Librarian Competence, Work Environment And ICT on Library Service Performance: A Systematic Review

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Abstract. The digital transformation has redefined the modern library from a passive repository into a dynamic, technology-driven service hub, necessitating a new performance paradigm centered on service quality and user satisfaction. This study aims to systematically review the literature to: (1) identify specific ICT tools implemented for service performance; (2) delineate the librarian competencies required to leverage these technologies; and (3) determine the characteristics of the work environment that influence their successful adoption. Adopting a Systematic Literature Review (SLR), this research investigates the complex interplay between Information and Communication Technology (ICT) tools, librarian competencies, and the work environment. Following the PRISMA 2020 guidelines, a comprehensive search of eight major databases identified 20 relevant studies published between 2021 and 2025. The findings reveal that key ICTs, such as IoT, AI, cloud platforms, and data analytics, significantly enhance service accessibility, efficiency, and personalization. However, their effective deployment is contingent upon evolved librarian competencies, including technical and data literacy, pedagogical skills, and ethical judgment. Crucially, the work environment acts as a fundamental mediator; factors like leadership support, strategic alignment, and resources for training enable or hinder successful adoption. The review concludes that performance is driven by the synergistic interaction of these elements and recommends an integrated strategy combining technological governance, continuous staff development, and a supportive organizational environment to achieve responsive and evidence-based service outcomes.

Keywords: Librarian Competence, Work Environment, ICT, Service Performance, Library Management.Introduction

1 Introduction

For centuries, the library has been universally perceived as a physical sanctum of knowledge, defined by its vast collections of printed materials and its role as a quiet space for study and reflection [1]. However, the digital revolution, characterized by the exponential growth of the internet and the ensuing information explosion, has fundamentally disrupted this traditional model. The modern library is no longer merely a repository but has transformed into a dynamic, technology-driven hub central to

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facilitating information access, promoting digital literacy, fostering community engagement, and supporting knowledge creation [2]. Consequently, the performance of a library is increasingly measured not by the sheer size of its collection but by the quality, accessibility, and user satisfaction of its services, necessitating a re-evaluation of the factors that drive this new performance paradigm [3].

2 Theoretical Framework

At the heart of this transformation are Information and Communication Technology (ICT) tools, which serve as the fundamental engines powering modern library service delivery. These tools encompass a wide array of systems and applications, including Integrated Library Systems (ILS) for automation, digital repositories for preserving and providing access to unique collections, electronic resource management systems, user-centric discovery layers, and emerging technologies like AI-driven chatbots and data analytics platforms [4]. The effective implementation of these ICTs is intrinsically linked to enhanced library service performance, enabling faster information retrieval, 24/7 remote access to resources, personalized user experiences, and vastly more efficient internal operations [5].

While technology provides the tools, its effective application hinges on human expertise. Traditional librarianship skills, such as cataloging, reference, and collection development, remain necessary but are insufficient on their own in this new environment [6]. The adoption of sophisticated ICT tools has created a significant competency gap, generating a demand for a new and complex blend of skills. Librarians must now possess not only technical proficiencies (e.g., managing specific software or understanding metadata schemas) but also advanced digital literacy to evaluate and curate online information, coupled with essential soft skills such as teaching, user support, and adaptability to continuous change [7]. This evolution of required expertise forms a critical pillar of effective service performance.

Technology and skilled personnel, however, do not operate in a vacuum. Their effectiveness is profoundly mediated by the organizational context, the library's work environment [8]. This environment encompasses several key characteristics: organizational support (manifested through adequate funding for technology, dedicated training budgets, and strong leadership commitment), organizational culture (including an openness to innovation and a collaborative spirit), robust physical and digital infrastructure (like reliable internet and hardware), and supportive policies that incentivize skill development and ICT utilization [9]. A negative work environment can stifle innovation and nullify the potential of both technology and human skill, whereas a positive and enabling environment acts as a crucial catalyst, unlocking their full potential to enhance service performance [10].

