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AI-Driven Transformation in Libraries: AI Features in Open-Source vs. Proprietary Applications

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Abstract

Libraries are fast-growing with the implementation of Artificial Intelligence technologies, trans-forming operations, resource management, and user services. This study examines AI implementa-tion in open-source and proprietary library systems. AI-driven solutions enhance cataloguing, metadata management, search functionality, discovery services, virtual assistance, and personalized user experiences. Proprietary systems are competitive in exploring AI adoption with predictive ana-lytics, automated classification, linked data, discovery services, and virtual assistants. In contrast, open-source systems show potential but require further technological advancements in the current studies. The study also explores the role of AI in digital repositories, research management, and dis-covery services. Future developments should try to improve open-source AI tools to ensure wider accessibility and inclusion of various types of libraries.

Keywords: Artificial Intelligence, Machine Learning, Academic Library, Open-Source Software, Proprietary Software, Library transformation

Introduction

Libraries have continuously embraced advanced technologies throughout history, evolving from custodians of knowledge into modern digital information centers. Early cataloguing methods and practices were established in ancient civilizations such as Alexandria and Mesopotamia. Today, libraries implement advanced technologies, standardized protocols, and user-focused designs to enable easier access to information. Studies indicate that libraries have begun adopting best practices for linked data, which involves using URIs (Uniform Resource Identifiers) to name and access items, provide relevant information, and link to other resources (Heath & Bizer, 2011). Modern libraries are also reimagining user spaces by integrating makerspaces, 3D printing, virtual reality equipment lending, self-service systems, chatbots, and AI-driven tools for individuals with disabilities. Historically, libraries adopted microfilm and microfiche for preservation and access. Major academic institutions such as Cambridge, Harvard, and MIT demonstrate how technologies like digital repositories, e-resources, and AI have transformed library services (Subaveerapandiyan, 2023).

The development of artificial intelligence (AI) has transformed the socio-political landscape and brought attention to the potential for AI to replace librarians in libraries and information centers (Subaveerapandiyan, 2023). Richard Baldwin, an economist from the Geneva Graduate Institute, expressed concerns at the 2023 World Economic Forum, stating, "Somebody using AI will take your job" (Subaveerapandiyan, 2023). While some librarians fear the transformation, others see opportunities to enhance services through AI tools. The automation of library workflows has laid the groundwork for AI integration, revolutionizing cataloguing, classification, and circulation operations. Various projects highlighting AI technologies, including machine learning, chatbots, natural language processing (NLP), and image recognition, to improve library operations and user experiences. The book emphasizes how libraries implement NLP and machine learning in projects related to content and metadata extraction, optical character recognition, and speech recognition (Egyankosh, 2017). It showcases how automated tools can facilitate content accessibility through augmented reality and audiovisual formats. The study compares the features and AI functions used in the open-source solutions for library management systems and data repositories with the proprietary library applications offered by Clarivate, OCLC, and Elsevier.

Literature Review

AI allows information centers to enhance user services, improve operational efficiency, and support strategic planning. AI creates personalized experiences, improving search functionality, self-checkout, and retrospective services. The technology fosters innovative spaces like 3D printing and augmented reality (AR). AI-driven usage analytics allows for decision-making and strategic planning while ensuring the 24/7 availability of library services. The study emphasized AI-based personalized library user services and library

