GMR
The Original

FROM ICT GAPS TO INTELLIGENT LIBRARIES: WHAT HAS CHANGED SINCE 2012—AND WHAT HAS NOT?

Dr Mange Ram[1], Dr Rajbir Singh[2]

[1]University Librarian, Central Library, Dayalbagh Educational Institute, Dayalbagh, Agra, Uttar Pradesh, India, **Email:** mangeram@dei.ac.in
[2]Former Librarian, Vaish P.G. College, Rohtak, Haryana, India
***Corresponding Author**: Dr Mange Ram, Email: mangeram@dei.ac.in

ABSTRACT
University libraries' digital development depends not only on acquiring technology but also on reliable connectivity, trained staff, institutional support, user guidance and sustainable stewardship. This paper re-examines a 2012 thesis-based comparative survey of five state and five central university libraries in North India through the lens of innovations available by 2026. The historical findings show that 4 of 5 state libraries (80%) reported external-support needs for staff training, connectivity/bandwidth, digitisation and institutional repositories, and a new library building. Among central libraries, 4 of 5 (80%) reported a need for staff training, while 3 of 5 (60%) identified needs for connectivity, digitisation/repositories, and a new building. The paper does not treat these figures as current measurements. Instead, it distinguishes enduring needs—access, competence, trust, funding and preservation—from changing mechanisms such as national e-resource licensing, cloud services, integrated discovery and AI-assisted research support. It argues that innovation can improve how libraries respond to longstanding needs, but cannot eliminate the need for skilled staff, reliable infrastructure, ethical governance, and stable institutional investment. The small historical sample limits generalisation; a contemporary follow-up survey would be required to establish present conditions.

KEYWORDS: Academic Libraries; Digital Infrastructure; Institutional Capacity; Library Development; North India; Staff Training; University Libraries

1. INTRODUCTION

Digital transformation in academic libraries is frequently discussed through visible outputs—computers, library-management systems, electronic journals, repositories, and online services. Yet the availability of technology does not automatically produce equitable access or dependable service. Infrastructure must be maintained; staff need opportunities to develop technical and instructional competence; users need usable access points; and digital collections require sustained workflows, policies, and institutional responsibility. When any one of these elements is weak, the practical value of investment may be reduced.

This issue is especially relevant when comparing libraries operating under different institutional and resource conditions. The thesis underlying this paper examined selected central and state university libraries in North India. Its comparative chapter describes a pattern in which state libraries had a higher combined number of computers, while central libraries more consistently reported internet access. At the same time, both groups identified constraints involving staffing, connectivity, digitisation, space, and user ICT skills. These observations suggest that a single indicator—such as computer count—cannot adequately represent institutional digital readiness.

The present paper deliberately isolates a distinct analytical strand from the thesis: reported constraints and requests for external support. Unlike a paper centred on the inventory of ICT facilities or user-level information-literacy experiences, this analysis asks what kinds of institutional support libraries said they needed and how those needs can be translated into a practical development sequence.

2. Research objectives and questions

The study has three objectives: (a) to compare the external-support needs reported by selected state and central university libraries; (b) to identify recurring constraints affecting the provision of electronic facilities and resources; and (c) to develop a phased, evidence-linked framework for prioritising institutional support.

The analysis addresses two questions: Which support needs were most frequently reported by the two groups of libraries? What do the reported patterns imply for planning digital-library capacity beyond the purchase of technology?

3. LITERATURE REVIEW

Research on ICT in academic libraries has repeatedly treated infrastructure, automation, staffing, training, and service delivery as interdependent concerns. A review of ICT applications in Indian college libraries by Hanumant and Tadasad

(2021) synthesised literature across different types of institutions and highlighted the need to understand the extent and pattern of ICT adoption rather than assuming uniform development. Such review-based evidence provides context for interpreting local surveys, although it cannot substitute for direct measurement in each institution.