Existing scholarly literature has extensively documented the individual importance of ICT tools, librarian competencies, and a supportive work environment for modern libraries. However, these elements are frequently examined in isolation, creating a fragmented understanding of their collective impact [11]. A significant gap exists in the form of a comprehensive synthesis that explores the dynamic interplay or nexus

between these three critical factors. It is precisely this complex interaction, how competencies and environment shape ICT adoption and use, that ultimately determines library service performance. Therefore, this systematic literature review is structured to holistically investigate this complex interplay by pursuing three integrated objectives: to identify the specific ICT tools implemented to enhance service performance; to delineate the librarian competencies required to effectively leverage these technologies; and to identify the characteristics of the work environment that influence the successful adoption of both the ICT tools and the application of these competencies.

This systematic literature review is guided by three primary research objectives. First, it seeks to identify the specific Information and Communication Technology (ICT) tools that are being implemented to enhance library service performance. Second, it aims to delineate the precise competencies that librarians require to effectively leverage these technologies in their service delivery. Finally, the research investigates the critical characteristics of the work environment, such as organizational culture, leadership, and resources, that influence the successful adoption of these ICT tools and the application of the corresponding librarian competencies, thereby ultimately determining their impact on overall service performance.

3 Research Method

This systematic literature review (SLR) was conducted utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The PRISMA 2020 statement and checklist [12], provided the guiding principles for reporting the title, objectives, methodology, search strategy, results, and eligibility criteria of this study. Although initially developed for healthcare research, the PRISMA protocol has demonstrated significant utility and rigor across various disciplines, including library and information science [13]. For this review, the PRISMA protocol was employed to systematically identify, screen, and evaluate published literature concerning the interplay of librarian competencies, work environment factors, and ICT tools in shaping library service performance. The review process adhered to the four-phase flow diagram outlined by PRISMA: identification, screening, eligibility, and inclusion.

A comprehensive and systematic search strategy was designed and executed to identify all relevant published literature addressing the study's objectives. The search was conducted across eight major electronic databases known for their extensive coverage of library and information science, social sciences, and multidisciplinary research. The selected databases were: Sagepub, Taylor & Francis, Emerald, Wiley Online Library, Google Scholar, EBSCO, Proquest, and Springer.

To retrieve the most pertinent publications, a structured Boolean search query was developed using a combination of keywords and phrases related to the core concepts of the study. The search terms were grouped into two primary clusters:

Table 1. Search String Clusters.

Cluster	Search Strings

Cluster 1: Librarian Competency	("librarian competency" OR "librarian skills" OR "librarian competencies" OR "professional development")
Cluster 2: Work Environment and Organizational Support	("work environment" OR "organizational culture" OR "organizational support" OR "management support")
Cluster 3: ICT and Technology in Libraries	("ICT" OR "information technology" OR "digital tools" OR "library technology" OR "emerging technologies")
Cluster 4: Library Service Performance	("library service performance" OR "service quality" OR "user satisfaction" OR "service innovation")

These clusters were combined using the AND operator to ensure the results addressed all key themes, while OR operators were used within each cluster to broaden the scope. The search was primarily focused on the title, abstract, and keywords of articles to ensure relevance. To refine the search results and select the most appropriate studies, the following inclusion and exclusion criteria were applied:

Table 2. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Peer-reviewed journal articles published between 2021 and 2025.	Articles published before 2021 or after the search date (August 2025)
Articles published in the English language.	Articles published in languages other than English.
Empirical studies, conceptual papers, and systematic reviews.	Editorials, opinion pieces, book chapters, conference proceedings, theses, and dissertations.
Research that addresses at least one of the core themes: librarian competencies, work environment factors, ICT tools, or library service performance.	Research that does not address any of the core themes of this study.
Studies with findings directly applicable to the research objectives on the interplay of competencies, environment, and technology.	Studies where the findings are not generalizable to the context of library service performance.