operational support in informed decision-making (Husni & Armizawati, 2024). The author describes that telepresence allows virtual meetings, while humanoid AI (social robots) in public libraries engage users, teach coding, and enhance library interaction by recognizing surroundings, faces, emotions, and behaviors (Tella, 2023). The study highlights how technology enhances "user-friendly interface design, improving search functionality with logical taxonomy, tags, and rich metadata," allowing users to access and interconnect related resources with minimal response time (Panda & Kaur, 2023). The project explores how AI-based summarization improves user experience, especially for special collections like handwritten pamphlets, improving resource quality, visibility, and accessibility (Flannery, 2020). By examining the capability to streamline the research tasks such as "literature reviews, data collection, analysis, citation management, and plagiarism detection". Additionally, it enhances brainstorming, making research more efficient (Meakin, 2024). The study analyzes collection development by analyzing circulation trends, user behavior, and emerging topics; AI enables data-driven purchasing, optimizes budget allocation, and automates licensing (Jothimani et al., 2024). The study says a team uses AI to analyze the statement of responsibility text, generating missing contributor access points and relator codes to advance library efficiency and access (Saccucci & Potter, 2024). Ghadami et al., (2026) present a bibliometric mapping of artificial intelligence applications in supply chain management.

The study examined AI and linked data technologies to enhance resource organization and discoverability. Their approach generates linked subject systems for library cataloguing, improving discovery services by automatically linking data with richer databases, thereby reducing the need for manual classification (Malmsten et al., 2025). The detailed study on the upgradation from an older version of D-Space to D-Space 7. This version features a new Angular-based frontend and a REST API backend, an improved admin interface, batch import/export capabilities, enhanced content recognition, GDPR compliance, easier installation, and better integration with platforms like ORCID and OpenAIRE (Formanek, 2023). Despite the complexities of migration, the upgrade offers improved security and functionality for data repositories. Some investigated how KOHA can cost-effectively use AI technology, like image recognition, by combining open-source AI toolkits with cloud services (Balnaves, 2024).

The projects highlight the potential of open-source AI projects to enhance library services without significant financial investment. Companies like Clarivate, OCLC, Elsevier, and EBSCO offer AI-powered library systems with predictive analysis, personalized recommendations, advanced search, and metadata enrichment features. These systems streamline research, enhance discovery services, and support digitization and preservation through image and voice recognition technologies. Clarivate provides various solutions and resources to support academic and research libraries (p. 3). The offerings of various services, solutions, and resources (Harisanty et al., 2023). To serve as library management services,

metadata services, resource-sharing services, and discovery and reference services for multiple applications are offered (Harisanty et al., 2023). Different offerings of researcher tools and databases to build an institutional strategy with the data-driven library and research operational, ranking based on the research outputs and skills development, especially for the STEM, Open access, and lib-guides.

Results and Discussion

The study results show the comparison of the features offered by the library open-source software like KOHA, Evergreen, D-space, Harvard Dataverse, and Proprietary applications from Clarivate, OCLC, and Elsevier.

Library Open-Source Software:

Cost-effective, customizable, and scalable automation tools are the significance of open-source solutions (OSS). Different expensive and proprietary systems are mainly affordable to premium and big academic institutions. However, the good thing is that OSS like KOHA, Evergreen ILS, D-Space, and Harvard data repositories allow libraries greater accessibility, flexibility, and freedom.

The solutions improve cataloguing, classification, and repository management, inspiring innovation and collaboration within the library community. Deploying AI technologies in OSS helps to evolve and ensure that libraries continue to be in line with the latest technological advancements. This paper highlights essential OSS platforms that have attempted to get the integration status of AI to improve library automation and resource management (Figures 1 and 2).

Library Proprietary Software: technologies

Premium institutions choose a mix of proprietary and open-source library solutions to meet user needs with tailored, user-friendly features, advanced tools, and efficient support. Proprietary library solutions compete to integrate AI and ML for improved and efficient library services. This study examines key features, platforms, user experience, and AI considerations by OCLC, Clarivate, and Elsevier, which have altered library operations through digital innovations, space optimization, resource management, and analytics for informed decisions. These companies have laid a solid groundwork for library automation and modernization (Table 1).