Recent work on digital-library development has also emphasised that barriers are not independent. Raju and Patnala (2024), using Interpretive Structural Modelling and MICMAC analysis with domain experts in India, identified institutional policy, financial resources, management support, and physical and technological infrastructure as relevant barriers. Their modelling approach differs from the descriptive survey analysed here, but the emphasis on interacting institutional conditions is consistent with a capacity-oriented interpretation.

A 2025 study of remote-access services in Indian academic libraries similarly identifies infrastructure limitations, digital-literacy gaps, and authentication security as challenges that must be addressed alongside access expansion (Vaishnav & Sharma, 2025). This reinforces the distinction between making digital content available and ensuring that users can access and use it reliably. In the present thesis-derived dataset, training, bandwidth, digitisation, and space appear as recurrent support requests. These findings are best understood as institution-specific evidence that complements, rather than generalises beyond, the wider literature.

A gap addressed by this paper is the translation of descriptive support-needs data into an actionable prioritisation framework. The goal is not to claim a new universal model, but to show how a small comparative survey can inform a transparent sequence of institutional decisions.

4. METHODOLOGY

4.1 Research design and setting

The paper uses a descriptive, comparative secondary analysis of library-level findings reported in the thesis's comparative chapters and conclusions. The analytical units are ten selected university libraries: five state university libraries in Haryana, Punjab, and Uttar Pradesh, and five central university libraries in North India. The thesis used librarian/library-level questionnaires and a separate user questionnaire; this paper analyses only the library-level findings relevant to institutional constraints and external-support needs. The fieldwork year was confirmed as 2012 by the thesis author. The 2026 section is a contextual interpretation of later policy and technological developments, not a new survey of these institutions.

4.2 Data extraction and analysis

Counts and percentages were extracted from the thesis narrative and comparative tables and are presented with counts wherever possible. Each group contains five libraries; therefore, one library corresponds to 20 percentage points. The reported group percentages were not subjected to inferential testing, and no statistical significance or causal effect is claimed. Challenge categories reported together in the thesis conclusion are treated as a combined challenge set rather than as separate item-level frequencies. The paper does not interpret self-reported needs as audited expenditure, objective network-performance measurements, or verified system-uptime data.

4.3 Scope and limitations of the source

The evidence is a historical baseline from 2012 and does not establish the current condition of the same libraries. The thesis provides a small library-level sample, and some challenges are summarised collectively rather than reported as separate frequencies. The analysis preserves the thesis's reported categories and does not infer missing values. The exact fieldwork month, institutional ethics documentation, and author-contribution details were not established from the materials reviewed; these should be confirmed from original records before submission.

5. Contemporary context: interpreting 2012 evidence in 2026

The original survey was conducted in 2012. Its percentages and institutional observations must therefore be treated as a historical baseline, not as evidence of the present condition of the same libraries. The purpose of this paper is not to suggest that the 2012 results describe today's infrastructure. Instead, it compares the kinds of problems recorded in 2012 with the new tools and policy environment available by 2026, asking which underlying needs persist and how the means of addressing them have changed.

The continuity is important. Libraries still require dependable access to information, adequate funding, trained staff, reliable networks, discoverable collections, user guidance, privacy, and sustainable preservation. Innovation changes the delivery mechanisms, not the underlying public-service purpose. A library may move from local computer workstations to cloud-hosted platforms and AI-assisted discovery, but it still needs trusted metadata, accessible services, responsible staff, secure systems, and long-term institutional commitment.

Table 1. Interpreting the 2012 baseline alongside the 2026 innovation environment

The 2026 column is contextual analysis based on official policy information and contemporary literature; it is not a new survey of the ten institutions. ONOS began operations in January 2025, with Phase I approved for 2025–2027 and access to more than 13,000 journal titles through national licensing for eligible institutions (Government of India, 2024; One Nation One Subscription, n.d.).

