This demand had reached its peak at the time of the COVID-19 pandemic in the world. At that time, people cannot be closer to each other for learning and education (Creazzo *et al.*, 2021). The collaborative nature of Union Catalogs also extends to the development of shared policies and practices among libraries. By participating

in a Union Catalog, libraries can align their cataloging standards and practices, leading to improved consistency and accuracy in bibliographic records. This standardization is essential for ensuring that users can easily locate and access materials across different institutions. Furthermore, the shared governance of Union Catalogs fosters a sense of community among libraries, encouraging them to work together towards common goals (Chisita and Fombad, 2020). Despite the numerous benefits of Union Catalogs, challenges remain in their implementation and maintenance. Issues such as data quality, interoperability among different systems, and the need for ongoing funding and support can hinder the effectiveness of Union Catalogs. Libraries must navigate these challenges to ensure that their Union Catalogs remain relevant and useful for their patrons. For instance, the need for continuous updates and maintenance of bibliographic records is critical for ensuring the accuracy of the information provided through Union Catalogs (Crespo, 2022). The implementation of union catalogues has not been without challenges. Issues such as metadata accuracy and the integration of diverse collections have been highlighted in the context of digital libraries (Gonçalves *et al.*, 2007). Efforts to address these challenges have involved the development of quality models and criteria to ensure the reliability and effectiveness of union catalogues (Pauer *et al.*, 2016). Furthermore, initiatives like creating national union catalogues have been proposed to streamline access to resources, particularly in specific domains like electronic theses and dissertations (Saka *et al.*, 2021).

Union Catalog is very important for a nation. It is a key apparatus of library resources sharing and for providing interlibrary loan services. A library cannot provide better services to its users without having a Union Catalog. Library staff can easily find their valuable books or any related information by using it. It is also a key means for providing reference and referral services. It creates a framework for information discovery in a knowledge-based nation. Nowadays, information is the most valuable thing. Moreover, this is the age of information explosion. In this age, information is created across many traditions and distributed in many ways. There are many forms of information storage and retrieval. Libraries are the most authentic places for information storage, universally recognized. In this regard, the Union catalog plays the most significant role in discovering and disseminating information to end users. The author thinks the following are the importance and functions of the union catalog-

- (1) It serves as a key tool for library resource sharing in a country. Librarians can do interlibrary loan by using the Union Catalog.
- (2) The Union Catalog works as a resource locator. A library user or information seeker can easily find where to get what they require using the union catalog.
- (3) It works as a book selection apparatus for librarians. By using the union catalog, a librarian can select their library's reading materials.
- (4) It has importance for cooperative cataloging. Catalogers can use the Union Catalog to help catalog their reading materials.
- (5) It serves as a metadata-sharing tool for librarians.
- (6) A union catalog is a resource that a library lacks.

Initiative for the union catalog in Bangladesh

For three years, the author tried to establish a union catalog in Bangladesh. The authors have held several discussion meetings with librarians from universities and public libraries over the last three years. They presented the benefit and importance of the Union Catalog to them. The librarians of North South University, Independent University Bangladesh, Dhaka University, and Daffodil International University gave their consent to work toward establishing a Union

Catalog in Bangladesh. The authors contacted the University Grant Commission (UGC) of Bangladesh to convince them to establish the Union Catalog in Bangladesh. UGC gives its consent for establishing the Union Catalog in Bangladesh.

Reference
Services Review

Resource sharing and union catalog

There is a deep relation between resource sharing and the union catalog. Resource sharing among the libraries cannot be fruitful without having a union catalog. The libraries of Bangladesh cannot share their resources with other libraries without the Union Catalog. The author has tried to show previous data on the resource shearing status of Bangladesh here. However, Formal resource sharing began in 1976 when an interlibrary loan (ILL) agreement was signed between the ICDDR, B and the National Health Library and Documentation Center (NHLDC). In 1985, both libraries agreed to avoid duplication in journal subscriptions and in the purchase of books and reference materials. It means that funds can be used for additional subscriptions or other development purposes. The ICDDR, B library also maintains ILL agreements with the libraries of the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine, and Metabolic Disorders (BIRDEM) and the Bangladesh Institute of Development Studies, both located in Dhaka. Established in 1974, NHLDC is the central component of the national biomedical information network, serving as the ultimate resource library. The network has three tiers: the NHLDC at the top, libraries with some resources in the middle, and 49 libraries with few resources and no professional staff at the bottom. Without adequate funding and staff, these libraries are dependent on resource and backup libraries. To improve document delivery services and the use of indigenous literature, NHLDC compiled the Bangladesh Index Biomedicus, covering 1972–1987 and including both English and Bengali literature (Khan *et al.*, 1990).

Many studies have revealed various methods and trials for establishing a modern online public access catalog, reflecting changing technological and authoritative standards. For instance, (Park *et al.*, 2019) state, “while BIBFRAME is a hopeful next generation bibliographic standard, the implementation of it has been met with huge challenges”, which supports our view of an evidence-based, gradual modernization approach in Bangladesh. Similarly, (Apostolaki *et al.*, 2019), in recording the Hellenic Libraries Union Catalog (HLUC) pilot phase, stress that centralized governance, iterative feedback, and collaborative refinement are needed to ensure the success of service provision. In a low-resource environment, (Sahaa, 2025) CLOUD BASED LIBRARY MANAGEMENT AT ASSAM demonstrates a MERN-stack library management system for Assam University, which provides increasing resources and collection capabilities with a more scalable model to developing countries; thereby, improved resource discovery and prevented redundant work are described. Additionally, (Lappo *et al.*, 2022) show how the Belarus Digital Union Information Resource, powered by IRBIS64 and other distributed technologies (OAI-PMH, SRU/SRW), was able to realize an unprecedented level of multi-library interoperability and discoverability—a valuable model for BDLP’s long-term goals for cross-library integration and shared resource visibility.