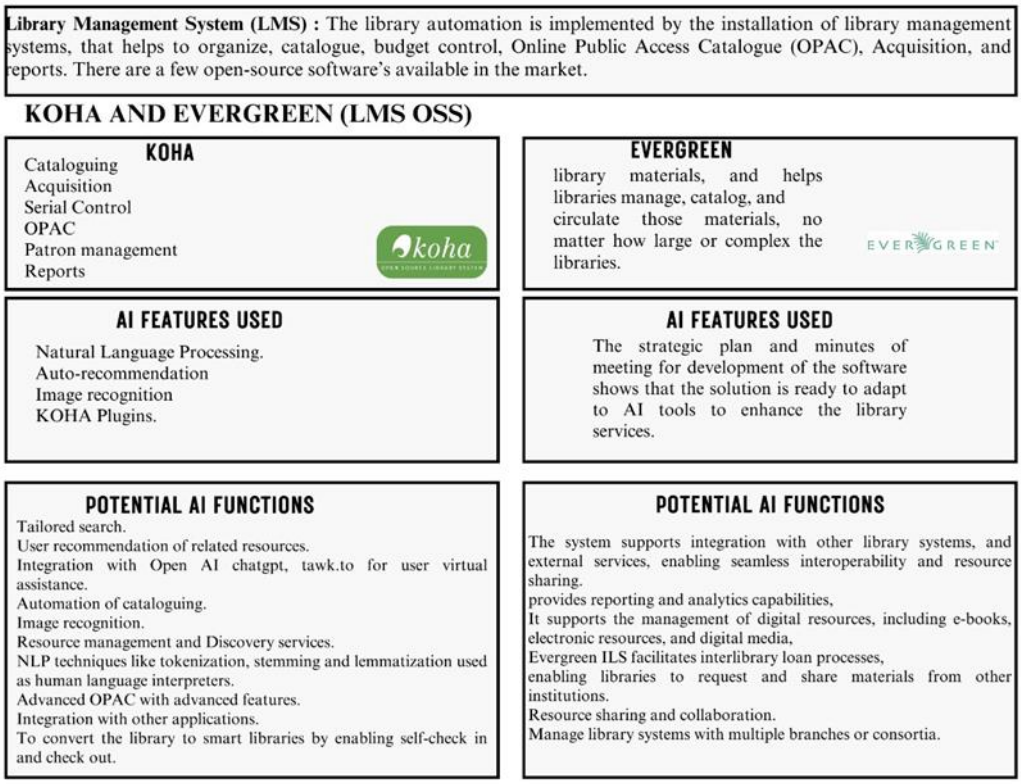

Figure 1. OSS LMS: Features and AI Functions

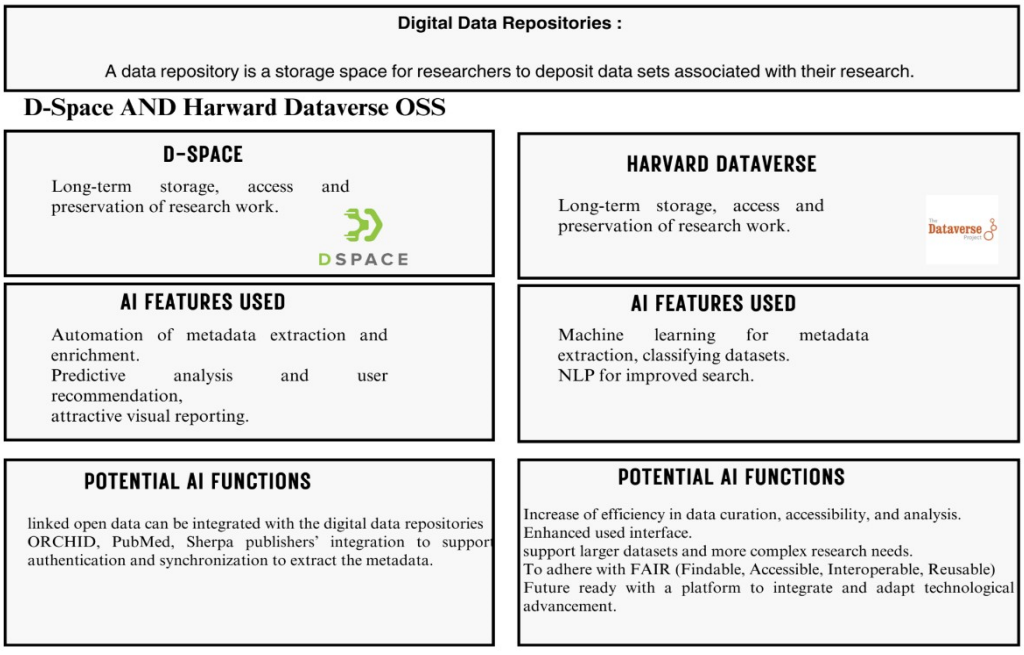

Figure 2. OSS Data Repositories: Features and AI Functions

Table 1. AI Applications and Features of Library Proprietary Solutions

Clarivate	The library products offered and those accompanying Ex Libris and Innovative are under the domain Clarivate Academia and Government, alongside the "Web of Science research platform, EndNote citation and reference tool, RefWorks reference manager, InCites research evaluation tool, Esploro research management system, and ScholarOne journal workflow management tool". The platform/applications offered by Clarivate are Alma, Primo, Leganto, CampusM, Library Mobile, Rapido, Rosette, Alethea, RapisILL, and Aleph. **AI Features** - Library management and research support through NLP-powered search, multilingual options, summarization, and visualization to improve user experience. - Clarivate employs AI-driven automation for acquisition, cataloguing, metadata management, and predictive analytics for collection development. - Enhance research integrity with plagiarism detection and content credibility analysis.
OCLC	There is a wide range of applications and services offered for libraries worldwide by OCLC, which is a non-profit organization founded in Dublin, Ohio. The organization offers community services as well as compete with other products and services in the general library community. OCLC is exploring the use of AI to enhance its resource sharing services, enabling interlibrary loan and document delivery among other libraries. AI-powered systems optimize the routing of requests based on factors such as location, availability, and cost, ensuring that materials are delivered to patrons in a timely and cost-effective manner. The