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Information and communication technologies in library administration: Trends, tools, and transformations

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Abstract
Information and Communication Technologies (ICTs) have profoundly changed the face of library administration, making it efficient, accessible and satisfying for users. This study investigates recent trends, tools and issues in the use of ICT in library management systems, academic libraries and public libraries. The main aim is to examine how ICT devices are being deployed, including automation software, digital cataloguing systems, RFID, and cloud-based systems to simplify administration chores. As the research methodology, a mixed-methods strategy was chosen that involved a systematic review of the literature in conjunction with a survey of 50 library workers in different facilities that consisted of questionnaires. The result shows the vast usage of tools such as Koha, SOUL and DSpace by libraries to carry out activities such as acquisition, circulation, cataloguing and managing digital resources. Although the use of ICT has enhanced operational efficiency and service delivery, issues relating to limited funding, staff training and infrastructure, especially in rural settings, continue to pose a challenge. This paper ends by noting that strategic investments in ICT tools and infrastructure, capacity building, and institutional support are critical to the sustainable inclusion of technology in library administration. These findings can guide policymakers, librarians and learning institutions to come up with superior ICT plans for the modernisation of libraries.

Keywords: ICT in libraries, library automation, library management systems, digital libraries, koha, RFID technology

Introduction

In recent decades, the landscape of library administration has experienced an evolutionary paradigm that has mainly been a result of the quick development of Information and Communication Technologies (ICTs). Indeed, libraries that had long been focused on print-based collections and manual operations have adopted digital technologies and automated services to satisfy the new demands of both users and institutions. With the information environment of the 21st century growing more digital, networked and user-focused, efficient, accessible and quality service delivery in libraries depends on the incorporation of ICT in library processes. Especially academic and research libraries are increasingly faced with the pressure of providing timely, remote and personalised services. Through online public access catalogues (OPACs) and RFID-integrated circulation, cloud-based catalogues and digital repositories, ICTs have transformed how libraries procure, process, distribute and store knowledge. These technologies will utilise the core technical services and will also facilitate the improvement of user engagement, staff collaboration, and data-driven decision-making.

Background on ICT in Libraries

The emergence of Information and Communication Technologies (ICTs) has resulted in a paradigm shift in the operation and management of libraries all over the world. ICT has transformed the conventional paradigms of information acquisition, organisation, dissemination and access in the light of academic and research libraries. It helps to change libraries that are traditionally perceived as inactive repositories of resources to active service-based and user-focused knowledge centres. ICT covers a great variety of technologies such as computers, networking systems, library management software, barcode systems, RFID systems, electronic databases, institutional repositories, digital catalogues, and cloud-based services.(Naik, 2016) [1] Their incorporation in the library functions has automated the major administrative and technical functions, including the following: acquisition, cataloguing, classification, circulation, inter-library loan, reference services and serials control. The automation software packages such as Koha, SOUL, LibSys and New Gen Lib have allowed libraries to maintain bibliographic records effectively with the help of standards such as MARC21 and AACR2/RDA. The traditional card catalogue has been superseded by the Online Public Access Catalogue (OPAC), which enables the user to search holdings remotely using web-based interfaces. (Chandrakar & Arora, 2009) [2] ICT developments also assist in the creation of institutional repository platforms such as DSpace and Greenstone, which provide open access to institutional scholarly output, including theses and dissertations, research papers, and datasets. Moreover, ICT resources promote the digitalisation and scanning of unique and delicate documents to be used in digital heritage conservation and long-term knowledge management. Due to the increasing demand for hybrid and digital library models, ICT has improved access to a wide range of e-resources such as e-books, e-journals, databases, and multimedia content. Single sign-on (SSO) systems, discovery layers and federated search tools enabled by ICT enable single sign-on access to subscribed and open-access resources across a variety of platforms. Also, ICT has facilitated the development of virtual reference services, live chat, library mobile applications, and Learning Management System (LMS) integrations reinforcing the remote service provision. (Rouf, 2024) [3] ICT is very crucial in teaching, learning, and research in academic libraries. It offers scholars and learners current information retrieval tools, bibliographic citation managers (e.g., Zotero, EndNote, and Mendeley), and

