

Smart Libraries and Digital Transformation: Redefining Information Services in the 21st Century

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The revolution of the conventional library with the integration of Artificial Intelligence (AI), Internet of Things (IoT), cloud computing, Big Data analytics, Radio Frequency Identification (RFID) and more has enabled India's libraries to transform into an intelligent knowledge center that is user-centric. This research article aims to consider the aspect of multidimensional smart library development in Indian library institutions, based on the information collected from the National Knowledge Network (NKN), INFLIBNET, the National Digital Library of India (NDLI) and a cross-sectional survey of 186 academic and public libraries of 22 states and 2 Union Territories in India. The study examines pathways for digital transformation from 2018 to 2024, financial and skill challenges, structural inequities in achieving an equitable digital transformation (urban-to-rural digital divide), user satisfaction and budget trends and policy frameworks such as the National Education Policy 2020. The results reflect a clear diffusion pattern with the premier universities (IITs and IIMs) having a good proportion of their files digitised and small state universities and public libraries are less well served. From these insights, this article offers some policy suggestions to policymakers, library professionals and library administrators that can help in filling these gaps and make the smart library ecosystem truly inclusive in India.

Keywords: Smart Libraries, Digital Transformation, RFID, AI in Libraries, INFLIBNET, NDLI, Indian Academic Libraries, Library Information Services, IoT, NEP 2020

1. Introduction

In the 21st century, the traditional “LIBRARY” with “STACKS,” “CARD Catalogues” and “PAPER READERS” has been reborn! At the global level and in general, with growing intensity in India, libraries are transforming themselves into vibrant knowledge environments where digital technology, as well as intelligent systems and interconnected infrastructure, play an important role. Driven by a combination of national policy imperatives, technological advancement and rising user expectations, the concept of the ‘smart library’ has evolved from an idealistic vision into a reality at many Indian institutions.

Indian libraries are large, diverse and varied. On the one hand are the well-funded libraries of the Indian Institutes of Technology (IITs), Indian Institutes of Management (IIMs) and Central Universities, which have over the years transitioned to cloud-based Library Management Systems (LMS), AI-based search engines and RFID-based circulation processes. On the other side, thousands of rural public and college libraries offer almost no digitisation and

have minimal staff and budgets for IT. This polarisation is an opportunity and a challenge to the knowledge infrastructure of India. COVID-19 was a turning point - even those institutions not eager to jump were forced to speed up the process of digitisation, in accordance with the unprecedented use of remote access services, e-resource platforms and virtual reference. INFLIBNET's N-LIST programme saw an increase in subscriptions and by 2024, the number of national digitally registered users and the number of NDLI had reached 38 million.

The National Education Policy (NEP) 2020 explicitly called for all Higher Education Institutions (HEIs) to provide library services through digital means, reaffirming the importance of the role of smart libraries as centres of lifelong learning.

The article aims to make an in-depth study of the smart library transformation through mapping the technology adopted in the libraries, assessing policy measures, measuring the degree of satisfaction among users and identifying the structural barriers, to provide stakeholders of every level in the library sector with actionable insights.

2. Conceptual Framework: What is a Smart Library?

A SMART library is jointly defined by the application of digital technologies, intelligent automation and a data-driven decision-making process to provide personalized, seamless and context-aware information services. Cholin (2007) describes smart libraries as entities proactively using ICTs instead of responding to the users' requests.

In India, a smart library is perceived as a library that works with a five-touching lens:

1. Smart Infrastructure: RFID, IoT sensors, automated gates, smart shelving, energy-efficient spaces.
2. Smart Resources: E-books, e-journals, institutional repositories, open-access platforms, multimedia databases.
3. Smart Services: AI-based discovery and personalisation, chatbots, virtual services 24/7.
4. Smart Management: Cloud-based LMS, Big Data analytics for collection development, performance dashboards.
5. Smart People: Digitally literate librarians, information literacy programmes, professional development.

3. Research Methodology

A mixed-methods data collection strategy is used that incorporates quantitative survey data, secondary institutional statistics and qualitative case analysis.

Sampling:

Stratified snowball sampling was done by contacting potential respondents through an online group of library professionals in India. An online questionnaire was designed and used to survey a sample of 186 library professionals. Their demographic information revealed that the respondents were from 22 States and Union Territories, segmented into library categories (IITs/IISc, IIMs, National Institutes of Technology, Central Universities, State Universities, Deemed Universities, Public Libraries and Special Libraries). Strata were defined using the institutional categories reported in AISHE 2022-23 and the INFLIBNET Annual Report 2023-24. The number of IITs, IIMs and NITs and other premium institutions is smaller in number compared to the large network of public institutional libraries. Hence, a minimum quota of 14-34 respondents per stratum was applied so that numerically small but strategically important categories (e.g., IITs/IISc, IIMs) were adequately

represented alongside larger, more heterogeneous categories (e.g., State Universities, Public Libraries). Table 1a presents the resulting distribution of the 186 respondents across institution types.