platform/ applications offered by the OCLC are OCLC provides support by geographical area. There are multiple applications for the same purpose in different areas. Choreo Insights, CONTENTdm, EZproxy, GreenGlass, ILLiad, OCLC Meridian, WorldCat, Tipasa, web visibility, WorldCat Discovery, Worldshare, wordlshare inter library loan. **AI Features** • AI algorithms automatically correct the errors in bibliographic records to ensure data accuracy and consistency. • Analyze library automated subject headings and classification numbers, which reduces manual cataloguing efforts. • The library platforms use ML to provide personalized services to library patrons based on user interests and borrowing history. • OCLC is also exploring AI to enhance resource-sharing services. • AI can drastically change and improve technical services, library administration, and user engagement. • Linked data to allow and support the discovery services

Elsevier	Elsevier is one of the leading global providers of scientific, technical, and medical information. To enhance research, teaching, and learning, the company supports the academic community by offering various platforms, services, and initiatives. **AI Features** Extensive databases providing access to peer-reviewed scientific literature enhance research intelligence and analytics, allowing researchers to analyze and benchmark work against that of others through discovery services. Open Access options and maintaining Institutional Repositories (Digital Commons). Advanced Research management tools with advanced metadata extraction tools. Digital notebooks. AI technologies to improve search capabilities, personalize, and enhance the accuracy of research analytics. Researchers can perform text and data mining on the content for better analysis and to promote transparency.