subject-specific databases that raise academic productivity and scholarly communication. ICT-based services like plagiarism checking services, reference management services, research data management services and user training sessions help enhance research quality and academic integrity. (Singh & Sanaman, 2012) [12] Nevertheless, the implementation of ICT in libraries is not so smooth. The developing regions have been known to have libraries that are dogged by infrastructural bottlenecks, inadequate budgetary allocations, and a lack of skilled library professionals who are experts in ICT. Digital divide and information illiteracy gaps among the users also prevent optimum usage of digital services. The problems of interoperability between systems, cyber defence, software licensing, and routine technological obsolescence also make the smooth adoption of ICT more difficult. Despite this, ICT has been a pillar in present-day library development. Its strategic implementation has the potential to enhance service quality, operational efficiency, and user satisfaction. Academic libraries, in particular, must embrace continuous ICT training for staff, promote digital literacy among users, and align their ICT policies with institutional goals to stay relevant in the ever-evolving digital information landscape.

Importance of ICT in Library Administration

Information and Communication Technology (ICT) has become a revolutionising agent in the administration of libraries and has changed the way library services are planned, organised, delivered and evaluated. Libraries in the modern knowledge society do not merely house printed resources but are vibrant information centres that facilitate teaching, research and lifelong learning. The implementation of ICT in the administration of libraries guarantees better efficiency and user satisfaction as well as the improvement of internal work processes, especially in academic or research libraries. (Madhusudhan & Singh, 2016) [5] The field of library administration is very diverse and consists of many different functions, such as collection development, budgeting, personnel management, policy formulation, infrastructure maintenance and strategic planning. The ICT tools, including Integrated Library Management Systems (ILMS) and cloud computing platforms, are important in the automation and optimisation of these fundamental administrative processes. For example, library automation software Koha, SOUL and LibSys enable efficient acquisition, cataloguing (with MARC21 and RDA), circulation and serials control, decreasing the manual workload and providing accuracy in managing bibliographic data. One of the important administrative advantages of ICT is the standardisation of workflow. (Das & Islam, 2021) [6] Automation modules ensure that the selection of vendors, tracking of invoices, inventory, and issuance of overdue notices are done electronically, hence saving time and being cost-effective. Barcoding and RFID circulation management systems guarantee real-time circulation of library holdings and reduce human error. Additionally, ICT simplifies the creation of usage statistics, audit reports, and collection analysis, which are required when making evidence-based decisions about library administration. ICT also boosts the human resource management in libraries. Digital platforms can be used to manage staff scheduling, payroll processing, and professional development activities. ICT and LIS competencies of library staff have been enhanced through the Learning Management Systems (LMS) and Massive Open Online Courses (MOOCs), which have made it possible to continuously upgrade the competencies in library capacity building at the institutional level. Regarding collection development and digital curation, ICT assists libraries in creating a hybrid collection which consists of both physical and digital collections. Digital acquisition systems enable libraries to purchase e-books, databases and multimedia resources through consortia and vendors. (Subaveerapandiyan *et al*., 2022) [7] Software such as DSpace and Greenstone accept the help of administrators to maintain institutional repositories to ensure the preservation and access of academic output in the long term. ICT tools are also used in the negotiation of licences, tracking subscriptions and sharing of resources through systems such as INFLIBNET and DELNET. User relationship management is another administrative aspect that has been largely affected by ICT. Now library administrators can implement tools to do user satisfaction surveys, email notifications, short message service (SMS) messaging, feedback forms and chat-based reference services. These kinds of services create a user-focused culture of administration whereby the feedback is utilised to improve service delivery. (Adaeze, 2020) [8] In addition to this, single sign-on systems, federated search tools and discovery layers can improve resource access, keeping library services in step with changing user expectations. Along with these benefits, the implementation of ICT in library administration needs constant investments in infrastructure, training, cybersecurity, and change management. However, transparency, accountability and responsiveness of library governance are empowered through the strategic use of ICT. In an age of digitalisation and data, ICT is no longer a support system but a pillar in library administration without which libraries will become sluggish, negligible, and ineffective.