Resource sharing is a critical part of library work. It allows libraries to make available to their users an even bigger array of information sources than is possible through their own collection alone. In the digital age, the need for effective resource sharing is even more glaring as libraries try to meet the mounting needs of their patrons (Ashiq *et al.*, 2022). One way to ease resource sharing is to use a union catalog, which brings together the holdings of multiple libraries into a single place for searching (Maina and Mwiti, 2024). The advantages of union catalogs for resource sharing are obvious. By providing users with a “one-stop shop” for the collections of participating libraries, they enable users to obtain and use materials from a wider variety of sources (Anene, 2024). It can mean better use of resources, less duplication in acquisition, and improved access to information for library users (Yuxin *et al.*, 2024). They can also facilitate interlibrary loan (ILL) services (Prosman and Renaville, 2023). Libraries lend

each other's materials, thereby expanding the resources available to their patrons. However, setting up and maintaining union catalogs has its pitfalls, centered on several problems. One of the major ones is data management and integration, since one library may use different systems for cataloging, metadata standards or media formats than another library (Adee and Mouratidis, 2022). Overcoming these technical barriers involves developing robust data conversion and normalization procedures and adopting similar standards and protocols (Zhang *et al.*, 2023). Another difficulty is the coordination and cooperation that participating libraries must offer to get a good union catalog up and running. For these to become a reality, libraries must be prepared to share their holdings data, abide by mutually agreed-upon pluralist protocols and procedures, and contribute to the ongoing development or maintenance of that system (Ratnayake, 2022). It is especially tough when there are competing priorities and limited resources in the library (Ratnayake, 2022). Researchers have proposed several strategies and models for coping with these challenges to resource sharing through union catalogs. Some have examined the use of cloud computing and linked data technology to enhance the scalability, interoperability, and accessibility of union catalog systems (Alajmi and Albudaiwi, 2020; Jun, 2022). Others have examined the contributions of library consortia and inter-library cooperation networks to resource sharing and how these promote the adoption of union catalogs (Mengping, 2023). During the COVID-19 pandemic, libraries have seen just how important digital resource sharing is and that they need to adjust their services and work. Methods accordingly (Ashiq *et al.*, 2022; Skalski, 2023). Some libraries, for instance, increased their ability to share resources and offer access by turning to social media, using mobile technology (Alajmi and Albudaiwi, 2020; Dinazzah and Rahmi, 2022).

The development of union catalogs can also be strategic. In this sense, modern union catalogs are an important goal for university libraries. In developing settings, an effective union catalog must have strong leadership and government departments capable of addressing the various challenges of assembling such information services nationally (Ikenwe and Udem, 2022). Mairaj and Mukaram report the central role of leadership, professional associations, and the National Library of Pakistan in shaping the status, problems, and prospects of a national union catalog (Mairaj and Mukaram, 2023). Greece also demonstrates the potential for complete union catalogs. The Hellenic Libraries Union Catalog (HLUC) brings together the collections of various Greek libraries into a single, searchable catalog that aims to enhance access and interoperability (Apostolaki *et al.*, 2019). These cases show that digital transformation, policy leadership, and centralized catalog initiatives come together to promote unified patron access to resources across library networks.

Overall, libraries still face the challenge of developing and implementing effective union catalogs for resource sharing. It involves technological innovation, interorganizational cooperation, and user-centered design (Jun, 2022; Skalski, 2023). With these challenges, libraries can continue to support the information needs of their communities while assisting researchers and educators in their work.

Tools for developing a union catalog

For building a Union Catalog, there are some open-source tools, such as VuFind (Developed by Villanova University), SOPAC (Developed by Darien Public Library, Connecticut), Blacklight (Developed by the University of Virginia), and the Extensible Catalog project (University of Rochester). All of these are discovery tools. These are used for building a library catalog. Almost all of these use the same technology to discover library resources. On the other hand, there are some commercial tools for buying a discovery library catalog in the present market, such as Encore (Developed by Innovative Interfaces, Inc.), Primo (Developed by Ex Libris), AquaBrowser Library (Developed by Medialab Solutions), Visualizer (Developed by VTLS Inc.), The Summon Service Serial Solutions (Developed by ProQuest), EBSCO Discovery Service (Developed by EBSCO), Enterprise, which was developed by SirsiDynix, BiblioCore (Developed by BiblioCommon) and WorldCat Local that developed by WorldCat.

WorldCat is an actual Union Catalog among the above-mentioned software. Many of them are used for library discovery searches. The author chooses VuFind to build the Union catalog among these. VuFind uses it as a discovery search catalog in libraries. However, the author uses VuFind for building the Union Catalog.

About VuFind

VuFind is developed and maintained by Villanova University's Falvey Memorial Library. The developer of VuFind is Andrew Nagy. Its first version, 1.0, was released in July 2010, after three years of beta releases. Now, VuFind 9.1.1 is the latest stable release, unveiled on 16 September 2019. It is open-source software. VuFind runs on Solr. Apache Solr, an open-source search engine, delivers impressive performance and scalability, enabling VuFind to respond to search queries in milliseconds. It can be distributed if users need to spread the catalog load across multiple servers or in a server farm. VuFind is offered under the GPL open-source license. It means that users can use the software for free. Any user can modify the software and share their successes with the community! (VuFind®, 2025). The results of this study showed that university students preferred VuFind over the Koha OPAC. Among the respondents, almost half used only VuFind, while nearly one-third used only the OPAC, and less than one-quarter used both Koha and VuFind. The comparison of students' opinions regarding the Koha OPAC and VuFind interfaces showed no significant differences in age, gender, years of computer use, or computer skills for either interface. Although less than a quarter of students used both interfaces, they were significantly more satisfied with VuFind than the Koha OPAC. It seems VuFind has significant potential to enhance students' experience with the library catalog search (Yesmin and Ahmed, 2016). However, most libraries are using various software to provide library services. Libraries are using Koha, Evergreen, OpenBiblio, SLiMS, and other software to fulfill their library automation needs. Likewise, they are using DSpace, Fedora Commons, Eprints and other software to execute their digital library or institutional repository needs. The reason is that there is no open-source software that meets all the needs of libraries and librarians. Thus, librarians and library users have to use different search interfaces to find the necessary resources. VuFind is a federated search engine that can integrate searches and provide a single interface for librarians and library users to search all library materials. Not only has VuFind integrated all journal database searching, but users can also search the entire library collection through a single integrated interface.