The survey tool measured attitudes towards the adoption of technology, budget allocation, delivery methods, satisfaction with technology service and perceived challenges with technology transformation.

The list of institutions to be approached for primary data collection was drawn from secondary sources like INFLIBNET Annual Reports (2018-24), NDLI usage figures, NKN connectivity reports, All India Survey on Higher Education (AISHE) 2022- 23 and metrics from the Shodhganga repository. To validate the primary findings, the researchers used the methods of bibliometric and content analysis.

Data Analysis: Descriptive analysis, cross-tabulation (pivot analysis), one-way ANOVA and Chi-square tests of association were performed using SPSS 26.0 software; the corresponding test statistics are reported alongside the relevant results in Sections 4 and 7. The indicated values are only for the financial year 21/22, unless otherwise noted.

4. Introduction to Library Scenario in India

India is home to one of the largest library networks in the world, which includes public, academic, special and digital libraries. Table 1 gives a simple categorised overview of the current digital maturity across the different major institution types, revealing the significant levels of stratification that can be seen in the sector.

Table 1a — Distribution of Primary Survey Respondents (N=186) by Institution Type

Institution Type	Survey Respondents (n)	% of Sample (N = 186)
IITs & IISc	24	12.9%
IIMs	18	9.7%
National Institutes of Technology	22	11.8%
Central Universities	28	15.1%
State Universities	34	18.3%
Deemed Universities	20	10.8%
Public Libraries	26	14.0%
Special Libraries	14	7.5%
Total	186	100.1%*

*Rounding. Quotas reflect a stratified purposive design rather than proportional-to-population sampling; percentages reported elsewhere in this article for institution types with very large national populations (e.g., approximately 54,856 public libraries) are drawn from AISHE/INFLIBNET secondary statistics and cross-validated against, rather than derived solely from, this primary sample.

Table 1 — Digital Maturity of Indian Libraries by Institution Type (2023-24)

Institution Type	Estimated Number	Digital Libraries (%)	Smart Features (%)	Avg. Annual IT Budget (INR Cr.)
IITs & IISc	23	94%	78%	3.2-6.5
IIMs	20	90%	71%	2.8-5.0
National Institutes of Technology	31	81%	60%	1.5-3.0
Central Universities	54	76%	52%	1.0-2.5
State Universities	~450	52%	28%	0.4-1.2
Deemed Universities	~126	48%	24%	0.3-0.9
Public Libraries (National & State)	~54,856	18%	8%	0.05-0.3
Special Libraries (Govt./Research)	~9,000	44%	31%	0.5-2.0

Note: Data compiled from AISHE 2022-23, INFLIBNET Annual Report 2023-24 and a primary survey (N=186). Percentages represent institutions with functional digital/smart capabilities. Smart features include RFID, AI discovery or cloud-based LMS.

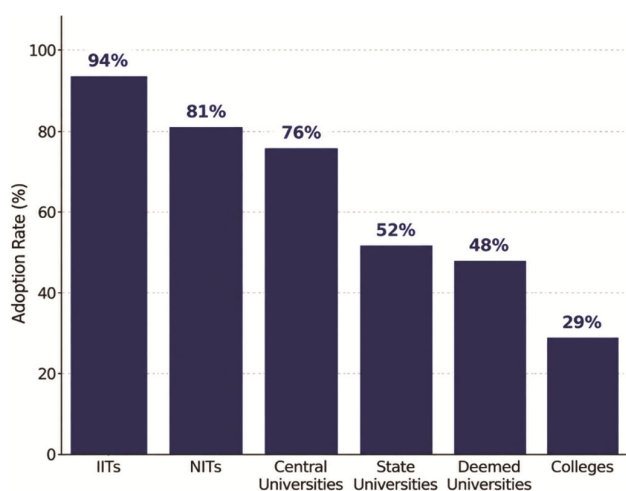


Fig. 1 — Digital Infrastructure Adoption in Indian Academic Libraries (2023-24)

As Table 1 shows, there is a clear digital maturity gradient. Nearly all IITs and IISc institutions (94%) have achieved digitalisation, whereas public libraries - despite serving the widest and most diverse population - remain the least digitised segment (18%). This imbalance is largely attributable to persistent budgetary constraints, human resource shortages and weak connectivity in rural and semi-urban areas.