Generative AI creates another shift. It can assist with discovery, summarisation, translation, metadata workflows and research support, but it also increases the need to verify sources, protect personal and institutional data, disclose appropriate AI use, and teach users to evaluate machine-generated answers. UNESCO's guidance recommends a human-centred approach that addresses privacy, ethical validation, equity and capacity building. AI should therefore be treated as a layer

that augments professional judgement—not as a replacement for librarians or information-literacy instruction. (Miao & Holmes, 2023)

This comparison must be read carefully: the 2012 survey did not measure AI, cloud services, contemporary national licensing, or present-day research data services. The paper does not retroactively attribute these concepts to respondents. Instead, it uses the historical findings to identify enduring needs and then discusses how contemporary innovations may respond to those needs.

6. Findings

Dimension	What the 2012 thesis reported	2026 context: changed tools, enduring need
Connectivity and access	Internet access was uneven across the selected state libraries; bandwidth and reliability were reported as concerns.	Cloud platforms, remote authentication and large-scale digital access have expanded possibilities. Reliable connectivity, cybersecurity and equitable access remain essential.
Electronic resources	Libraries reported uneven e-resource use and a need for user training.	National licensing initiatives such as ONOS broaden access for eligible institutions, but discovery, authentication, awareness and effective use still require local library support.
Staff capacity	Training and retention of skilled staff were recurring concerns.	Staff now need continuing development in AI literacy, research data, digital preservation, metadata, copyright, privacy and evaluation of online information—not just basic ICT operation.
Digitisation and repositories	Digitisation and institutional repositories were identified as support priorities.	Repository platforms and digital workflows are more mature, but long-term preservation, rights clearance, metadata quality, backups and stewardship remain institutional responsibilities.
Information literacy	Users needed instruction in finding and using information and electronic resources.	Information literacy now also includes AI-generated content evaluation, source verification, algorithmic awareness, data literacy and ethical use of generative AI.
Automation and discovery	The thesis focused on library software, computer workstations and local digital services.	Integrated discovery, cloud-based library systems, APIs and AI-supported search can improve workflows, but system interoperability, transparency and human oversight are still needed.
Funding and governance	Libraries reported funding, space, maintenance and staffing constraints.	New technology introduces recurring costs for licences, compute, security, training and governance. Innovation cannot substitute for stable budgets and accountable institutional planning.

6.1 External-support priorities in state university libraries

Four of the five state university libraries (80%) reported needing external support for staff training, improved internet connectivity and bandwidth, digitisation and institutional repositories, and a new library building. The thesis table also records requests for funds for computers and electronic resources from two libraries (40%) and support for library-management software/automation from two libraries (40%). These figures suggest that the most frequently reported needs extended beyond procurement: workforce capability, connectivity, digital preservation/development, and physical space were all prominent.

Table 2. External-support priorities reported by state university libraries (2012)

Support area	Libraries reporting need (n=5)	Percentage
Training of library staff	4	80%
Improve internet connectivity and bandwidth	4	80%

Digitisation and institutional repositories	4	80%
New library building	4	80%
Funds for computers and e-resources	2	40%
Library-management software and automation	2	40%

6.2 External-support priorities in central university libraries

In the central-university group, the thesis reports that four of five libraries (80%) required external support for training of library staff. Three of five libraries (60%) reported needs relating to internet connectivity/bandwidth, digitisation and institutional repositories, and a new library building. The same comparative summary indicates that four of five central libraries (80%) did not require external support for library-management software/automation and for routine library operations/services. This does not establish that all systems were fully adequate; it records the support responses as summarised in the source.

Table 3. External-support priorities reported by central university libraries (2012)

Support area	Libraries reporting need (n=5)	Percentage
Training of library staff	4	80%
Improve internet connectivity and bandwidth	3	60%
Digitisation and institutional repositories	3	60%
New library building	3	60%
Library-management software/automation: no external support required	4	80%
Routine library operations/services: no external support required	4	80%

6.3 Recurring constraints affecting electronic facilities and resources

The thesis conclusion reports that four state libraries (80%) faced a set of recurring challenges involving insufficient funds for hardware and e-resources, difficulty retaining or recruiting trained staff, lack of computers, internet speed and reliability, computer security, incomplete automation, frequent power cuts, limited library space, and low ICT literacy or e-resource use among users. In the central group, three libraries (60%) were reported as facing the listed set of challenges. Since the thesis summarises these as a group of challenges rather than providing a separate count for every item in the narrative, the percentages should not be interpreted as item-specific frequencies.