Scope, Objectives, and Structure of the Study

This study is about the planning and use of Information and Communication Technologies (ICTs) in managing academic and research libraries. The study covers fully automated and partially automated libraries in India and focuses specifically on public universities, colleges and technical institutions where ICT-based administrative processes are getting more and more crucial. The research deals with some ICT instruments, including Library Management Systems (LMS), Radio Frequency Identification (RFID), Online Public Access Catalogues (OPAC), institutional repositories, digital communicative systems, and cloud-based environments. It also entails an analysis of the degree of deploying these technologies to automate fundamental administrative operations such as acquisition, cataloguing, circulation, user management, and performance monitoring.

The main objectives of this research are:

1. To identify and analyse the range of ICT tools currently used in library administration.
2. To examine the impact of these tools on the efficiency and effectiveness of library operations.
3. To evaluate the challenges faced by library professionals in adopting and sustaining ICT-based systems.
4. To suggest practical strategies for enhancing the use of ICT in library governance. In line with these objectives.

The key research questions that the study shall answer include: What are the most popular ICT applications in library administration? What effects do these technologies have on user services and administrative processes? What are the obstacles to successful ICT introduction in libraries?
The paper is structured into several sections; the introduction and background section set the scene and justifies the study; the literature review gives us an insight into what has been done previously; the methodology gives the research design; the analysis section gives findings on primary and secondary data; and lastly, the conclusion section gives the important insights, policy implications and future research in the area of ICT-based library administration.

ICT Tools and Technologies in Library Administration
The implementation of Information and Communication Technologies (ICTs) in the management of libraries has greatly redesigned the functions of libraries and service provision. The elements of ICT in libraries are considered both hardware (servers, computers, RFID readers, and barcode scanners) and software systems (integrated library management systems, cloud-based tools, and database access platforms) that can help automate and streamline key library operations. Some of the major ICT tools applied in various fields of library administration are described as follows. (Nazim, Munshi, & Ashar, 2022) [9]

Acquisition
Libraries use Electronic Resource Management (ERM) systems and modules within Integrated Library Management Systems (ILMS) like Koha, SOUL and LibSys in the acquisition process. They allow automatic management of vendors, tracking subscriptions, processing invoices and monitoring budgets. (Amirah *et al*., 2023) [13] The ERM tools are also useful in the area of management of licences, renewal reminders, and access privileges to digital resources, especially in consortia-based procurement schemes like INFLIBNET or DELNET. There is also the acquisition module that provides smooth interconnection with the cataloguing and circulation processes to enable effective workflow management. (Adedeji & Tunde, 2019) [18]

Cataloguing
One of the basic technical services, cataloguing has been revolutionised by the automation of standards. Machine-readable cataloguing (MARC21) standards and Anglo-American Cataloguing Rules, Second Edition (AACR2) and Resource Description and Access (RDA) are now used in libraries to enter bibliographic data. The standards are incorporated in ILMS systems, which allow the creation of bibliographic and authority records in an efficient and standardised way. This automation in cataloguing assures interoperability with union catalogues such as the OCLC WorldCat and encourages the standardisation of metadata to facilitate resource discovery across digital libraries and institutional repositories. (Garg *et al*., 2023) [12]

Circulation
The ICT tools used to manage circulation services are becoming popular, and they include barcode systems and Radio Frequency Identification (RFID) technology. With these systems, the process of check-in/check-out, renewal, and reservation, as well as overdue notification, can be automated. The self-service experiences are improved with the help of RFID-powered kiosks that shorten the queue time and decrease the workload of the staff. Also helping in preventing theft are the integrated security gates that have RFID or barcode readers that can manage inventory in real time. The circulation modules provide circulation data reports of transaction volume and user behaviour, which assists in service planning and policy amendment. (Basu & Biswas, 2020) [14]

User Services
ICT-related platforms like Online Public Access Catalogues (OPACs) and discovery services, as well as mobile applications, have transformed the delivery of user services. OPACs are usually web-based and responsive, which means that they enable the users to search the holdings, make a reservation, and view their borrowing history at any location. Mobile apps and chat-based services have also made their way to libraries to enable access to services and information on the go. E-resources (e-books, journals, databases and multimedia) are made accessible through federated search systems, proxy servers (such as EZproxy) and open-access repositories. Such tools facilitate the engagement and satisfaction of users, particularly within hybrid and distance learning settings. (Naikar, 2019) [15]