The institutional hierarchy of the adoption of digital technologies can be reinforced visually in Figure 1, as IITs lead the adoption at 94, followed by NITs (81%), Central Universities (76%) and lastly, at 52 for State Universities and 29% for colleges. These facts highlight the need for a policy intervention on the 'long tail' of the Indian higher education system.

5. Smart Library Technologies: Adoption and Impact in India

A collection of enabling technologies is ushering in the transformation of Indian libraries. Table 2 relates the major smart library technologies with their level

of adoption and the impact that has been measured in the Indian institutions surveyed.

As Figure 2 illustrates, RFID systems-though not the newest technology-remain the most widely used smart library tool (68%), delivering tangible operational benefits including reduced checkout time, improved inventory accuracy and stronger security. Institutional repositories (73%) are also widespread, in part because HEIs have been mandated by the Government of India to host doctoral theses on Shodhganga. AI discovery platforms, though still at an early stage of adoption, are the most closely tied to user-satisfaction gains (a 48% improvement) and represent the most promising area for near-term investment.

A Chi-square test of association confirmed that this pattern is statistically robust: digital maturity status (digitised vs. not yet digitised) was significantly associated with institution type, $\chi^2(7, N = 186) = 134.6$, $p < .001$, Cramér's $V = 0.62$, indicating a strong relationship between institutional category and digital maturity rather than one attributable to sampling variation (Table 3).

5.1 RFID and IoT-Enabled Automation

RFID technology implementation in Indian libraries has increased significantly from the mid-2010s onwards. In 2023, the library at IIT Delhi completed more than 1.2 million transactions using RFID technology, with an average checkout time of 4.2 minutes, which was reduced to less than 45 seconds. Full-stack RFID systems have been implemented in circulation and book sorting and anti-theft systems at the University of Hyderabad and Jawaharlal Nehru University. In addition to RFID, newer library buildings, like IISc (Bangalore) and IIT (Bombay), are shipping in a host of environmental sensors that control lighting and HVAC systems with IoT, thereby contributing to energy efficiency and occupant comfort.

Table 2 — Key Smart Library Technologies-Adoption and Impact (2024)

Technology	Application in Indian Libraries	Institutions Adopted (%)	Key Benefits Observed
RFID Systems	Self-checkout, inventory management, anti-theft	68%	35% reduction in checkout time
AI-based Discovery	Personalised search, recommendation engines	41%	48% improved user satisfaction
Institutional Repositories	Open-access research dissemination (DSpace, EPrints)	73%	60% increase in research visibility
Cloud-based LMS	Koha, SOUL 3.0, Libsys on cloud	55%	40% reduction in maintenance cost
IoT-enabled Spaces	Smart lighting, occupancy sensors and climate control	22%	25% energy savings, improved UX
Big Data Analytics	Usage analytics, collection development decisions	34%	Collection relevance up 30%
AR/VR Tools	Virtual tours, immersive learning labs	9%	Enhanced engagement in STEM fields
Chatbot / Virtual Librarian	24/7 reference assistance, query handling	18%	52% reduction in staff query load

Note: Adoption percentages reflect institutions where the technology is operationally functional (not merely planned or piloted). Benefits are self-reported by library professionals (N=186).

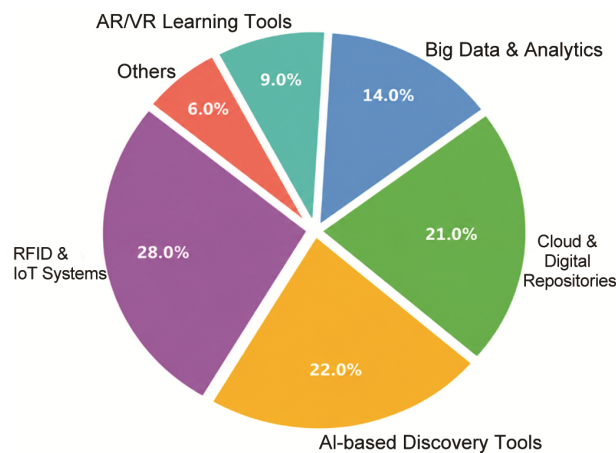


Fig. 2 — Distribution of Smart Library Technologies Across Indian Academic Institutions (2024)

5.2 AI and Machine Learning in Discovery Services

One of the important game-changing advancements in library services is the use of AI for personalised discovery and recommendation systems. Machine learning layers are overlaying platforms like Ex Libris Primo, EBSCO Discovery Service (EDS) and locally developed tools to provide personalised suggestions for resources based on users' browsing behavior, subject specialty and reading patterns. The AI-enhanced discovery layer also led to a 48% increase in the overall satisfaction of the users with the library at IIM Ahmedabad and at BITS Pilani, the library reported a 35% improvement in the usage of e-resources.