Table 4. Recurring challenge cluster reported in the thesis conclusion

Reported challenge cluster	State libraries	Central libraries	Interpretive note
Funding for hardware and e-resources	Reported by 4/5 (80%) as part of the listed challenge set	Reported by 3/5 (60%) as part of the listed challenge set	Budget and recurring maintenance are linked
Staffing and training	Included in the listed challenge set	Included in the listed challenge set	Skills and retention affect service continuity
Connectivity, power and security	Included in the listed challenge set	Included in the listed challenge set	Reliability matters as much as nominal access
Space, computers and automation	Included in the listed challenge set	Included in the listed challenge set	Physical and digital capacity interact
Low ICT literacy/e-resource use	Included in the listed challenge set	Included in the listed challenge set	User support must accompany access

6.4 The infrastructure paradox: more computers do not necessarily mean better access

The comparative chapter lists 303 computers across the five state libraries and 205 across the five central libraries. The state-group total is therefore higher in absolute terms. However, the same source reports internet access in four of five state

libraries (80%) and all five central libraries (100%). These are aggregate group-level counts; they do not control for differences in enrolment, staff size, opening hours, computer condition, or the proportion of machines reserved for staff. They should not be used to rank the groups by overall service quality.

Table 5. Selected infrastructure indicators reported in the thesis

Indicator reported in thesis	State libraries	Central libraries
Libraries surveyed	5	5
Total computers reported	303	205
Libraries with internet access	4/5 (80%)	5/5 (100%)
Libraries reporting staff-training support need	4/5 (80%)	4/5 (80%)
Libraries reporting digitisation/repository support need	4/5 (80%)	3/5 (60%)

The comparison points to a measurement issue for library planning: hardware totals are an input measure, while meaningful access depends on availability, reliability, maintenance, location, and user support. A sound assessment should therefore record not only how many computers exist, but how many are operational, accessible to users, connected reliably, and supported by trained staff.

7. DISCUSSION

The first key finding is the high frequency of staff-training needs in both groups. Four of five libraries in each group requested external support for training. This is important because digital services require more than the installation of a system: staff need the competence to maintain workflows, support users, manage electronic resources, and contribute to digitisation and repository processes. The evidence does not reveal which specific competencies were weakest, so a training programme should begin with a local skills audit rather than assume a uniform deficit.

Second, connectivity remains a practical concern even where computer facilities are present. The state-library group reported a higher combined computer count but lower reported internet coverage than the central group. The data cannot establish why this difference occurred, nor can they show the quality of each connection. They do, however, support the recommendation that institutions monitor uptime, bandwidth, user-to-workstation ratios, equipment condition, and access restrictions as separate indicators.

Third, digitisation and institutional repositories were recurring support priorities. These activities should be treated as long-term institutional functions, not isolated projects. Sustainable repository work requires selection and rights review, metadata standards, file management, preservation planning, quality assurance, staff time, and clear responsibility for ongoing maintenance. Funding a scanner or repository platform without these elements risks creating an incomplete or poorly sustained service.

Fourth, the reported need for new library buildings in both groups indicates that physical space remained part of the digital-development problem in the surveyed institutions. Digital services still depend on suitable study spaces, accessible workstations, reliable power, network infrastructure, and staff areas for processing and support. Space planning should therefore integrate physical and digital service requirements.

Finally, the responses that some libraries did not require external support for software or routine operations should be interpreted narrowly. They may indicate that these areas were not the most urgent external-support requests, not that all processes were optimised. A useful funding framework should separate baseline operational responsibility from needs that genuinely require shared, regional, or national support.