Regarding open-source software

Open-source software is freely available software whose source code is released under a particular open-source license. There are several popular open-source licenses: the GNU General Public License (GPL), the MIT License, the Mozilla Public License 2.0, the Apache License 2.0, the FreeBSD License, and the Common Development and Distribution License. Librarians have a deep relationship with open-source software. A librarian cannot be a good professional if they do not have an open mind. However, Open-source software (OSS) has become prevalent in libraries over the past few years due to its cost-effectiveness, flexibility, and community support (Ahammad *et al.*, 2024a; Choi and Pruett, 2019). Library automation is rapidly growing as libraries increasingly adopt OSS, enabling them to perform library activities and provide services independently (Ahammad, 2014; Khan and Sheikh, 2022; Khan and Shahzad, 2022). Cost-effectiveness is one of the most important benefits OSS offers libraries. Compared to proprietary software, the majority of OSS can be downloaded free of charge, which permits libraries to manage on a tight budget elsewhere (Choi and Pruett, 2019; Khan and Sheikh, 2022). It is beneficial for libraries in third-world countries and small-budgeted organizations (Khan and Sheikh, 2022). Furthermore, because these software tools are open source, libraries have more flexibility and control over their systems. Librarians will be able to tailor the software to their individual requirements, bolt it onto existing systems, and provide feedback to inform its continued development. Much of this customizability and

control is often impossible with proprietary software (McIlwain, 2023). The open-source community is also essential to the functioning of these library automation systems. Developers and users work together to make the software better, fix bugs, exchange best practices and build a cooperative ecosystem that libraries can enjoy. This type of cooperative mentality benefits the long-term survival and utility of this software (Ahammad *et al.*, 2024b; McIlwain, 2023). However, it is not all beer and skittles for libraries rolling out OSS. Librarians may need extensive training and support to use these systems effectively, and migration can be complex, requiring careful transition from legacy systems to new ones (Hasan *et al.*, 2021; Khatun and Ahmed, 2018). Relevant information on privacy and data security may also be raised, particularly regarding sensitive personal data. To counter these problems, scholars emphasize the significance of LSs and professional organizations in training for new technologies, including OSS, for both graduates and professionals in library science. Developers of OSS products should also provide extensive training and support so that librarians can work independently and efficiently with such systems (Hassan *et al.*, 2022).

In the end, OSS adoption in libraries can help the library professionals revolutionize their library operations, serving patrons faster and at lower cost. The use of OSS would provide libraries with opportunities to extend resource-sharing facilities, enrich digital collections, and meet the changing requirements of their own communities (Ahammad *et al.*, 2024b; Khan and Shahzad, 2022; McIlwain, 2023).

Methodology

This research employs a qualitative case study to examine a joint venture among 10 academic and special libraries in Bangladesh that collaborates to develop a union catalog using VuFind open-source software. The case study approach is particularly appropriate for exploring actual library practices in their institutional contexts and yields a deep account of the technical, organizational, and strategic aspects of implementation. A purposive sampling technique was used to select the participating organizations, which included both private and international organizations. It was promoted by supporting bodies that had been instrumental in financing, coordinating policy, and facilitating technical support.

Data were gathered through 12 semi-structured interviews with participants serving in different positions (cataloging librarians, IT administrators, and library directors). In addition to interviews, institutional documents, project reports, and records of the VuFind customization were examined to complement and validate the findings. Watching system demonstrations also offered another perspective on the configuration and use of software. The thematic analysis revealed common themes across the interviews, including metadata harmonization, system interoperability, collaborative workflows, and sustainability. Ethical fundamentals were respected, including obtaining informed consent and maintaining the privacy and security of information.

Proposed model and area

The author proposes a complete model and all areas for the union catalog in Bangladesh. He included the hard and soft copies of the reading materials metadata in the union catalog. Hard-copy resource metadata includes books, journals, magazines, reference materials, and other library materials. Softcopy resources metadata consists of ebooks. The proposed model of the Union Catalog is shown in Figure 1. The figure shows that participating institutions are providing their bibliographic metadata through the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). VuFind collected the metadata through its OAI-PMH server. The author faces some difficulties in this process. Data from all participating institutions cannot be used directly in VuFind. The author had to make necessary metadata modifications using MarcEdit. However, the author has attempted to automate the data harvesting process using the OAI-PMH protocol in VuFind.

