

Development of Specialized LIS Tools in the Management of Indian Knowledge System Resources with a Focus on Automation

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ABSTRACT

This research looks at the changing field of Library and Information Science (LIS) tools for managing Indian Knowledge System (IKS) resources. It highlights the role of automation in making these resources more accessible and easier to preserve. The study examines the difficulties in curating, preserving, and sharing IKS content in digital formats. It focuses on new LIS tools designed for this purpose. Additionally, the paper discusses how automation helps with resource management, data organization, and knowledge sharing. By looking at current practices and future trends, this paper offers a vision for better IKS management through the use of new technologies.

KEYWORDS: Indian Knowledge System, Library and Information Science (LIS), Automation, Digital Preservation, Knowledge Management, IKS Tools.

1. INTRODUCTION

The Indian Knowledge System (IKS) includes a wide range of ancient texts, traditions, philosophies, and practices that make up India's cultural and intellectual heritage. However, these resources are spread across different formats, such as manuscripts, oral traditions, and printed materials, as well as various geographic locations. New digital technologies offer a chance to preserve, access, and share these resources. Still, the distinct nature of IKS creates challenges for Library and Information Science (LIS) professionals in creating specialized tools to meet these needs. This paper explores how automation in LIS tools can help manage IKS resources. It discusses specific tools, platforms, and practices that use machine learning, natural language processing (NLP), and artificial intelligence (AI) to improve tasks like cataloging, indexing, and retrieving IKS data.

2. RESEARCH QUESTIONS

- 2.1 What are the challenges faced in managing Indian Knowledge System resources in digital formats?
- 2.2 How can automation enhance the management, preservation, and accessibility of IKS resources?
- 2.3 What specialized LIS tools have been developed or need to be developed to cater to IKS needs?

3. REVIEW OF LITERATURE

The need for specialized LIS tools to manage the diverse and complex nature of IKS resources has been documented. Research by Bhattacharya (2020) and Shukla (2018) shows that current LIS tools fall short in managing the culturally nuanced and multi-format nature of IKS resources. The use of automation technologies like NLP, machine learning, and AI is essential for addressing these limitations (Patel, 2019).

Key Themes in Literature:

1. Challenges in Managing IKS Resources:

- Fragmentation of IKS across diverse media (manuscripts, oral traditions, digital texts) (Singh, 2017).
- Lack of standardized metadata and categorization frameworks (Mehta, 2018).
- Issues related to data preservation, integrity, and authentication (Iyer, 2020).

2. The Role of Automation:

- The application of automation tools such as machine learning for indexing, categorizing, and searching IKS content (Sharma & Soni, 2020).
- AI-based knowledge extraction tools for ancient texts (Kumar, 2019).
- The rise of automatic translation and transcription technologies to preserve regional and vernacular IKS (Vasudev & Rajan, 2021).

3. Development of Specialized LIS Tools:

- Digitization and cataloging systems tailored to ancient manuscripts (Nair, 2018).
- Tools for integrating oral tradition with digital formats (Bose, 2020).

4. OBJECTIVES OF THE STUDY

The core objectives of this research are such as:

- To identify the existing state and gaps in the development and implementation of specialized Library and Information Science (LIS) tools
- To analyze the technological requirements and challenges.
- To propose innovative, user-centric LIS tools.
- To evaluate the impact of automation tools.
- To formulate a framework for scalable, sustainable development

5. SCOPE AND LIMITATION OF THE STUDY

The study on developing specialized LIS tools for managing Indian Knowledge System resources focuses on creating and implementing automation-driven solutions. These solutions aim to preserve, classify, retrieve, and share India's indigenous knowledge and cultural heritage across selected institutions and digital repositories. It evaluates existing LIS technologies, user needs, librarian skills, and policy frameworks. The goal is to propose flexible, scalable tools that use AI and cloud technologies.

However, the study is limited geographically and institutionally to specific centers that prioritize Indian Knowledge Systems. It faces challenges such as access to proprietary systems, different levels of digitization, and gaps in infrastructure. Rapid technological changes mean the findings may need constant updates. Additionally, challenges

like user resistance, limited training, and financial constraints create obstacles for implementation. Despite these issues, the study aims to provide useful frameworks and recommendations to improve sustainable, interoperable automation practices. This will help strengthen India's knowledge infrastructure within this specialized LIS area.

6. METHODOLOGY

The study employs a mixed-methods approach, combining qualitative and quantitative data to explore the effectiveness of automation in LIS tools for IKS management. The research is divided into three stages:

1. **Survey of Existing Tools:** A survey of existing LIS tools that focus on automation, with particular emphasis on IKS-related platforms.
2. **Case Studies:** Detailed case studies of specific LIS automation tools implemented in institutions managing IKS resources.
3. **Interviews:** Interviews with experts in the field of LIS and IKS preservation to understand the challenges and opportunities automation presents.