8. A Phased Institutional-Support Framework

Table 6. Proposed phased institutional-support framework (author-developed)

Phase	Priority actions	Suggested indicators	Responsible level
1. Diagnose	Conduct infrastructure, skills, access and workflow audit	Operational workstations; connectivity uptime; staff skills matrix	Library and university administration
2. Stabilise	Address power, network reliability, equipment maintenance and user access	Monthly uptime; repair turnaround; user-access hours	University IT/works units and library
3. Build capability	Create recurring training for e-resource support,	Training completion; demonstrated	Library leadership, HR and training partners

	metadata, digitisation, repository workflows and information-literacy instruction	competencies; support requests resolved	
4. Develop digital stewardship	Adopt repository, digitisation, metadata, rights and preservation procedures	Items processed; metadata completeness; documented preservation checks	Library, research office and IT unit
5. Review and improve	Review service outcomes and allocate annual recurring budgets	Annual service dashboard; budget execution; user feedback	Library committee and institutional leadership

The framework is a proposed interpretation based on the support needs reported in the thesis, not an intervention tested by the original study. Libraries should sequence actions according to local audits and avoid treating the percentages as a universal ranking for all institutions.

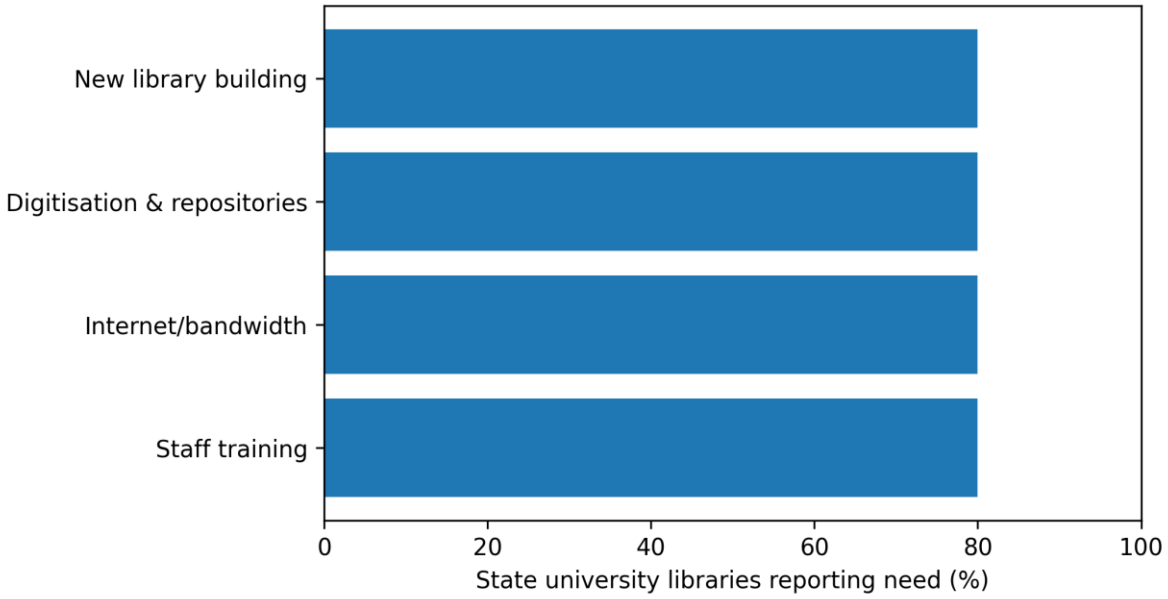

Figure 1. Most frequently reported external-support priorities among the five state university libraries. Source: thesis comparative chapter; 4 of 5 libraries reported each listed need.

9. Implications for policy and practice

At the institutional level, library development plans should combine capital expenditure with recurrent spending for connectivity, maintenance, training, and digital stewardship. At the university level, libraries should be represented in IT, research-data, accessibility, and infrastructure planning, since repository and e-resource functions cross organisational boundaries. At the system level, shared training, repository support, technical templates, and cooperative procurement may reduce duplication, but shared services should not replace local responsibility for content quality and preservation.