Experimental

A "PRISMA-style flowchart" explains the systematic literature selection process. Initially, 50 records, including journal articles and book chapters, were identified from different databases. Ten records were removed due to duplication and publication dates before 2020, except for one relevant article from 2015, resulting in 41 records assessed for eligibility. Many addressed the ethical usage of AI technologies, with 38 papers and three book chapters included in the qualitative synthesis. Observations were also part of the review, with a screening of various library systems and software websites offering insights into advanced platforms. The technological aspects of each system are examined to aid the findings and conclusions. Additionally, promotional content and research articles from proprietary systems are reviewed to connect offerings with technological advancements. Open-source software (OSS) is categorized into library management systems and data repositories. Tables and figures were designed using Canva online software.

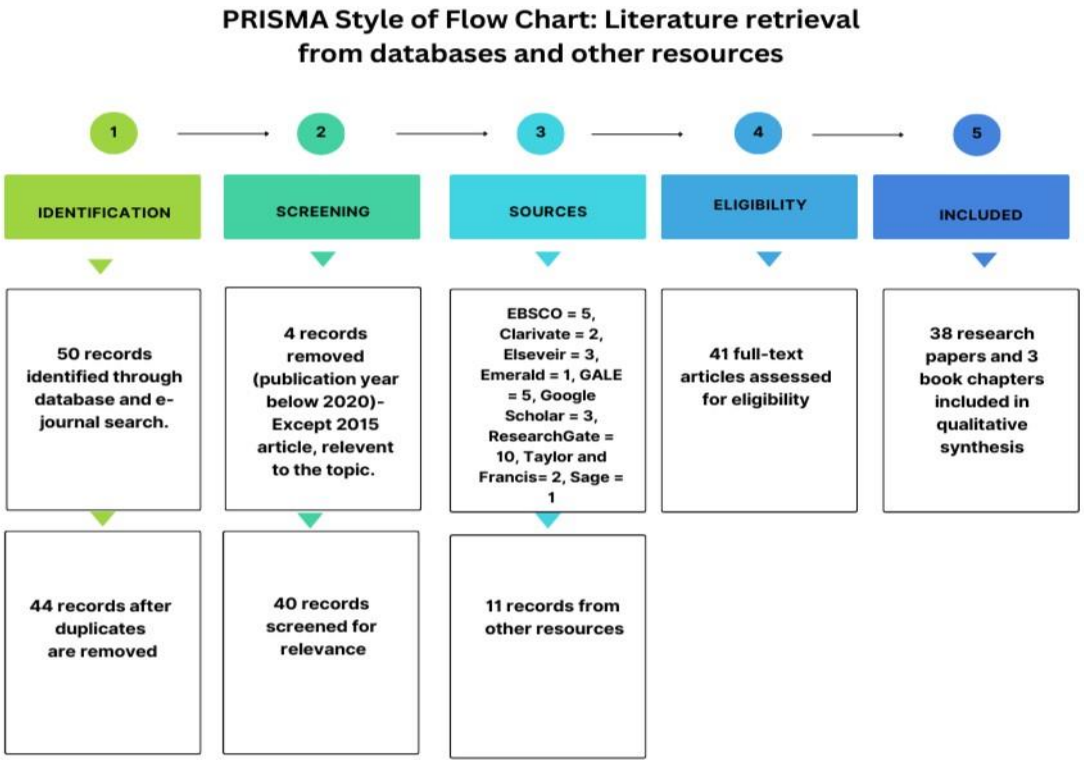

Figure 3. PRISMA Style Literature Review

Conclusion

When deploying AI technology in libraries, it is very important to consider libraries of all types and sizes. The Proprietary systems showcase a strategic and competitive method of adopting AI to achieve and sustain their monopoly in this field. Libraries are transforming with AI tools, improving resource management, discovery services, and user experience through NLP and virtual assistants. The companies support content summarization, metadata extraction, especially for ancient texts, and optimized use of archives and museum resources. Such enhancements convert to smart library spaces where human intelligence and AI collaborate and create "collaborative intelligence." However, such transformations primarily benefit premium institutional libraries. As inclusivity plays a more significant role in the future, well-designed strategies should be developed to enhance open-source software (OSS) to make all types of libraries smart.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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