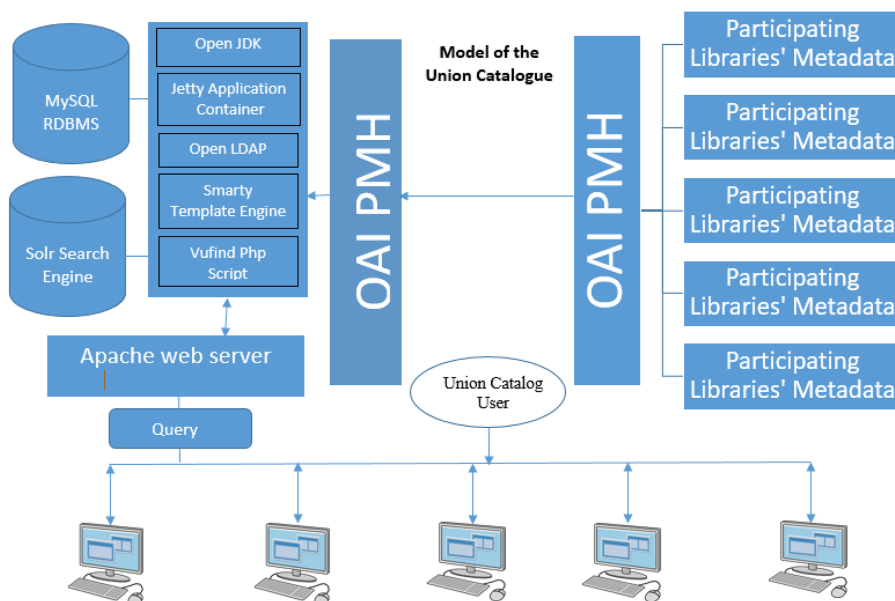


Figure 1. Shows the proposed model of the Union Catalog. Source: Authors' own work

A Union Catalog with open-source technologies (Figure 1) proposes a model for implementing a Union Catalog using several open-source technologies. Fundamental Features and Technologies The following are the important features and technologies employed in the model:

- (1) OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting): This protocol is used to harvest metadata from various sources. It provides the union catalog with an opportunity to pull bibliographic data from multiple libraries.
- (2) Open JDK (Java Development Kit): Open JDK is used for developing and running Java applications included in the union catalog system.
- (3) Jetty Application Container: A small web server and servlet container for deploying Java-based web applications.
- (4) MySQL RDBMS (Relational Database Management System): MySQL is the RDBMS used throughout the database management process, storing metadata and some data from the union catalog.
- (5) OpenLDAP (Lightweight Directory Access Protocol): OpenLDAP manages directory services and authenticates/informs about users.
- (6) Smarty Template Engine: The template engine is implemented to separate the presentation and application layers, simplifying the user interface of the union catalog.
- (7) Solr Search Engine: To index and search bibliographic data, we use Solr, a search server. It enables fast, high-performance querying of the union catalog.
- (8) VuFind PHP Script: VuFind is a library resource portal and an open-source PHP script. It offers intuitive search and retrieval tools for the union catalog resources.
- (9) Apache Web Server: Apache serves as the web server for the union catalog application. It listens to user requests and presents the VuFind frontend.

Figure 1 *General view of the diagram:* The above figure shows how these components act upon and communicate with each other, together constituting a working union catalogue:

- (1) Union Catalog User: characterizes the final users who access the union catalog.
- (2) Query Process Flow:
- (3) Users submit queries to the Apache web server.
- (4) The Apache web server serves up the queries to the VuFind PHP code.
- (5) Searching is done against the Solr search engine when users use VuFind to query the catalogue.
- (6) The Smarty Template Engine formats the output for human-readable web pages.
- (7) Metadata and so on are stored in a MySQL RDBMS, and OpenLDAP handles user authentication.
- (8) Jetty Application Container and Open JDK for running and managing Java-based applications that may be part of the system.

This model combines several open-source tools to develop a low-cost, high-performance union catalog system to promote the sharing of resources among libraries. The above technologies have been used because they combine flexibility and scalability and are easy to maintain, which would be relevant for the library of a developing country like Bangladesh.

Procedures for developing a union catalog

VuFind is developed with PHP and MySQL. The complete documentation for installing and customizing is available at vufind.org. VuFind is usable on any operating system. The author used a trial-and-error approach to develop a Union Catalog with VuFind.

Software needs for VuFind:

Its developers use all open-source software to develop it. The software usage is as follows-

- (1) Ubuntu Server (Latest Version)
- (2) Apache Web Server
- (3) MySQL/MariaDB Database server
- (4) PHP programming language (software)
- (5) Java JDK (Java Development Kit)
- (6) Apache Solr for Search Engine
- (7) MarcEdit Software for preparing MARC21 data (for experimental purpose only)

Hardware usage for VuFind:

The author used a production server at DIUL (Daffodil International University Library) to develop the Union Catalog alongside Koha ILS (Integrated Library System). He uses the following hardware for developing the Union Catalog.

- (1) HPE DL580 GEN10 8SFF 4xXEON-P 8160 Gen10 Server with 32 GB RAM
- (2) Standard Desktop PC for Creating MARC21 Data or Metadata

VuFind installation and configuration

The author first installed VuFind on a Desktop computer for a trial basis. After everything was in order, he installed it on a production server. He installed all the prerequisite software for VuFind on the production server. Figure 2 shows the newly installed User Interface (UI) for VuFind. He used VuFind's default theme. Installation documentation is available at <https://vufind.org/wiki/installation:ubuntu>. After installing VuFind, he configured it to meet the Union Catalog's needs. He created several custom configuration files to show the correct search results. The configuration documentation is available on the VuFind installation page.

Prepare MARC21 data for the union catalog

The author collected demo MARC21 data from the participating universities. He also collected data from online journals. He prepared the data using MarcEdit software, developed by Terry Reese.

It is an excellent software for editing MARC21 data. Most libraries in Bangladesh use Koha ILS. Therefore, he uses MARC21 data from exporting the Koha ILS. After testing with the demo data, the author used OAI-PMH to collect data for the production system. It needs to run the command to harvest data from different sources. With the help of a cron job, it has been automated.