The screening process rigorously adhered to the PRISMA protocol, progressing through four distinct stages to ensure the selection of relevant studies. Initially, the identification phase involved executing a comprehensive search across all designated databases, yielding a total number of records which were then exported to Mendeley reference management software for the removal of duplicates through both automated and manual processes. Subsequently, the screening phase entailed a preliminary evaluation of the titles and abstracts of the remaining articles by two independent reviewers against the established inclusion criteria to exclude obviously irrelevant studies. Following this, the eligibility phase involved a thorough assessment of the full text of the remaining articles to determine their final suitability based on the pre-defined

criteria. Only those articles that satisfied all requirements progressed to the final stage and were included for in-depth qualitative synthesis and thematic analysis.

4 Results

The article selection and screening process conducted in this study is illustrated in Fig. 1. This section presents a synthesis of findings from twenty journal articles, structured into three interconnected thematic categories that explore the integration of Information and Communication Technology (ICT) in modern libraries.

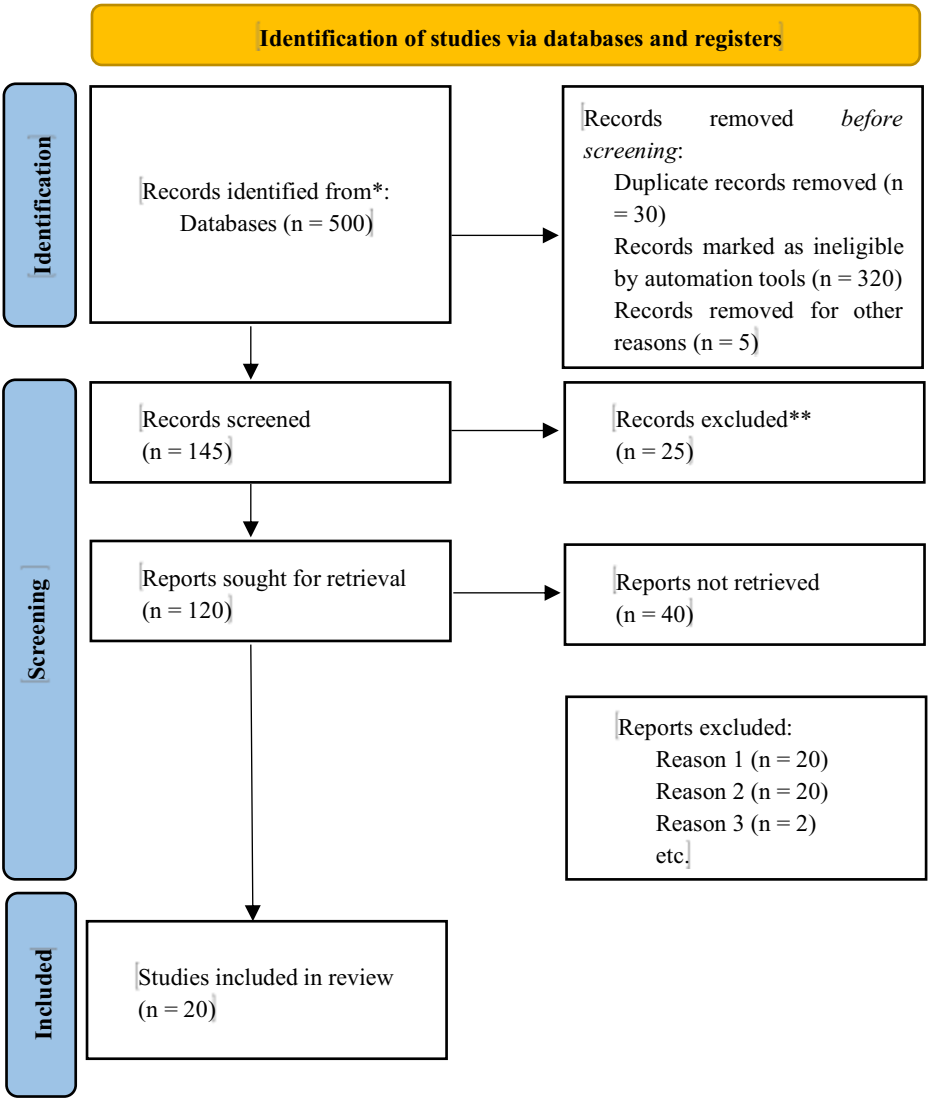

Fig. 1. PRISMA flow diagram (result generated using prisma 2020)

