



Challenges and Innovations in ICT Adoption for Library Cataloguing

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Abstract

The adoption of Information and Communication Technology (ICT) in library cataloguing has transformed how libraries organise and share books and digital items. This review examines the main challenges and innovative solutions in this field. It synthesises studies, examples, and frameworks from 2015 to 2025 to provide a comprehensive overview. Traditional cataloguing methods, such as manual metadata entry on cards, now encounter difficulties in integrating diverse digital systems. In many regions, particularly under-resourced libraries in developing countries such as India, financial limitations and unreliable internet access pose significant barriers. Staff often lack adequate training, and concerns over data security intensify these issues. The rapid influx of online content, including e-books and videos, requires efficient automation while maintaining bibliographic precision. Innovations offer promising pathways forward. Machine learning tools, a form of intelligent software, automate metadata creation in platforms like Koha or Alma. Blockchain technology provides secure, decentralised tracking of catalog records, enabling tamper-proof sharing in collaborative networks. In India, initiatives like INFLIBNET leverage linked data to enhance interconnections among libraries. These developments combine human oversight with technological support to improve efficiency and searchability. This review suggests that effective ICT adoption depends on enhanced training programs, equitable policies, and collaboration among librarians, technologists, and policymakers. It compares global and Indian contexts to identify gaps and opportunities. Ultimately, robust ICT integration can position libraries as vital gateways to knowledge, benefiting diverse users—from students to everyday readers—in a digital era. The findings advocate for adaptive strategies to navigate evolving technological landscapes.

Keywords— *ICT adoption, library cataloguing, digital transformation, artificial intelligence, metadata management, interoperability challenges*

I. INTRODUCTION

Libraries have always served as key spaces for accessing books and gaining knowledge. However, the advent of computers and the internet has made cataloguing—the task of recording and describing items to facilitate easy discovery—far more intricate. Information and Communication Technology (ICT) encompasses tools such as software applications, databases, and online networks that enable libraries to perform this work more swiftly and accurately. This review investigates the challenges and innovations in ICT adoption for library

cataloguing. Its significance lies in ensuring that well-organised catalogues democratise knowledge, thereby supporting education and research worldwide.

On a global scale, libraries manage vast volumes of digital materials annually. The Library of Congress, for example, incorporated over two million digital books between 2015 and 2020, yet manual processes proved insufficient to handle the volume [1]. This resulted in backlogs and inaccuracies. Organisations like the International Federation of Library Associations (IFLA) promote unified standards, including Resource

Description and Access (RDA), to interconnect catalogues internationally [2]. Nevertheless, obstacles such as elevated costs and skill deficiencies impede advancement. A 2023 study revealed that just 55% of public libraries in Europe have fully integrated ICT into cataloguing owing to budgetary constraints [3].

In India, the scenario mirrors global trends but is influenced by domestic priorities. Home to over 1.3 billion individuals, numerous rural libraries continue relying on paper-based systems, whereas urban centres embrace digital solutions. The National Digital Library of India (NDLI), launched in 2016, aggregates 200 million items from more than 300 sources, though cataloguing non-English materials in languages like Hindi or Tamil presents ongoing difficulties [4]. INFLIBNET, a national network, facilitates catalogue sharing among universities through software like SOUL, connecting 15,000 libraries by 2025 [5]. A 2022 survey by the Indian Library Association indicated that 40% of librarians contend with internet disruptions and insufficient training [6]. The COVID-19 pandemic accelerated digital transitions, yet disparities in rural regions widened further.

This review synthesises over 50 studies spanning 2015–2025, blending international perspectives from UNESCO and OECD with Indian insights from INFLIBNET and DELNET. It seeks to inform librarians and policymakers alike. By analysing issues like data proliferation and solutions such as AI, it demonstrates how ICT can render cataloguing equitable and intelligent. In India, where education fuels national development, robust catalogues are essential for cultivating a knowledge-based society. The subsequent sections address foundational concepts, global and Indian developments, the contributions of ICT and AI, policy frameworks alongside challenges and innovations, a comparative analysis, and prospective recommendations.

II. CONCEPTUAL BACKGROUND AND KEY DEFINITIONS

Cataloguing forms the foundation of library operations. It involves generating records containing essential details—such as title, author, and subject—for each resource, enabling users to locate and access them effortlessly. In essence, it resembles compiling a detailed index for an extensive collection of shelves. Prior to the ICT era, librarians documented these details manually on index cards stored in cabinets. Today, ICT introduces digital efficiencies: computers maintain records in searchable databases that facilitate global linkages.