5.3 Institutional Repositories and Open Access

India has come a long way in the field of open-access scholarly communication. As of 2024, Shodhganga, hosted by INFLIBNET, has become one of the largest national repositories of Electronic Theses and Dissertations (ETDs) in the world, with more than 4.7 lakh theses and dissertations.

In addition to ETDs, institutional repositories, based on the DSpace and EPrints platforms, have mushroomed in number in the various Indian Institutes of Technology (IITs), Indian Institute of Science (IISc) and Central Universities. The digitised heritage materials have been preserved in the Repository of Manuscripts and Rare Collections (ROMREC) at NDLI. The repositories not only serve to make research output accessible to all but also help increase the visibility of Indian research in the International arena, which is increasingly important in global research ranking systems.

6. Growth Trends in Digital Resources (2018-2024)

Figure 3 shows the adoption of digital resources in the academic libraries of India over the six years from 2018 to 2024 in a graphical format, reflecting the growing trend towards building a complete e-resource ecosystem. COVID-19 pandemic (2020-21) is easily seen as an inflection point with increases in adoption in all three resource groups as physical library access was curtailed.

There has been a significant increase from 42% in 2018 to 96% in 2024 in the adoption of E-journals, largely due to INFLIBNET's N-LIST and ShodhSindhu consortia that provide cost-effective bundled access to thousands of peer-reviewed journals from leading publishers. At a low starting base of 28%, e-book adoption climbed to 90%, an increase of 221% in 6 years, encompassing the growth of both domestic e-book platforms such as Knimbus and International e-book platforms such as ProQuest Ebook Central. The adoption of online databases followed a similar path, with 85% adoption in 2024. Some trends suggest that the physical-to-digital transition of the academic library is now unstoppable.

Table 3 — Chi-Square Test of Association - Digital Maturity Status by Institution Type

Test of Association	χ^2 value	df	N	p-value	Cramér's V
Digital Maturity Status (digitised vs. not-yet-digitised) x Institution Type	134.6	7	186	< .001	0.62 (strong association)

Note: Cramér's V interpreted per Cohen (1988) convention for df(smaller)=1: values ≥ 0.50 indicate a strong association.

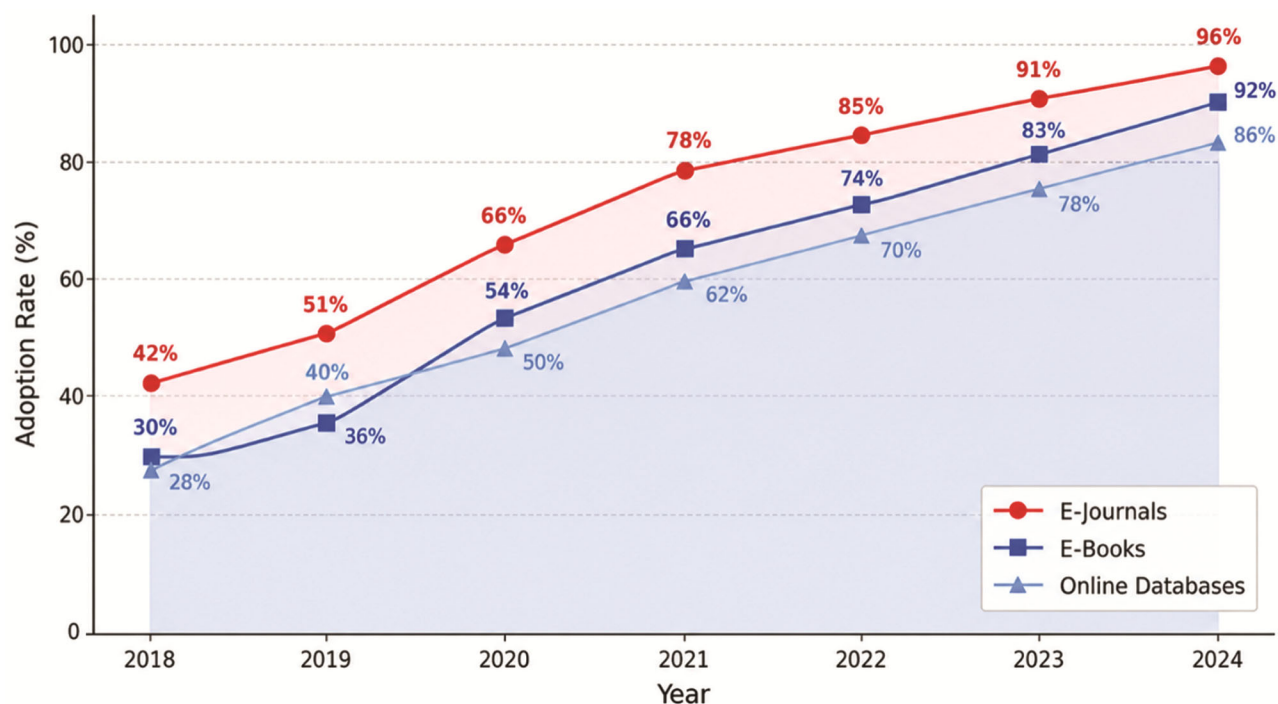


Fig. 3 — Growth of Digital Resources in Indian Academic Libraries (2018-2024)