The synthesis of findings extracted from the twenty selected journal articles is presented in Table 3. The table summarizes the ICT tools implemented in libraries, the competencies required by librarians, and the work-environment characteristics influencing successful ICT adoption in modern library services. First, it examines the specific ICT Tools Implemented in Libraries for Library Service Performance [14] [19] [21] [22] [23] [26] [27] [31], detailing technologies such as IoT, AI, and cloud computing and their direct impact on service delivery. Second, it analyzes the Librarian Competencies Required to Effectively Leverage ICT Tools [16] [19] [28] [30] [32] [33], outlining the necessary skills, knowledge, and psychological attributes for success in a digital environment. Finally, it investigates The Characteristics of the Work Environment that Influence Successful Adoption [17] [18] [20] [22] [24] [25] [29], considering the organizational, cultural, and social factors that enable or hinder technological implementation and the application of new competencies. Together, these subsections provide a holistic view of the technological, human, and organizational dimensions crucial for enhancing library performance in the digital age.

Table 3. Data extracted from 20 journal articles.

Title of Article (Year; Citation)	ICT Tools Implemented in Libraries	Librarian Competencies Required	Work-Environment Characteristics that Influence Adoption
From silent spaces to smart spaces: Leveraging IoT-based innovative services to enhance library system performance (Khan et al., 2024).	IoT solutions for smart spaces: sensors, occupancy monitoring, RFID/self-service, environment monitoring, smart signage.	Technical IoT literacy, data interpretation, systems integration skills, vendor-management and basic analytics.	Investment in IoT infrastructure, cross-unit collaboration (IT + library), vendor support, data-privacy/policy readiness, funding.
Characteristics & trends in literature of library service quality as reflected in Scopus (Vaidya et al., 2021).	ILS, discovery layers, e-resources, assessment tools (literature focus).	Research synthesis, quality-assessment, competency in evaluating service quality metrics.	Scholarly/evaluative culture, access to bibliographic databases, emphasis on performance measurement and metrics.
The level of digital competencies for provision of smart information service at academic libraries in Jordan (Hamad et al., 2024).	Smart services: digital platforms, remote access tools, institutional repositories, smart library interfaces.	Digital literacy, e-resource management, remote services, user-support and training skills.	Availability of CPD, institutional policy toward smart services, management support, staff training.

Access to information for sustainable development in the digital age: Librarians' perspectives in two Nigerian universities (Omekwu et al., 2023).	E-resources, online repositories, digital access platforms to support SDG-related information.	Advocacy and user-instruction, digital curation, outreach and information literacy competency.	Strategic alignment with university goals, digital access policies, bandwidth/infrastructure, stakeholder partnerships.
Research support services in academic libraries in the digital environment in Zimbabwe (Hwalima & Khanye, 2021).	Research support tools: bibliographic software, data-management platforms, institutional repositories, discovery tools.	Data management, reference & research support skills, bibliometrics, training for researchers.	Research-led culture, liaison with faculties, funding for research services and training.
How artificial intelligence might change academic library work (Cox, 2023).	AI tools: NLP/search enhancement, recommender systems, automation and chatbots (conceptual).	AI literacy, ethical judgment, service re-design skills, competence in hybrid human–AI workflows.	Professional role negotiation, ethical/policy frameworks, openness to role redefinition and collaboration.
The Impact Of Organization Culture Due to Digital Transformation on Employee Engagement for Library Officers (Pakpahan & Siregar, 2022).	Digital transformation enablers: intranets, LMS interfaces, internal service portals.	Change management, communication, digital skills, innovation attitude.	Organizational culture, leadership support, communication channels, training and recognition mechanisms.
The use of ICT facilities for information service delivery for students with special needs (Gomna et al.).	Assistive technology, accessible websites, adaptive reading devices, screen-readers, mobile access.	Accessibility knowledge, inclusive service design, assistive-tech operation, user needs assessment.	Commitment to inclusive services, procurement of adaptive tech, staff training, accessibility policy.
Impact of organisational, environmental, technological and human factors on cloud	Cloud platforms for repositories, preservation, discovery, and	Cloud governance, vendor management, IT security	Top management support, regulatory context, trust in providers, infrastructure