Understanding core terminology illuminates this evolution. Metadata refers to "data about data," akin to labels on a photograph indicating its date and location. In cataloguing, MARC (Machine-Readable Cataloging) serves as a longstanding format for encoding digital records, though its structure limits adaptability for multimedia content [7]. RDA, revised in 2010, offers greater flexibility for web-integrated information. ICT adoption entails employing technology to streamline these processes, from optical scanning of books to online dissemination of records. Innovations in this domain include artificial intelligence (AI), where algorithms learn from patterns to propose metadata, potentially halving processing times [8]. Early trends in library automation, as outlined in global surveys, further underscore the need for such shifts [33].

Challenges emerge at the conceptual level as well. Inconsistent definitions across institutions often yield incompatible records. A 2018 UNESCO report highlighted in the absence of standardised approaches, international searches encounter failures in 30% of instances [9]. Theoretically, models like FRBR (Functional Requirements for Bibliographic Records) organise materials by distinguishing works, expressions, and manifestations, thereby supporting seamless digital workflows. Implementing such models, however, necessitates comprehensive training.

Critically, this foundational overview underscores that ICT extends beyond mere tools; it demands a paradigm shift in practice. Pioneers like the British Library adopted XML-based metadata schemas as early as 2015, resulting in a 25% enhancement in resource accessibility [10]. For non-technical personnel, however, the transition can feel daunting. Grasping these principles lays the groundwork for practical applications, guaranteeing that cataloguing prioritises user needs over complexity.

Table 1: Global Growth of ICT Adoption in Library Cataloguing (2010–2025)

Year	Adoption Rate (%)	Source
2010	25	[2]
2015	45	[11]
2020	65	[12]
2025	82	[13]

III. GLOBAL DEVELOPMENTS AND CASE STUDIES

Libraries globally are at the forefront of ICT integration in cataloguing. Europeana, an EU-funded endeavour,

consolidates 50 million artefacts from 3,000 collections via linked data standards since 2015, allowing seamless navigation across institutional boundaries and reducing retrieval times [14]. In the United States, the Library of Congress's BIBFRAME initiative supplants MARC with web-oriented schemas, piloted on 100,000 records in 2020 [1]. A 2023 evaluation demonstrated a 40% uplift in discoverability, albeit requiring substantial staff upskilling [3].

Australia's National Library employs cloud-based platforms like Primo for instantaneous updates, managing two million electronic items per year. A persistent hurdle is interoperability, where disparate systems fail to communicate effectively; a 2022 OECD analysis reported that 35% of libraries internationally grapple with format incompatibilities [15]. Innovations in Africa, such as Kenya's iHub network, enable catalogue sharing through mobile applications, extending reach to underserved communities since 2018 [16]. The NDLI/INFLIBNET initiative in India connects 15,000 libraries with 200 million items as of 2025, while Europeana links 3,000 institutions to 50 million resources in 2023, and the World Digital Library spans 200 libraries with 20 million items in 2022 [5, 14, 17].

Critically, these exemplars reveal that outcomes correlate closely with financial support. Affluent countries progress more rapidly, yet open-source alternatives like Koha democratise access—deployed in 4,000 institutions by 2024 [18]. Ethical considerations, including biases in automated tagging, warrant vigilance. Collectively, global patterns favour hybrid methodologies that harmonise legacy practices with contemporary technologies for dependable access, as highlighted in recent analyses of digital initiatives in academic libraries [35].

Table 2: Key Metrics of Selected Digital Cataloguing Initiatives

Initiative	Connected Libraries	Aggregated Items (Millions)	Year
NDLI/INFLIBNET (India)	15,000	200	2025 [5]
Europeana (Global)	3,000	50	2023 [14]
World Digital Library (Global)	200	20	2022 [17]

IV. INDIAN LIBRARY LANDSCAPE AND DIGITAL ADOPTION

India's library ecosystem blends heritage practices with modern advancements. Village-level public facilities frequently depend on manual inventories, contrasting with the comprehensive digitisation in institutions like the Indian Institutes of Technology. By 2025, 60% of higher education libraries have embraced ICT through INFLIBNET's consortia, disseminating 10 million records [4]. Shodhganga, a repository for doctoral theses, encompasses 500,000 digitally catalogued entries since 2017 [19].

Government initiatives have propelled this momentum. The 2019 National Education Policy emphasised digital infrastructure, spurring projects like N-LIST for electronic resources. Rural penetration remains limited, however, with only 25% enjoying consistent connectivity, according to a 2021 DELNET assessment [20]. A notable instance is Delhi University's library, which achieved full automation in 2018 via RFID integration, elevating visitor numbers by 30% [21].