Importing data into VuFind

After doing the correct configuration, the author started to import MARC21 data into VuFind. He collects MARC 21 data from the participating libraries. There are two ways of collecting data from the participating libraries. One is the use of OAI-PMH, and the other is raw MARC21 records from participating libraries' ILS systems. The author uses both methods for collecting data. There are two primary methods for importing data into VuFind. The first is an automated process using cron jobs via OAI-PMH, and the second is a manual process that, despite being manual, is straightforward and requires just a single command. The author used both methods for data collection: the OAI-PMH protocol and direct retrieval of raw MARC21 records from libraries' Integrated Library Systems (ILS). The author is determined to use OAI-PMH to import data into the Union Catalog. The author uses a cron job to automate data harvesting in the Union Catalog. The author also tried to harvest the data by using the MarcEdit

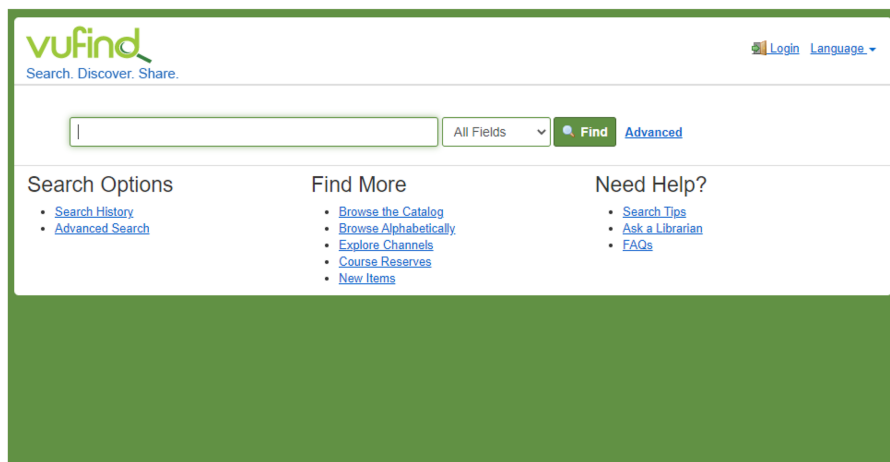


Figure 2. Shows the newly installed VuFind software. Source: Authors' own work

OAI tool for experimental purposes. This tool also works well for harvesting the data. [Figures 3 and 4](#) show MarcEdit Software data harvesting tools.

[Figure 5](#) shows the search results for the term marketing. The search term “Marketing” yielded 5,945 items in the Union Catalog. The results are from a range of institutions and libraries providing a full range of resources. Users can narrow their result lists by institution and library in the search interface, which displays detailed information about what is available. Ahsanullah University of Science and Technology leads with 2,190 items, followed by Uttara University with 1,084 and North South University with 978. Other distinguished organizations include Independent University (948 items), Daffodil International University (483 items), and BRAC University (262 items).

Among individual libraries, the Kazi Fazlur Rahman Library has the most extensive collection of marketing materials (2,190). It has been succeeded by the M Aziur Rahman Library, with 1,084 items, and the NSU Central Library, with 978 items. The IUB library provides 948, and the DIU central library provides 483, followed by Aysha Abed’s Library with 262. There are rich sources of marketing efforts within many library settings. Library staff and customers can use the union catalog to search for materials they want to read. The holding library information is very well displayed on the Vufind search results page after searching the Union Catalog.

Analysis of interview data (12 participants)

(1) Participant Profile Overview

- Institutions Represented: Librarians from all 10 institutions attended, as shown in [Table 1](#), one from each and two from the larger institutions (BRAC University and Independent University Library).
- Roles: Participants included cataloging librarians, systems librarians, IT staff, library directors and project liaisons.

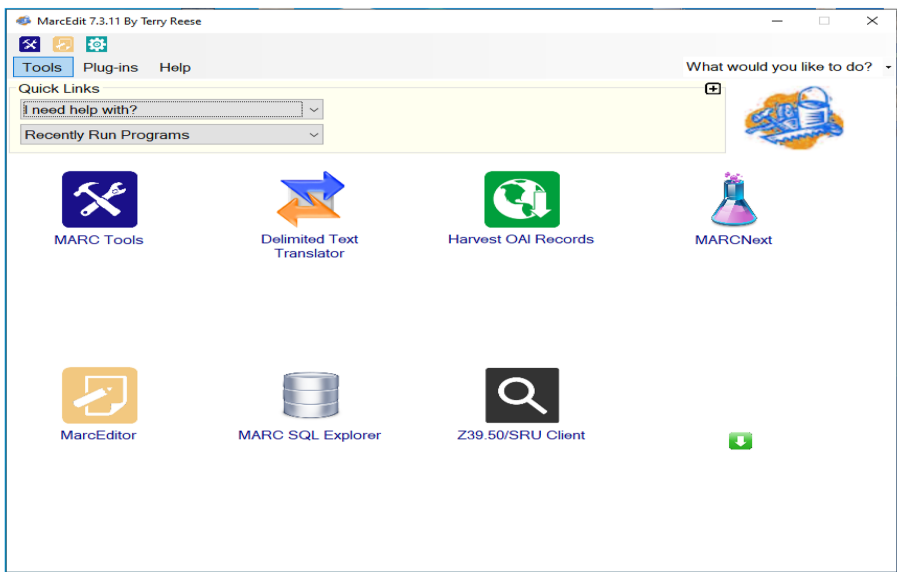


Figure 3. Highlights the MarcEdit software used to prepare Marc data to import into VuFind. Source: Authors’ own work