computing adoption for university libraries (Ibrahim et al., 2025).	collaborative services.	knowledge, data preservation skills.	readiness, staff training.
Application of artificial intelligence for library services: A systematic literature review (Marasinghe et al., 2024).	AI applications: chatbots, recommendation engines, metadata enhancement, automated classification.	ML/NLP familiarity, metadata quality skills, evaluation of AI outputs, ethical oversight.	Research culture encouraging experimentation, data availability, vendor/IT partnerships, ethical/policy controls.
The Influence of Social Factors on Resistance to Technology Adoption in University Libraries in Bangladesh (Rahman et al., 2025).	OSS/adoption dynamics; technologies vary (OSS, e-services).	Social/interpersonal skills, change-management literacy, ability to communicate benefits to peers.	Peer influence, social norms, budget constraints, management commitment, national pressures.
Factors influencing the adoption of mobile services among academic librarians (Hussain & Ismail, 2024/2025).	Mobile OPAC, SMS/notifications, mobile discovery apps, mobile-friendly portals.	Mobile service design, security/privacy awareness, mobile UX support, troubleshooting.	Connectivity quality, security policies, staff digital literacy, user demand, institutional support.
Emerging trends and impact of Internet of Things in academic libraries (Bagavathi, 2023).	IoT: smart shelving, occupancy sensors, automated check-in/out, beacons.	IoT awareness, networking, system maintenance, data privacy knowledge.	Procurement capacity, interoperability standards, IT/library governance, maintenance budget.
Research data services in libraries: a systematic literature review (Safdar et al., 2023).	RDM tools: data repositories, metadata standards, DMP platforms, preservation systems.	Research data management, metadata/schema skills, data curation, training and consultation skills.	Research policy alignment, repository infrastructure, liaison with research offices, funding for RDM.
Improving digital literacy of university librarians using educational technology (Tong & Lu, 2024).	Educational tech: CPD platforms, MOOCs, blended training, simulation tools.	Digital pedagogy, self-directed learning, instructional design for adult learners.	CPD culture, access to training budgets/platforms, incentives for skill development.
Perceived influence of innovation management on library service	Innovation enablers: service prototypes, digital	Innovation management, project management,	Supportive leadership, risk tolerance, KPI-

delivery (Adeyemi et al., 2025).	tools, internal idea platforms.	evaluation and scaling skills.	oriented culture, innovation funding.
A model for enhancing digital transformation through technology-related CPD in academic libraries (Nakaziba & Ngulube, 2024).	CPD delivery platforms, e-learning systems, practice labs for digital tools.	Lifelong learning, facilitation, ability to translate CPD into practice.	Institutional CPD strategy, learning organisation culture, time allocation, incentives.
Performance-based evaluation of academic libraries in the big data era (Islam et al., 2021).	Big-data analytics tools: performance dashboards, usage analytics, altmetrics.	Data analytics, KPI design, interpretation of usage metrics, evidence-based decision-making.	Data governance, analytics infrastructure, cross-unit data sharing, policy on metrics.
Psychological capital & information literacy skills as determinants of job performance (Popoola & Tabuke, 2021).	Information literacy platforms and training materials.	Instructional skills, motivational/mentoring competence, assessment skills.	Supportive HR practices, staff wellbeing, training opportunities.
Exploring academic librarians' perception of OER through TAM (Tang & Tseng, 2023).	OER platforms, open repositories, LMS integration.	OER licensing knowledge, repository skills, TAM literacy, advocacy.	Institutional OER policies, incentives, technical support for OER integration

5 Discussion

5.1 ICT Tools Implemented in Libraries for Library Service Performance

This category includes studies that focus on the specific technologies, systems, and tools (like IoT, AI, Cloud Computing) being adopted and their direct impact on library services, performance, and information delivery. Across the studies, libraries adopt a mix of infrastructure, user-facing systems, and data tools that together reshape service delivery. Common categories are: (1) Sensors and IoT for smart spaces; (2) AI and automation; (3) Cloud platforms and repositories; (4) Mobile and access tools; (5) Analytics and performance dashboards.