Language barriers persist, with 80% of content in English, sidelining vernacular materials. Critically, adoption exhibits urban-rural imbalances: metropolitan libraries flourish, while modest ones require bolstering. On an optimistic note, NDLI's mobile application engages 10 million users annually, signalling potential for broader inclusivity.

Table 3: ICT Adoption Levels in Academic Libraries (India vs. World)

Category	Global (%)	India (%)	Source
High	65	45	[22, 23]
Medium	25	35	[22, 23]
Low	10	20	[22, 23]

V. ROLE OF ICT, AI, AND DATA MANAGEMENT

ICT revolutionises cataloguing by mechanising repetitive duties. Platforms like Evergreen utilise barcode scanning for immediate record generation. AI elevates this further: machine learning parses texts to assign subjects, as evidenced in OCLC's solutions adopted by 10,000 libraries [24]. Data management safeguards record integrity through application programming interfaces (APIs) that synchronise platforms. The handling of big data volumes in these systems presents both opportunities for enhanced analytics and challenges in storage and processing [34].

Empirically, AI minimises discrepancies; a 2024 Library of Congress trial auto-catalogued 23,000 e-books at 85% precision [1]. In India, AI aids multilingual tagging within NDLI [5]. The deluge of billions of files, however, demands astute storage solutions like cloud repositories.

Critically, AI introduces risks of cultural bias; datasets skewed towards Western publications may overlook Indian nuances. Mitigating this through human validation is imperative. In summary, these technologies render cataloguing scalable, evolving libraries into intelligent knowledge centres.

Table 4: User Satisfaction and Accessibility in Digital Cataloguing — Survey Data

Aspect	India Score	Global Score	Respondents	Source
Search Speed	7.2	8.5	5,000	[25]
Accuracy	6.8	8.0	5,000	[26]
Mobile Access	7.5	8.2	5,000	[27]

VI. POLICIES, CHALLENGES, AND INNOVATIONS

Policies steer ICT deployment. IFLA's 2020 directives advocate open standards, paralleled by India's UGC stipulations tying funding to automation [2, 28]. Foremost challenges encompass cybersecurity, with data breaches surging 14% in the first quarter of 2022 [29]. Budget shortfalls afflict 30% of Indian libraries [30].

Countermeasures abound in innovations. Blockchain fortifies collaborative catalogues, as trialled in Europeana during 2024 [14]. Indian experiments with augmented reality (AR) applications allow book previews via scans [31]. Critically, policies must embed ethical training on data privacy. Such measures convert obstacles into catalysts for advancement.

Table 5: Emerging Technologies Usage Trend in Library Cataloguing Services

Year	AI (%)	ML (%)	AR/VR (%)	Total (%)	Source
2020	20	15	5	40	[13]
2025	67	50	15	132	[24]

VII. COMPARATIVE GLOBAL-INDIAN ANALYSIS

Global ICT adoption reaches 82%, contrasting India's 55% [13]. The USA's Library of Congress deploys AI

comprehensively, whereas India's INFLIBNET prioritises expansive consortia over advanced AI [5, 1]. Challenges diverge: international entities navigate stringent privacy regulations, while India contends with infrastructural deficits [15].

India distinguishes itself through vernacular adaptations, such as localised tagging, against global emphases on universal standards. Critically, India could emulate open-source models to narrow divides, promoting equitable knowledge dissemination.

VIII. FUTURE PROSPECTS AND RECOMMENDATIONS

Projections indicate AI dominating with 80% adoption by 2030 [32]. For India, UGC-led national training in AI is essential. Recommendations include forging partnerships with technology providers, allocating funds for rural connectivity, and conducting pilot implementations. These actions will align catalogues with user expectations.

IX. CONCLUSION

This review illuminates how ICT is reshaping library cataloguing, navigating a landscape of formidable challenges and transformative innovations. From conceptual underpinnings to global exemplars like Europeana and Indian milestones in NDLI, a narrative of interconnected knowledge emerges, accelerating discovery. AI and data management herald efficiencies, yet impediments like resource scarcity and competency gaps necessitate proactive responses. The comparative lens reveals India's distinctive trajectory—robust in collaborative networks, yet poised for technological augmentation.

Central insights advocate hybrid paradigms: technology augments, while human expertise steers. User contentment escalates with intuitive systems, as empirical data affirms. Horizons brim with interconnected, intelligent catalogues, empowering learners universally.

Practically, libraries ought to commence modestly—equipping staff with free tools like Koha and pursuing cloud subsidies. Policymakers should formulate inclusive frameworks and champion rural digitisation. Academic curricula must incorporate ICT modules. Through these imperatives, libraries will anchor India's developmental narrative and the global information continuum. In essence, fortified cataloguing erects inclusive conduits to enlightenment, ensuring participation in our digital epoch remains universal.

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