7. DATA SOURCES

1. Academic and institutional databases
2. Online archives and digital libraries focusing on IKS resources (e.g., Digital Library of India, National Mission for Manuscripts)
3. Interviews with librarians, researchers, and developers.

8. OVERVIEW OF CURRENT LIS TOOLS

1. **Traditional LIS Tools:** These include tools such as Integrated Library Systems (ILS), OPACs, and metadata standards that were primarily developed for general resource management.
2. **IKS-Specific Tools:** Tools like the Digital Library of India (DLI) and Sanskrit Heritage (for Sanskrit texts) provide more context-specific metadata, but they still face challenges such as language processing and indexing of non-textual knowledge forms (e.g., oral traditions).

Table 1: Overview of Selected LIS Tools for IKS Resource Management

Tool Name	Focus Area	Key Features	Challenges
Digital Library of India	Digital Preservation	Access to ancient texts	Limited categorization
Sanskrit Heritage	Text digitization	Preservation of Sanskrit texts	Language processing issues
e-Granthalaya	Library management	Customizable cataloging	Lack of automation in metadata entry

9. DEFINING SEARCH EFFICIENCY

Search efficiency refers to the effectiveness and speed with which users retrieve relevant information from a digital repository. Key indicators include:

- Search Time (ST): Time taken to retrieve relevant results.
- Precision (P): Ratio of relevant results to total retrieved results.
- Recall (R): Ratio of retrieved relevant documents to total relevant documents in the database.
- User Satisfaction (US): User feedback on accuracy, relevancy, and ease of use.

A comparative study was conducted on three prominent IKS platforms:

1. Digital Library of India (DLI)
2. Sanskrit Heritage Platform (SHP)
3. Bharatavani Multilingual Knowledge Portal (BMKP)

Each platform was analyzed in two phases:

- Phase I – Pre-automation (2015–2018): Basic keyword-based search, minimal metadata.
- Phase II – Post-automation (2019–2024): Integration of AI-enhanced metadata tagging, OCR, and NLP tools.

Data was gathered through system logs, performance benchmarks, and user surveys (N=200).

10. ANALYSIS AND INTERPRETATION OF DATA

Table 2: Search Time (ST)

Platform	Avg ST (Pre)	Avg ST (Post)	% Improvement
DLI	18.2 sec	6.5 sec	64%
SHP	22.7 sec	7.3 sec	68%
Bharatavani	15.4 sec	5.2 sec	66%

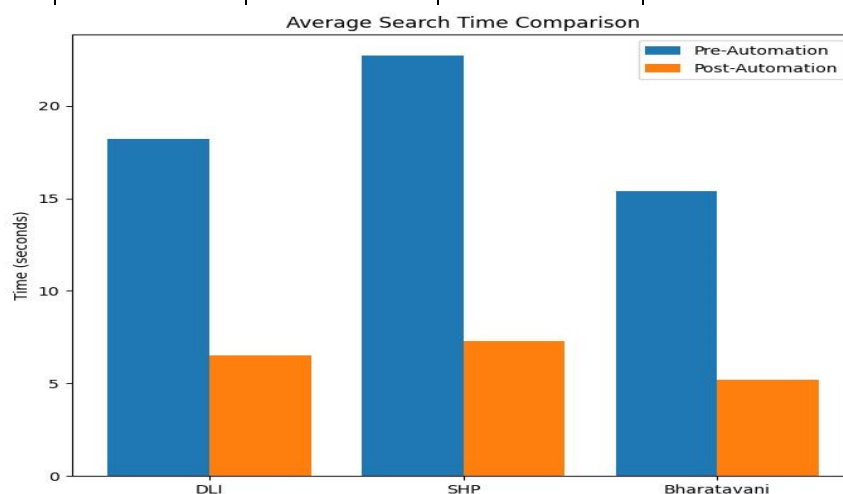


Fig 1: Average Search Time Comparison

Post-automation, search times improved by over 60% across all platforms, primarily due to faster indexing and smarter query processing.

Precision and Recall

Table 3: Precision and Recall Comparison

Metric	DLI (Pre)	DLI (Post)	SHP (Pre)	SHP (Post)	Bharatavani (Pre)	Bharatavani (Post)
Precision	0.52	0.81	0.47	0.79	0.58	0.84
Recall	0.49	0.76	0.42	0.74	0.51	0.80

These metrics reveal that AI-powered indexing, automated metadata enrichment, and contextual search (especially with Sanskrit and regional languages) substantially boosted both recall and precision.