In sensors and IoT for smart spaces, IoT devices and environmental sensors occupy the technological pillar by supplying real-time data that enable adaptive service layouts, optimized collection circulation, and automated operational workflows. Successful deployment requires organizational commitment to infrastructure investment and vendor partnerships, as well as staff competencies to interpret and act on sensor-generated data [14] [26] [16].

In AI and automation, Artificial intelligence and automation span the technological and human pillars by streamlining user interactions (e.g., chatbots, recommendation engines) and by reducing routine staff workloads through automated metadata processing and NLP-enhanced discovery. Effective adoption depends on robust data governance, targeted professional development, and role redesign to mitigate ethical risks and preserve service quality [19] [23] [16].

In Cloud platforms and repositories, Cloud-based platforms strengthen both the technological and organizational pillars by providing scalable storage, distributed collaboration, and long-term preservation services. Migration to cloud solutions should be guided by organizational strategy, regulatory constraints, and workforce capacity to manage security, continuity, and service availability [22] [27].

In Mobile and access tools, Mobile applications and responsive interfaces operate across the technological and environmental pillars by extending access across diverse contexts and devices. Their impact is mediated by user acceptance, socio-cultural barriers to adoption, and the organization's capacity to sustain mobile services over time [25] [20].

In Analytics and performance dashboards, Analytics and performance dashboards situate libraries within the technological and organizational pillars by transforming usage metrics and altmetrics into actionable evidence for decision-making. Realizing this potential requires reliable data infrastructures and staff analytical skills to interpret metrics and translate insights into policy and operational change [31] [16].

Studies report improvements in accessibility, responsiveness, and measurable service outcomes when tools are well-integrated; however, benefits are contingent on governance, interoperability, and staff capacity to operate and interpret these systems.

5.2 Librarian Competencies Required to Effectively Leverage ICT Tools for Library Service Performance

This category includes research on the skills, knowledge, abilities, and psychological attributes librarians need to effectively utilize new technologies and deliver services in a digital environment. The literature converges on a multi-dimensional competence profile necessary for effective ICT-enabled services (1) Technical and data skills; (2) Service and pedagogical skills; (3) Managerial.

In Technical and data skills and contemporary library services, systems literacy is a core competency that includes operating and managing integrated library systems and discovery platforms, overseeing cloud governance, maintaining IoT-enabled infrastructure, and coordinating with external vendors [14] [22]. Complementary data and analytics literacy enable librarians to design meaningful key performance indicators, interpret interactive dashboards for decision making, and engage with bibliometrics and research data management to support evidence-based services [31] [27]. Together, these literacies strengthen operational efficiency and position libraries as data-driven institutions capable of sustaining innovation and accountability [31] [27].

In Service and pedagogical skills, User support and instructional design have emerged as central professional domains, emphasizing digital curation, integration of

information literacy instruction, and outreach tailored to users with special needs and to research communities [17] [21]. Continuous professional development is essential, requiring librarians to translate training into practice and to design CPD initiatives that build adaptability and long-term capacity within the profession [28] [30]. These dimensions underscore a shift toward more user-centered and development-oriented librarianship.

In Managerial, ethical, and interpersonal skills, Effective change and project management demand competencies in innovation management, evaluation and scaling of initiatives, and negotiation of role transformations that arise within hybrid human–AI workflows [29] [19]. Ethical judgment and policy literacy are critical for navigating data privacy, applying AI ethics in service delivery, and managing OER licensing [23] [33]. Foundational soft skills such as clear communication, persuasion, and mentoring help reduce resistance, foster collaboration, and secure organizational buy-in for change [24] [32].