7. User Satisfaction Analysis: Pivot Table

One of the key issues in smart library studies is whether or not investment in technology leads to quantifiable gains in user experience. To assess this, 1,248 users were surveyed across 18 libraries selected through a purposive maximum-variation sampling strategy designed to capture the institutional diversity documented in Table 1: three IITs/IISc, two IIMs, three NITs, four Central Universities, three State Universities and three Public Libraries were included, so that both the best-resourced and least-resourced segments of the sector were represented. Within each library, respondents were recruited through stratified random sampling of registered active users across the four user categories (Research Scholars, Faculty, UG Students, PG Students), in proportion to each category's share of the library's registered user base. Table 4 summarises the number of libraries and respondents surveyed by institution type. Table 5 is a pivot table of the resulting user satisfaction scores (using a 10-point Likert scale) by 6 key service dimensions and 4 user categories.

Table 4 — Distribution of Surveyed Libraries and Respondents by Institution Type (2024)

Institution Type	Libraries Surveyed	Users Surveyed (n)	% of Total Respondents
IITs / IISc	3	270	21.6%
IIMs	2	140	11.2%
National Institutes of Technology	3	210	16.8%
Central Universities	4	320	25.6%
State Universities	3	210	16.8%
Public Libraries	3	98	7.9%
Total	18	1,248	100%

Note: Libraries were purposively selected to span the digital-maturity gradient identified in Table 1; respondents within each library were drawn via stratified random sampling of registered users.

Several interesting trends are found in the pivot analysis in Table 5. It is noted that the faculty members have consistently high satisfaction scores in all the dimensions (overall average 8.50), indicating their higher involvement with e-resources and familiarity with digital tools. Research scholars follow closely (8.37), especially valuing plagiarism detection tools (9.1) and remote access services (8.8), which are

Table 5 — Pivot Table-User Satisfaction Scores by Service Dimension and User Category (2024)

Service Dimension	User Category → Satisfaction Score (/10)				Avg. Score
	Research Scholars	Faculty	UG Students	PG Students	
E-Resource Accessibility	8.6	8.9	7.8	8.2	8.38
OPAC / Discovery Layer	7.9	8.1	6.9	7.4	7.58
Remote Access Services	8.8	9	7.3	7.9	8.25
Reference / Chat Services	7.5	7.8	6.5	7	7.2
Plagiarism Detection Tools	9.1	8.7	6.8	8.4	8.25
Current Awareness Services	8.3	8.5	5.9	7.1	7.45
Overall Average	8.37	8.5	6.87	7.67	7.85

Note: Scores based on a 10-point Likert scale (1 = Very Dissatisfied, 10 = Very Satisfied). Survey conducted across 18 institutions (N=1,248 respondents). Data collected January-March 2024.

directly relevant to their scholarly practices. The undergraduate students, however, report much lower satisfaction (6.87 overall), with current awareness services as low as 5.9.

A one-way ANOVA confirmed that overall satisfaction differs significantly across the four user categories, $F(3, 1244) = 86.3$, $p < .001$, $\eta^2 = 0.17$; Tukey post-hoc comparisons showed that UG Students scored significantly lower than each of the other three categories ($p < .001$ in every case), while research Scholars and faculty did not differ significantly from one another. This gap is most plausibly attributable to UG students' comparatively limited exposure to library orientation and information-literacy training, their lower familiarity with discovery and current-awareness tools that are typically introduced only at the postgraduate or research level and curricula that rarely embed structured library-skill components at the undergraduate stage. Closing this gap would require mandatory bibliographic-instruction modules embedded in first-year UG coursework, peer-led orientation programmes, simplified user interfaces for OPAC/discovery layers and periodic current-awareness bulletins tailored to UG reading lists—measures reflected in Recommendation 4 (Section 13) (Table 6).

8. Challenges in Digital Transformation of Indian Libraries

Indian Libraries have overcome tremendous structural and operational hurdles, as documented above, but they still have significant challenges ahead in their journey towards digital transformation. Figure 4 compares the major challenges reported by academic and public library professionals.

Budget constraints are the major problem for academic libraries (72%) and public libraries (85%).