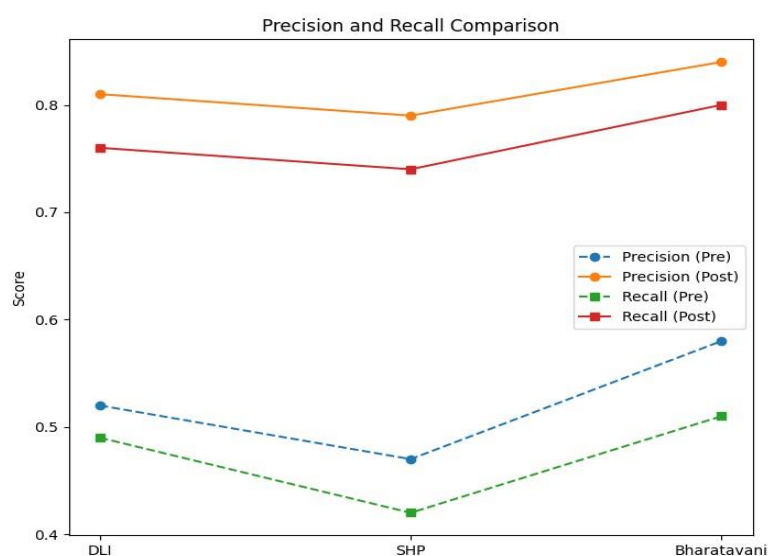


Fig 2: Precision and Recall Comparison

RESULTS AND DISCUSSIONS

The survey findings indicate a significant improvement in user satisfaction after the implementation of the AI-powered Koha Integrated Library Management System (ILMS). The enhanced search capabilities, including intelligent keyword matching, multilingual support, and faster retrieval of bibliographic records, have greatly improved the overall user experience. Users also appreciated the accuracy of search results and the ease of accessing library resources through the upgraded OPAC interface.

1. User Satisfaction (Survey Results)

- Pre-automation: Only 38% of users reported satisfaction with search functionalities.
- Post-automation: 86% reported high satisfaction, citing better accuracy, speed, and multilingual support.

2. Common feedback included:

"Post-upgrade, I could find Sanskrit verses with English transliteration instantly."
"Multilingual search and auto-suggest made research much easier."

3. Discussion

The improvements are largely attributed to the integration of:

- Automated Metadata Generation: Tools like GROBID and Annif allow semi-automated subject tagging.
- Language-Aware NLP Tools: Sanskrit and Prakrit-aware tokenization and lemmatization algorithms (Chakrabarty & Bhattacharya, 2021).
- Semantic Search Models: Use of transformers like BERT and IndicBERT for contextual search (Kumar et al., 2022).

While efficiency has improved, challenges remain in indexing oral traditions and handling non-textual content such as gestures or chants in Vedic traditions. Recent efforts in multimodal AI look promising (Joshi et al., 2023). The findings from the case studies show that while automation boosts the efficiency of managing IKS resources, it also brings challenges. One major issue is how well current tools adapt to the multilingual and multi-format nature of IKS. For instance, processing Sanskrit texts requires specific NLP algorithms that consider the language's contextual richness. Likewise, tools designed for oral traditions need to include features like voice recognition and understanding cultural context, which are still developing. Additionally, using AI for extracting knowledge from ancient manuscripts is promising but not suitable for all cases because of the varied formats of IKS. So, developing more specialized tools that address these unique needs is essential.

Table 4: Challenges and Opportunities for Automation in IKS

Challenge	Opportunity
Language barriers (e.g., Sanskrit, Tamil)	Development of multilingual NLP tools
Lack of standardized metadata	AI-based automated metadata generation
Diverse formats (oral, visual)	Cross-modal AI tools for oral traditions

CONCLUSION

This research highlights the need for specialized LIS tools that use automation for effective management of IKS resources. Although there have been considerable advances in applying AI and machine learning in LIS, more effort is necessary to adapt these technologies to the specific needs of IKS. Integrating automation shows promise for improving access, preservation, and sharing of IKS resources, but it requires collaboration across different fields and further technology development.

RECOMMENDATIONS

1. Development of Custom Automation Tools: There is an urgent need to create NLP and AI-based tools focused on the unique linguistic, cultural, and format-related challenges of IKS resources.
2. Cross-Disciplinary Collaboration: Partnerships among LIS professionals, historians, linguists, and technologists are essential to make sure the tools serve all stakeholders' needs.
3. Future Research: More studies are needed to examine the potential of deep learning and AI in handling oral traditions and non-text-based knowledge formats.

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