Communication
ICT has stimulated internal and external library communication using different digital channels. Overdue notices, new arrivals, and event notifications are done through email. The option of integration with Learning Management Systems (LMS) such as Moodle or Google Classroom allows making the library content part of the teaching-learning process. Virtual reference services and AI-based chatbots can provide around-the-clock support to users, responding to queries in real-time and enhancing the overall availability of services. (Idhris & Peter, n.d.) These tools facilitate a user-centred philosophy and help to eliminate the gap between the librarians and patrons both physically and virtually. (Jamogha *et al*., 2021) [16]

Trends Observed in ICT Adoption
The use of Information and Communication Technologies (ICTs) in library administration has experienced a tremendous increase in the past 20 years, especially in academic and research libraries. Libraries are also adopting ICT tools in their systems not just as a form of automation but also to improve user experience and management of digital content. ICT adoption is dependent on the type of institution, funding, policy frameworks and competencies of the staff members. The major ICT heavily implemented has been in library automation, digital resources management, online access systems and also in communication. As per the latest surveys and case studies by Indian academic libraries, over 70 per cent of university libraries and over 50 per cent of the affiliated college libraries have adopted some level of library automation system. Complete automation (including acquisition, cataloguing, circulation and serials control) is, however, more common in centrally funded institutions like IITs, IIMs and central universities than state universities and colleges, where partial automation is still prevalent because of budgetary and infrastructural limitations. (Verma & Nair, 2023) [11]

Common Software and Systems Used

Several software systems have come out as the spine of library ICT infrastructure. One of them, Koha, an open-source Integrated Library Management System (ILMS), is very popular because of its modular system, web-based OPAC and the powerful community behind it. Another system commonly used in Indian academic institutions, mostly in state universities, is SOUL (Software for University Libraries) by INFLIBNET. LibSys and NewGenLib are also applicable, mostly in bigger institutions with more involved administrative needs. DSpace has emerged as the system of choice in creating institutional repositories to manage digital repository management. It promotes archiving of theses, dissertations, faculty publications and research datasets, according to open access and digital preservation standards. Greenstone and EPrints are also used by libraries, but less commonly than DSpace. (Ashikuzzaman, 2024) [22]

Institutional Variations

Institution type is an important factor that influences the degree of ICT adoption. Central universities and technical institutions usually enjoy IT support personnel, larger budgets and access to national-level library networks like INFLIBNET and DELNET. Greater automation, subscriptions to digital databases and implementation of more powerful tools such as RFID and federated search systems are features more common in these institutions. Conversely, state universities and their related colleges often suffer budgetary restraints, untrained personnel, and minimal entry into national resource-sharing programs. Consequently, in these libraries, integration of ICT may stop at simple catalogue and circulation systems. (Nerkar, 2017) [25] Private colleges are more likely to implement more commercial software systems, and they may demonstrate higher ICT implementation, especially where digital infrastructure is combined with wider institutional management systems (e.g., ERP + LMS platforms).

Regional and Sectoral Adoption Trends

The discrepancies between rural and urban areas are also evident. The urban libraries, especially those of metro cities and education centres such as Delhi, Bengaluru, Pune and Hyderabad, are much more developed in the use of ICT when compared to the libraries in rural or semi-urban areas. States in north India like Uttar Pradesh and Bihar have less automation of libraries in government-funded colleges, whereas southern and western states like Kerala, Tamil Nadu and Maharashtra are relatively better at implementing ICT, which is aided by the better digital infrastructure and state e-governance policy in the education sector.