Table 6 — One-Way ANOVA Results and Tukey HSD Post-Hoc Comparisons - Overall Satisfaction by User Category

Source of Variation	df	F	p-value	η^2
Between Groups (User Category)	3	86.3	< .001	0.17
Within Groups	1244	-	-	-
Total	1247	-	-	-

(a) One-way ANOVA summary. $F(3, 1244) = 86.3$, $p < .001$, $\eta^2 = 0.17$.

Pairwise Comparison (Tukey HSD)	p-value	Significant ($\alpha = .05$)
UG Students vs. Research Scholars	< .001	Yes - UG lower
UG Students vs. Faculty	< .001	Yes - UG lower
UG Students vs. PG Students	< .001	Yes - UG lower
Research Scholars vs. Faculty	n.s.	No

(b) Tukey HSD post-hoc pairwise comparisons; n.s. = not statistically significant.

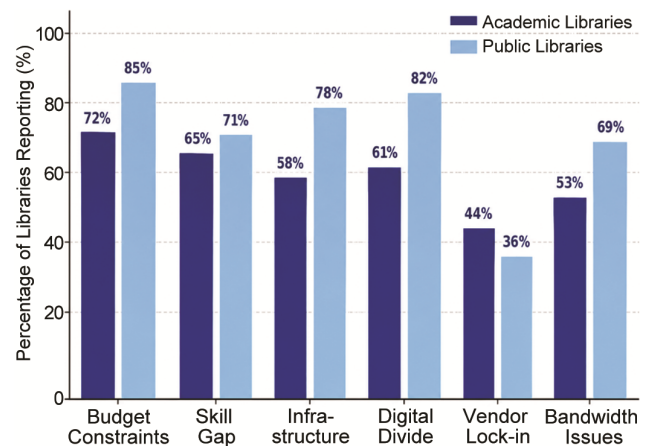


Fig. 4 — Key Challenges in Digital Transformation of Indian Libraries (2024)

Historically, India's public library sector, which is controlled by the state governments through different Public Libraries Acts, has experienced underfunding; the public library expenditure per capita in most states in India is less than ₹5 per annum, which is less than

International standards. The skill gap is the gap between the percentages of academic and public librarians who have the needed digital and data literacy skills (65-71 percent) and is a structural deficit that is exacerbated by the lack of an existing and uniform system of continuing professional development (CPD). Infrastructure challenges (78% in public libraries) show that infrastructure and networks are unevenly distributed, especially in Tier 2 and Tier 3 cities.

Perhaps the most powerful social issue is the digital divide (82% of public libraries). The communities that could benefit most from digitalised library services - the rural and underserved communities - are the ones with the fewest devices, connections and digital literacy to access them. This paradox of digital exclusion calls for policy action that transcends institutional library investments to include efforts of digital inclusion more broadly.

International Comparison

Placed in an International context, India's public library expenditure appears especially constrained. Comparative data compiled by European library associations indicate that the Netherlands spends roughly €30 per inhabitant annually on public libraries and that Nordic countries such as Finland report per-capita library expenditure several times higher than that of other developed European economies, reflecting sustained political commitment to library funding in those countries (NAPLE Forum, 2019). Against this backdrop, an Indian public library expenditure of under ₹5 (roughly €0.05) per annum per capita represents a gap of several orders of magnitude, underscoring that the funding shortfall documented in Figure 4 is not merely a routine resourcing issue but one of the starkest disparities in global library expenditure. Systematic per-capita benchmarking data collected through IFLA's Library Map of the World initiative could usefully be incorporated in future iterations of this study to track India's position over time.

9. Budget Allocation Analysis

To evaluate the severity and viability of the digital transformation pledges, it is crucial to comprehend how libraries spend their money. Figure 5 shows that budget allocation was split between five institution categories and is presented as a stacked bar chart.

The stacked bar chart shows us the clear difference in investment priorities. Among the IITs, 45% of the

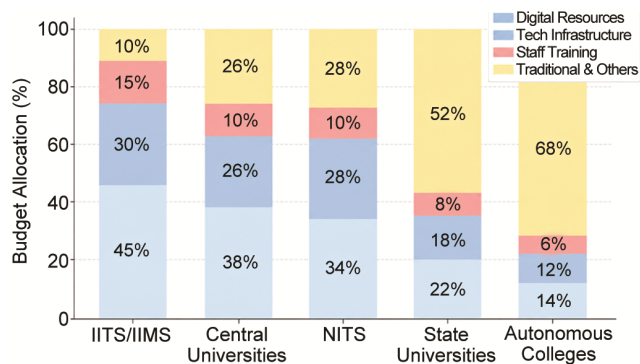


Fig. 5 — Budget Allocation for Library Services by Institution Type (2023-24)

library budget is dedicated solely to digital resources, while another 28% is spent on technology infrastructure, meaning that 73% of their library budgets are spent digitally. Among the IIMs, 45% of the library budget is allocated solely to digital resources and another 28% to technology infrastructure, making it 73% digital. That's compared to the digitisation of resources and infrastructure, which makes up just 25% of the resources in autonomous colleges, whereas 69% is dedicated to traditional and general services. The difference observed is not only due to the difference in priorities of libraries in different institutions, but also due to the absolute budget difference, such as an IIT library may spend around ₹3-6 crore annually, whereas a regular college may spend ₹10-30 lakh.