Funding proposals should be evidence-led. A request for additional computers, for example, should be accompanied by information on operational machines, usage patterns, user demand, connectivity, maintenance, and access equity. Likewise, digitisation proposals should specify selection criteria, copyright review, metadata standards, storage and backup, staff capacity, and long-term responsibility. This approach turns broad expressions of need into measurable development plans.

10. Limitations and future research

The study is limited to ten selected university libraries in North India and uses a small library-level sample. Because each library represents 20 percentage points within a group, percentage differences should be interpreted cautiously. The fieldwork was conducted in 2012; the findings are historical and do not establish present-day conditions. Several challenge categories are summarised collectively in the thesis narrative rather than reported as separate item-level frequencies. The study also lacks audited expenditure, network performance logs, system uptime data, and longitudinal outcome measures.

Future research should repeat the survey with a larger, clearly defined stratified sample and report the fieldwork period, institutional characteristics, questionnaire items, response rates, and analysis procedures. Triangulation with technical audits, staff competency assessments, access logs, repository audits, and budget records would help distinguish reported needs from observed service performance. A longitudinal or intervention design would be needed to test whether training or connectivity improvements produce measurable changes in e-resource use, repository completeness, or user satisfaction.

11. CONCLUSION

The thesis-derived comparison suggests that digital-library development in selected North Indian university libraries was constrained by a combination of staff capability, internet connectivity, digitisation and repository needs, physical space, equipment, funding, and user ICT literacy. Training was the most consistently reported external-support priority across both groups, while connectivity, digitisation, and building needs were also prominent. The difference between the groups' aggregate computer totals and reported internet coverage illustrates why hardware counts alone are an inadequate measure of digital readiness. A practical response is to combine local diagnostics, reliable infrastructure, recurring staff development, sustainable digital-stewardship workflows, and periodic review. These conclusions are descriptive and historical; they require verification against the complete thesis tables and should not be presented as current national estimates.

DECLARATIONS

Ethics statement: The paper analyses findings previously reported in the thesis and does not collect new participant data. The thesis materials reviewed did not document ethics approval or exemption; the authors must verify the original institutional record before submission.

Data availability: The findings are derived from the thesis's comparative chapters and conclusions. No new dataset was generated for this manuscript. The underlying thesis tables are the source for the reported counts and percentages.

Author contributions: The authors should confirm and approve the final contribution statement before submission.

Competing interests: To be confirmed by the authors before submission.

Funding: No funding from any sources.

Acknowledgements: None stated in the source materials reviewed.

REFERENCES

1. Hanumant, P., & Tadasad, P. G. (2021). ICT applications in Indian college libraries: A review of literature. Journal of Library and Information Communication Technology, 10(1), 38–44. https://doi.org/10.5958/2456-9399.2021.00006.7
2. Raju, R., & Patnala, R. K. (2024). Evaluating barriers to digital libraries development: Insights from Interpretive Structural Modeling (ISM) and Cross-Impact Matrix Multiplication (MICMAC). Malaysian Journal of Library and Information Science, 29(3). https://doi.org/10.22452/mjlis.vol29no3.4
3. Vaishnav, A., & Sharma, P. (2025). Remote access services transforming library resource utilization in India: A strategic digital evolution. Journal of Information Systems Engineering and Management, 10(3), 1139–1154. https://doi.org/10.52783/jisem.v10i3.6874
4. Government of India. (2024, November 25). Cabinet approves One Nation One Subscription (ONOS). Press Information Bureau. https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=2077098
5. Miao, F., & Holmes, W. (2023). Guidance for generative AI in education and research. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000386693
6. One Nation One Subscription. (n.d.). About One Nation One Subscription. Government of India. Retrieved October 12, 2026, from https://www.onos.gov.in/about