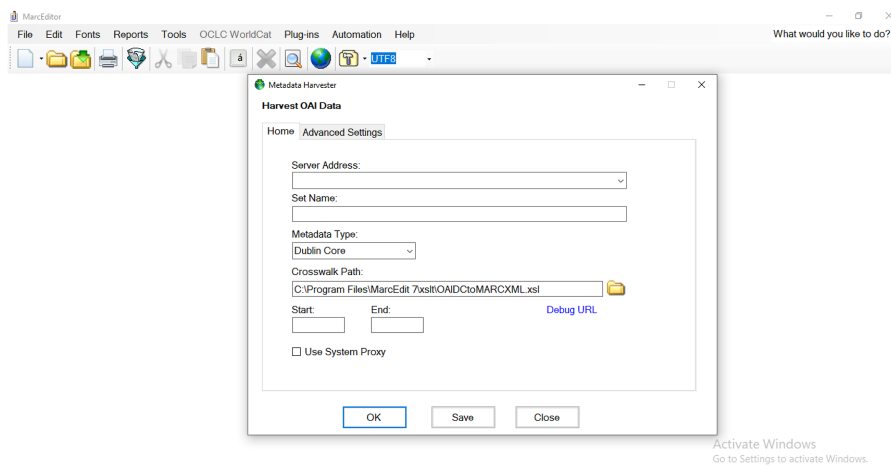


Figure 4. Shows the data-harvesting tools in MarcEdit software. Source: Authors' own work

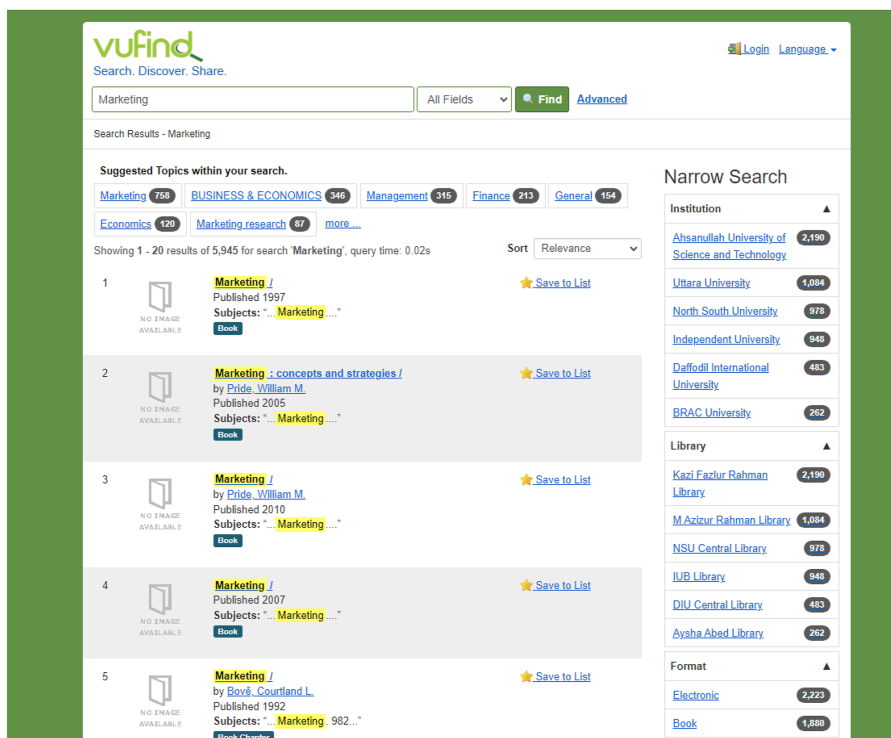


Figure 5. Shows the search result of the proposed Union Catalog. Source: Authors' own work

Table 1. Shows the proposed participating institutes’ names

No	Institutions name	Institution type
1.	Independent University, Bangladesh	Private
2.	BRAC University	Private
3.	East-West University	Private
4.	Daffodil International University	Private
5.	United International University	Private
6.	North-South University	Private
7.	Uttara University	Private
8.	International Islamic University, Chittagong	Private
9.	Ahsanullah University of Science and Technology	Private
10.	ICDDR, B Library	International
Source(s): Authors’ work		

- Experience: Most participants have more than 5 years of experience in library automation and digital library services.

(2) Emerging Themes and Interpretative Analysis

- Benefits to be Gained by a Union Catalog
Resource Discovery Improvement: 10 of the 12 interviewees mentioned that interlibrary holdings will be more discoverable.
a. “Our students can now look over our holdings outside the walls; that is a big step.” (P3)
Less Duplication: Several libraries reported decreased duplication in cataloging and acquisitions.
User Satisfaction: 7 patients showed initial evidence of improved user satisfaction.
- Technical Integration Challenges
Repertory of Metadata: 9 were struggling with metadata conversion (MARC, Dublin Core).
a. “Making sense from the legacy data when we brought it into a common schema was technically challenging.” (P8)
Server/Infrastructure raises: Most prominent amongst small organizations such as Uttara University.
Interoperability Issues: Some indexing mismatch was reported during VuFind installation in some cases.
- Role of Supporting Body
Funding and infrastructure: All 12 agreed on the importance of having a supporting body (probably similar to UGC or another organization).
a. “This event would not have happened if someone like us had not centralized funding and hosted it.” (P1)
Policy Fit: The presence of aligned training sessions and policy-level enablers was considered crucial.

(3) Human and Organizational Factors

- Training and skill gaps: 8 respondents stated that additional technical training was crucial.
- Institutional Readiness: 3 libraries were initially unwilling, owing to concerns about sharing data.
- Team Work, Collaboration: 10 respondents identified collaboration across the library as a key to their success.

(4) Sustainability and scalability

- Future Expansion: The overwhelming majority of participants expressed interest in adding more libraries and/or additional services such as federated search or interlibrary loan.
- System Maintenance Worries: 4 respondents worried about server maintenance and future upgrade cycles.