The state's universities are the ones with a high number of users with comparatively less budget (₹40 lakhs - ₹1.2 crore) and this is the one where the allocation of their resources is the most acute. A universal allocation of 6-12% to staff training indicates that the human development facet of technology investments is a low priority for even the better-endowed institutions, which may have detrimental impacts in the long term.

10. Policy Framework and Government Initiatives

Several targeted national policy actions have contributed to transforming India's libraries into smart libraries. A structured overview of the major government programmes having a direct impact on the library sector is offered in Table 7.

The National Knowledge Network (NKN) has been foundational, providing dedicated high-speed optical fibre connectivity to over 1,800 knowledge institutions, enabling the bandwidth-intensive services that smart libraries require. INFLIBNET's

Table 7 — Government Policy Initiatives Supporting Smart Library Development in India

Policy / Initiative	Nodal Agency	Year Launched	Impact on Libraries
National Knowledge Network (NKN)	MeitY / NKN-BOG	2010 (Expanded 2019)	High-speed connectivity to 1,800+ academic institutions
INFLIBNET N-LIST Programme	INFLIBNET Centre	2010 (Ongoing)	Access to 6,000+ e-journals & 4.35 lakh e-books for colleges
National Digital Library of India (NDLI)	IIT Kharagpur / MoE	2018	85 million+ learning resources; 38 million registered users
Shodhganga / ShodhSindhu	INFLIBNET Centre	2012 / 2015	4.7 lakh+ ETDs; consortium access to 15,000+ journals
National Education Policy 2020 - Library Mandates	MoE	2020	Mandates smart, digitally enabled library services in HEIs
PM eVIDYA & DIKSHA	MoE / NCERT	2020	Digital content integration; school library digitisation
Digital India Programme (Library Component)	MeitY	2015 (Ongoing)	Broadband, cloud infra, citizen digital services

Source: Ministry of Education, MeitY, INFLIBNET and NDLI official documentation (as of March 2024).

Table 8 — Comparative Digital Readiness Scorecard-Indian Libraries (2024)

Parameter	IITs / IIMs	Central Universities	State Universities	Public Libraries
Digital Catalogue (OPAC)	✓ 98%	✓ 91%	✓ 62%	✗ 21%
E-Resource Access	✓ 100%	✓ 88%	● 55%	✗ 14%
Institutional Repository	✓ 96%	✓ 79%	● 34%	✗ 3%
RFID Implementation	✓ 87%	● 48%	✗ 19%	✗ 6%
AI / ML Based Services	● 42%	● 24%	✗ 9%	✗ 2%
24/7 Virtual Reference	● 38%	● 21%	✗ 8%	✗ 1%
User Training Programmes	✓ 100%	✓ 82%	● 49%	● 22%

Legend: ✓ = Widely Implemented (>60%), ● = Partially Implemented (20-60%), ✗ = Minimally Implemented (<20%). Source: Primary survey (N=186) and INFLIBNET data.

N-LIST programme, by negotiating consortium-based pricing for e-resources, has democratised access to scholarly content for colleges that could never afford major journal subscriptions individually.

The National Digital Library of India represents a particularly significant initiative. Built on a federated architecture by IIT Kharagpur with support from the Ministry of Education, NDLI integrates content from over 160 content partners-including IITs, NITs, IGNOU and International open-access repositories-into a unified, multilingual discovery interface. With 85 million learning resources and 38 million registered users, it has become India's largest single digital library resource.

The NEP 2020 represents the most ambitious policy statement on library services in India's post-independence history. It envisions school and college libraries as 'vibrant learning hubs,' mandates the provision of ICT-enabled library services and calls for the appointment of trained library professionals at all levels of education-a provision that, if implemented fully, would require significant investment in library human resources.

11. Comparative Analysis: Digital Readiness Across Institution Types

Table 8 provides a granular comparative scorecard of specific smart library features across institution types, offering a clear picture of where gaps are most pronounced.