5.3 The Characteristics of the Work Environment that Influence the Successful Adoption of ICT Tools and the Application of Librarian Competencies for Library Service Performance

This category encompasses studies on the organizational, cultural, social, and environmental factors that either enable or hinder the successful implementation of technology and the application of new competencies. Studies consistently identify organizational and contextual enablers and barriers that shape whether tools and competencies translate into improved performance: (1) Leadership, strategy and policy; (2) Resources and infrastructure; (3) Culture, training and social dynamics.

In Leadership, strategy and policy, Top management support and strategic alignment are decisive for the long-term success of ICT initiatives; when leadership aligns library innovation with institutional goals and provides clear policy direction and sustained backing, funding stability and project sustainability improve markedly [17] [22]. Complementary ethical and governance frameworks, particularly for AI deployment, cloud governance, and data-privacy protections, are essential to moderate organizational risk and to strengthen public trust in library services [23].

In Resources and infrastructure, The sustainability of ICT integration depends heavily on structural enablers such as dedicated maintenance budgets, streamlined procurement processes, and well-managed vendor partnerships, which collectively ensure the reliability and continuity of technological systems [26] [14]. Equally important are connectivity and platform readiness, stable bandwidth and interoperable standards that underpin effective cloud, mobile, and IoT deployments and enable seamless, scalable service delivery [25].

Culture, training and social dynamics, Organizational culture and training practices shape the translation of technology into service improvements; institutions that cultivate a strong CPD culture with protected time for practice, hands-on labs, and

incentive mechanisms achieve more effective skill transfer and capacity building [30] [28]. An innovation climate characterized by supportive leadership, openness to experimentation, and KPI-driven evaluation further enables the scaling of prototypes into sustainable practice [29]. Finally, social norms and peer influence significantly mediate adoption: workplace resistance can hinder implementation but may be reduced through peer advocates and development of change-management literacy that build collective readiness [24].

The contemporary library landscape is also shaped by several critical tensions that influence how technology and human capital are integrated. Investments in advanced tools often yield limited returns if not accompanied by parallel commitments to developing staff competencies and cultivating supportive work environments, highlighting the interdependence between technological infrastructure and human expertise. Similarly, the accelerating speed of technological adoption, particularly with emerging tools such as AI, presents ongoing ethical and policy challenges that organizations must anticipate and address proactively to safeguard trust and accountability. Finally, debates around centralization and interoperability reveal the delicate balance between maintaining IT governance standards through centralized control and preserving the agility of libraries; governance models that successfully integrate both autonomy and standardization tend to deliver more sustainable and adaptive outcomes.

6 Conclusion

This systematic review concludes that contemporary library service performance is not a product of isolated factors but of the synergistic interaction among three critical elements: advanced ICT tools (e.g., IoT, AI, cloud platforms, analytics), evolved librarian competencies (encompassing technical, data, pedagogical, and ethical skills), and a supportive work environment (including leadership, culture, and infrastructure). The evidence indicates that these elements are mutually reinforcing; the full potential of technology is only realized when staff possess the requisite skills and operate within an organizational context that enables innovation. Therefore, an integrated management strategy is essential. We recommend that libraries simultaneously: (1) develop robust institutional governance, including a strategic digital roadmap aligned with broader organizational goals and supported by sustainable funding; (2) invest in continuous, multifaceted professional development to cultivate the technical and pedagogical competencies required to leverage new technologies; and (3) foster a supportive work environment through leadership that encourages innovation, provides adequate resources, and implements technologies using evidence-based, phased pilot projects.

This review is subject to several limitations. The findings are constrained by the scope of the eight databases searched and the specific inclusion criteria, which prioritized recent literature (2021-2025), potentially omitting relevant earlier studies. Furthermore, the qualitative nature of the synthesis and the focus on peer-reviewed articles may introduce selection bias and exclude valuable insights from grey literature or practitioner reports. These limitations highlight avenues for future research.

Longitudinal studies are needed to examine the causal relationships and long-term impacts of these synergistic interactions on specific service outcomes. Further investigation is also warranted into the efficacy of specific training models for developing librarian competencies and the role of organizational culture in technology adoption. Finally, expanding the geographical scope of research could provide deeper insights into the applicability of these findings across diverse cultural and economic contexts.

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