(5) Thematic summary table

Outcomes and benefits

The development of the VuFind-based union catalog has six key outcomes for participating libraries. Access to bibliographic resources was significantly extended and, for the first time, made available under a single point of access. It has dramatically increased the visibility of what libraries own, especially at smaller institutions where not all resources were being used. The library reported that users (particularly students and researchers) were pleased with the improved coverage and ease of discovery. For instance, P3 remarked that “some colleagues do search for books they could not see before in secluded catalogs of ours that our students now access”.

It also stimulated mutual visits and collaboration among libraries with little former contact. Uniform cataloging codes and cooperative training sessions developed unity of effort and trust. As a result, several libraries began discussing possibilities for larger cooperative projects, such as interlibrary lending and collective purchasing. In addition, users experienced a better user interface and said they found search faster, the results more relevant, and the interface cleaner and more modern with VuFind. From a technical and financial perspective, cost savings were achieved by adopting an open-source platform with no licensing costs and centralized hosting. Smaller organizations, in particular, were able to share resources and technical staff provided by the supporting organization, thereby alleviating the need for expensive vendor-driven systems.

Discussion

Examination of interviews with 12 librarians provides a description and an outlook on future trends in library automation and the development of union catalogs across different types of institutions. Those involved, including cataloging librarians, systems librarians, IT staff, library directors, and project liaisons, call out the pros and cons of this transition.

The advantages of a union catalog are impressive. 10 of the 12 respondents agreed that the union catalog is a significant improvement in resource discovery and that it facilitates access to inter-library holdings that were previously hard to reach. “Our students have no vision past our walls, and at least now they do; it is a huge step,” one participant mentioned (P3). The strength of discoverability can shift user experiences and promote a culture of information sharing and collaboration among libraries, positioning libraries as resources for community learning (Edwards, 2018; Keller, 2022). Further, reports of decreased duplication of cataloging across multiple libraries indicate a more efficient method of operation and resource sharing, which

are necessary for sustainable library operations (Keller, 2022). The analysis, however, reveals significant technical integration challenges, particularly in metadata coordination. Nine informants stated that reconciling different metadata standards, including MARC and Dublin Core, was challenging: “combining our legacy data into one schema was technically difficult” (P8). Practice: This paper is an example of the larger problems libraries may encounter in materializing the effective, interconnected systems required to support contemporary practices with digital materials and highlights the need for training resources (Kristyanto and Shintawati, 2023; Saripah *et al.*, 2019). These obstacles require a foundation of capacity-building programs to provide the technical acumen needed to bypass these roadblocks effectively (Saripah *et al.*, 2019).

The important role of funding bodies as a poor determinant for the sustainability of library services also proved to be a significant theme. All members agreed that certain institutions, such as the UGC, are essential for financial assistance, policy formulation, and infrastructure support. As one user mentioned, “This would not have been possible without centralized funding and hosting” (P1). This kind of centralized support is needed today to foster collaboration and help libraries deal with the complexities of automation and implementation (Pritting and Jones, 2015). Furthermore, synchronized training campaigns and policy-level interventions can play a crucial role as drivers in overcoming the identified skill gaps in these institutions, thereby improving the competencies of library staff, which is a precursor to a sustainable library management model.

The success of the union catalog project, Inter-organizational collaboration, Positive A key 10, Strong teamwork across libraries, were listed by 10 people as significant factors in overcoming shared challenges. This joint effort not only promotes the sharing of resources but also expands the scale of service provisioning for future developments such as federated searches and interlibrary loans (Qasim and Shah, 2023). Participants are excited about expanding library alliances and services, indicating the potential to encourage resource sharing in this area.

Concerns around the sustainability of library systems and their long-term maintenance were also expressed, with four participants expressing concerns about server maintenance and funding for future upgrades. It will be important to support libraries financially and technically, so that they can keep up with new developments in technology and users’ evolving needs to stay relevant and continue delivering services at current levels (Adetunla *et al.*, 2023).

In summary, Union cataloging offers the prospect of improved resource discovery and a more collaborative interlibrary environment. In the thematic summary, Table 2 presents the key insights, frequencies, and themes. However, it is accompanied by technical, organizational, and cost implications that must be resolved to ensure successful integration. Libraries should focus on continuous training, invest in infrastructure, and cooperate with others to navigate these complex issues and play their critical role as centers of education and information in the community.

Table 2. Shows the thematic summary table

Theme	Frequency (out of 12)	Key insights
Resource Discovery Benefit	10	Improved access to cross-institutional materials
Metadata Integration Issues	9	Significant barrier due to legacy system differences
Role of Supporting Bodies	12	Funding, training, policy and hosting support were essential
Staff Capacity/Training Need	8	Need for capacity building in VuFind and metadata standards
Inter-institutional Support	10	Strong collaboration fostered project success
Sustainability Concerns	4	Worry about technical upkeep and future funding
Source(s): Authors’ own work		

Limitations

Though VuFind offers some advantages for building the Union Catalog in Bangladesh, it also poses some barriers as a Union Catalog. Some are general challenges, and some are technical challenges. Some general challenges are related particularly to Bangladesh. The general challenges are -

- (1) Lack of government support
- (2) Lack of awareness
- (3) Lack of Initiatives
- (4) Lack of Skilled System Librarians
- (5) Lack of Volunteers

The technical challenge is significant for VuFind as a union catalog. There is no automated VuFind process for importing data from different libraries. Importing data into VuFind is entirely manual. Tech people have to prepare the data for importing into VuFind.