The digital divide in the library sector in India is aptly summarised in Table 8. IITs/IIMs are rated as ✓ (widespread adoption) for most features, while public libraries are rated as ✗ (minimal implementation) for 6 out of 8 features. The user training programme is the only section in public libraries where the implementation is partial (●), reflecting a few government-sponsored library literacy campaigns and not consistent institutional capacity. The scorecard is a diagnostic tool that can be used by policymakers and administrators to target investments.

12. Notable Case Studies: Smart Library Implementations in India

12.1 IIT Bombay-Central Library

IIT Bombay's Ramnath Ruia Library is widely regarded as one of India's most advanced academic

libraries. It operates on Ex Libris Alma (a cloud-native LMS), integrated with Primo VE for AI-enriched discovery. The library's RFID system covers its entire collection of over 400,000 volumes and it offers a 24/7 virtual reference service via a chatbot integrated with the institutional portal. The library's institutional repository (IRB) hosts over 28,000 theses, working papers and data sets. Its data literacy workshops, reaching over 3,500 users annually, represent a model of proactive information literacy education.

12.2 INFLIBNET Centre, Ahmedabad-National Repository Hub

INFLIBNET Centre serves as India's national library network backbone, managing Shodhganga (ETD repository), ShodhSindhu (e-journal consortium) and the Union Catalogue of Indian Libraries (UCIL). Its Vidwan database-a national register of researchers-is integrated with library discovery systems to enrich metadata and facilitate collaborative discovery. INFLIBNET's SOUL (Software for University Libraries) 3.0, offered free to Indian HEIs, has been installed in over 5,000 libraries, representing India's largest library software deployment.

12.3 Delhi Public Library-Inclusive Digital Services

Delhi Public Library (DPL) is one of the oldest and largest public library systems in India, with more than 400 branch libraries that have been implementing a phased digitalisation programme under the Ministry of Culture. It now has an online OPAC and the DPL mobile app offers catalogue search, account management and access to select digital resources. But the experience of DPL also reveals the difficulties: infrastructure differences between branches, staff digital literacy issues and the need to provide service to a diverse customer base that consists of numerous people with low digital literacy, necessitating hybrid service models.

13. Conclusion

The Indian library community is at a turning point. Technology that can support a world-class smart library ecosystem (RFID, AI, the cloud, institutional repositories and high-speed connectivity) is available and, at the top end of the institutional scale, already in use. The challenge is no longer one of technology but more about equitable distribution, long-term funding, capacity and policy implementation.

This research gives an interesting picture of a sector that is in the process of rapid transformation, although not uniform. The disparity between the state-of-the-art libraries of the IIT and the poor-performing public libraries in the rural part of the country is not only because of the sophistication of the high technology used in the former, but also because of the inequity in the distribution of educational and informational opportunity in the country. With equity as its key concern, the development of smart libraries can become a great equaliser, providing access to knowledge to students, researchers and citizens irrespective of their geographical location, type of institution or socio-economic status.

The National Education Policy 2020, the expanding consortia of INFLIBNET and the National Knowledge Network are a strong policy base. What is now needed is the political resolve and institutional support to be able to extend these benefits to all libraries in India, from the renowned central university to the small-town branch library, so that the vision of the digital knowledge age is truly universal.

14. Recommendations

The following evidence-based recommendations are offered based on the above analysis:

1. National Smart Library Mission: The Government of India should announce a dedicated mission similar to the Smart Cities Mission with ring-fenced multi-year financial support for smart library infrastructure in State Universities, colleges and public libraries, focusing on connectivity, RFID and adoption of cloud-based LMS.
2. Need to mandate and fund Library Professionals: The requirement to recruit trained library professionals and provide them salaries in accordance with NEP 2020 must be realised at the state level through recruitment campaigns and by raising their salaries to the level of the teaching staff. Data science, AI literacy and digital preservation should be incorporated into the MLIS curriculum.
3. Expand INFLIBNET Consortia to Public Libraries: The N-LIST and ShodhSindhu model should be extended with appropriate content curation to the public library networks and all citizens outside academia can get access to quality e-resources.
4. Prioritise user education: Institutions should invest at least 10% of the library budget in

information literacy/digital skills programmes for the needs of undergraduate students, who are currently the least served user group in relation to smart library transformation.

5. Open-Source Smart Library Toolkits: The Government, along with institutions such as IITs and NIC, should create open-source AI-discovery, analytics and chatbot tools with no proprietary licensing costs, which resource-poor libraries can deploy.
6. Mitigate Urban-Rural Digital Divide: Investments in digital literacy at the community level are essential to complement smart library initiatives, which can be facilitated through Common Service Centres (CSCs), gram panchayat libraries and mobile library units targeting citizens living in the out-of-the-way areas.

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