Supporting bodies in Bangladesh

Proposed role of UGC Digital library consortium

UGC (University Grants Commission) Digital Library Consortium was formed in June 2012. That was an excellent achievement for the higher education of Bangladesh. There was no central consortium before the formation of the UGC Digital Library Consortium for managing e-journal subscriptions in Bangladesh. Further to the above, given this solid base and well-established processes, it could safely be said that giving impetus to the UGC Digital Library consortium would have a significant effect on the development and realization of the Union Catalog project.

- (1) Central coordination and management: The UGC Digital Library Consortium can coordinate centrally for the Union Catalog project. Using its experience in controlling e-journal subscriptions, the consortium can monitor and assist in admitting several libraries into the Union Catalog and ensure that all participating libraries adhere to standardized practices and protocols.
- (2) Facilitate Collaboration and Communication: The consortium's information center can serve as a channel for libraries across various universities. Regular meetings, workshops, and professional training help the UGC Digital Library Consortium keep all concerned about the project and play their role in developing and maintaining the Union Catalog through collaborative work.
- (3) Funding and Resource Allocation: As a central organization, the project can generate funds through the UGC Digital Library Consortium. This negotiation takes place vis-à-vis government agencies, international bodies, and other funding sources to drive the allocation of the required funds for hardware, bandwidth, and cloud resources. The consortium also has the power to allocate this money, ensuring that all its libraries have what they need.
- (4) Technical Assistance and Training: The consortium will offer technical assistance and training to library personnel participating in the Union Catalog project. It relates to using VuFind, preparing the MARC21 data and system upkeep. Library staff training regarding the same can be of tremendous use for the successful sustainability and continuation of the UGC Digital Library Consortium project.
- (5) Standardization and Quality Control: The Union Catalog will be effective only if the bibliographic records are standardized and the cataloging practices of different

libraries, including data entry, are uniform. The UGC Digital Library Consortium Standards and Procedures for data entry, metadata format, and cataloging can be framed and implemented. It will improve the quantity and quality of data in the Union Catalog, providing a reliable source for the users.

- (6) Awareness and Advocacy: The UGC Digital Library Consortium could raise awareness of the Union Catalog project among stakeholders—academic institutions, researchers, and policymakers. The second rationale is that the consortium can raise awareness of and build demand for a central biblio, as well as enroll more libraries to promote or provide the resources.
- (7) Monitoring and Evaluation: Finally, the consortium may put in place mechanisms for monitoring and evaluating the union catalog project. It is important to maintain ongoing measures and feedback loops to identify problems and areas for improvement as the project progresses, so that it does not get off track or evolve into something that no longer serves its intended users.

Proposed the role of LiCOB

Bangladesh INAPS-PERI Consortium (BIPC) established in 2007. A national coordination committee operated this consortium. Dr M A Mazed, Director of the Bangladesh Academy of Science, was appointed as a coordinator with all primary contact officers as members. Bangladesh began subscribing to PERI/INASP (Program for Enhancement of Research Information/International Network for the Availability of Scientific Publications), and most public and private universities became subscribing members of this consortium. In 2011, BIPC was renamed LiCob. The author presented the proposed Union Catalog to the director. Moreover, agreed to provide all kinds of support for establishing the Union Catalog in Bangladesh.

Proposed role of ILLF, BD

Inter-Library Loan Forum, Bangladesh (ILLF, BD) is a newly formed library consortium for doing interlibrary loan activities among participating libraries in Bangladesh. It was formed in March 2019 at the Independent University, Bangladesh. Mr. Hossam Haider Chowdhury, Librarian of IUB, is the main initiator of this consortium. The participating institutions are listed in [Table 1](#). However, the author presented a proposal to establish a union catalog for this consortium at its executive committee meeting. He demonstrated the importance and functionality of a union catalog for interlibrary loan. He also demonstrated the union catalog using a dummy union catalog he built with VuFind for the demonstration. The committee members understood the importance and the functions of the union catalog and agreed to implement it. It is an outstanding achievement to establish a union catalog in Bangladesh.

Conclusion

This study has shown that creating and establishing a Union Catalog is possible in Bangladesh. It needs initiative from the experts. It also needs governmental support to establish a stable Union Catalog in a country. Nevertheless, the expert professionals can pave the way for establishing a Union Catalog. Educationalists in developing countries are usually not conscious of library services. Therefore, librarians must play a leading role in this type of library service. However, the importance of Union Catalogs in information discovery and dissemination is invaluable to users and professionals alike. It provides the general public with access to the required information and enables library professionals to develop their skills in resource management and exchange. The development of a Union Catalog System will

provide significant benefits to the library industry in Bangladesh, affirming its productivity in information delivery among institutions. To the extent that the Union Catalog goes live, these benefits will be realized, leading to its further growth and eventual realization as a nationwide Union Catalog. For this initial state, the open-source discovery engine VuFind provides an ideal basis for a proof-of-concept full Union Catalog. Due to its simple implementation, VuFind can be a convenient application for Bangladeshi libraries seeking ready acceptance and evidence of the benefits of a Union Catalog.

Bangladeshi libraries have to lead in this direction by proving their worth as tools for easy access to information, and finally, world libraries must be our inspirational model. This type of proactive activity not only will help us to grow the catalog but also may be brought to mind amongst users and others within the library community for its value and usefulness. Also, the role of supporting organizations is crucial to the makeup of the Union Catalog. The active support and participation of these major stakeholders are vital; the project would almost certainly not succeed without them. These organizations can offer the funding, expertise, and support to make the Union Catalog a reality and success.

In conclusion, the development of a Union Catalog using VuFind in Bangladesh can go a long way toward changing the way information is accessed and shared. A project that, with the cooperative work of librarians and financial support from supporting bodies, will significantly enrich the library's profile. When it is completed, it can create panic amongst academic libraries in Bangladesh, leading to an integrated academic environment enriched with resources.

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