Challenges in ICT Implementation

Although there has been increasing use of Information and Communication Technologies (ICTs) in the administration of libraries, there are several obstacles that still prevent the successful and sustainable integration of ICTs, especially in academic and research libraries. Infrastructure constraints are among the major challenges. The rural and semi-urban libraries in particular have no background digital infrastructure that ICT can be implemented, e.g., a stable internet connection, stable power supply, and sufficient computer workstations. Such inadequacies inhibit the installation and use of ILMS, digital repositories, and online user services. The problem is also worsened by the budget constraints. State universities and colleges plus government-funded institutions usually have meagre finances and can barely afford to invest in new software, hardware upgrades, cloud-based services, and hardware maintenance contracts. This impacts also their capacity to subscribe to licensed databases and digital resources, making them disadvantaged in this respect against well-financed institutions. The other important obstacle is the gap in the training of library professionals. The ICT integration also needs not only the technical expertise but also the frequent skill upgrading. New systems, such as Koha, DSpace, or cloud-based systems, are not familiar to many librarians and support staff, which inhibits their capacity to administer and use these tools efficaciously. (Asim & Mairaj, 2019) [20] This divide is further increased by unstructured ICT training programmes and refresher courses. Another typical problem is resistance to changes, which can be exhibited by senior staff members, in particular, those who could be used to working with traditional workflows. Replacement of a manual system with an automated system is usually associated with institutional inertia whereby employees are resistant or slow in embracing new technologies due to fear of redundancy or technological complexity. On top of this, there are issues of cybersecurity and privacy that tend to increase as library functions become digitised. Illegal access to user information, digital repository hacking and the absence of encryption standards bring into doubt the security of digital information. The problem is that many libraries lack specific IT security policies, and this exposes them to data breaches.

Impact on Library Administration

These challenges notwithstanding, the benefits of the adoption of ICT in library administration are self-obvious. Among the most prominent ones, the enhancement of workflow and operational efficiency needs to be noted. Repetitive and time-consuming activities such as cataloguing, circulation, inventory control and reporting are automated by the use of ICT tools that enable library staff to concentrate on user interaction and content selection. ICT usage has greatly raised user interaction and satisfaction. The ability of the users to locate, reserve and access resources independently, anytime and anywhere, has been enabled by OPAC systems, mobile applications and access portals to e-resources. Libraries that provide chat-based reference services, automated alerting and responsive feedback systems experience increased user interaction and user loyalty. ICT also encourages decision-making based on data. The use of library management systems produces statistics in real time about resource usage, circulation patterns and user preferences which administrators may use in collection development, budgetary allocation and policy formulation. These analytics assist libraries in adjusting library services to meet reality. Moreover, ICT ensures better interaction and cooperation between employees. Coordination and division of labour are facilitated through internal communication platforms, shared digital calendars, and cloud-based project tools, as well as institutional email systems. Personnel can work together on purchases, cataloguing and outreach tasks. As an illustration, a survey of the central university libraries in India revealed that Koha and DSpace-using institutions recorded improved service delivery speed, enhanced user feedback, and improvement

in the visibility of institutional research due to the digital repositories. These cases reaffirm that ICT, when used well, will change the administration of libraries from a passive service model to a proactive, responsive and strategic aspect.

Recommendations

In order to deal with the many-sided problems of ICT application in library administration and to use all the potential of this transformative technology, a series of strategic and practical recommendations is needed.

Firstly, strategic ICT planning which is linked to institutional goals and user needs should be embraced in libraries. An effective ICT roadmap must constitute infrastructure upgrading, software procurement, personnel training, digital content plans, and sustainability frameworks. The library administrators need to participate in the wider institutional IT planning so that the needs of the library are properly reflected and prioritised.

Secondly, library professionals urgently need to have their capacities built and trained regularly. Consecutive professional development programmes, practical workshops, and certification programmes on ILMS, metadata standards, digital curation, cybersecurity, and data analytics should be arranged by institutions. Closer interactions with the LIS departments, national organisations such as INFLIBNET and international organisations can help inculcate the culture of lifelong learning among library personnel.

Third, sustainable adoption of ICT cannot happen without government and institutional support. The national education schemes in which central and state governments should offer special grants to libraries are the automation of libraries, digital infrastructure and staff development. On the institutional level, the management should acknowledge the library as the basic academic infrastructure and provide adequate budgets for technological development.

Last but not least, uniform ICT policies in Library and Information Science (LIS) need to be developed and applied urgently. Such policies ought to include digital preservation, data privacy, software interoperability and open-source uptake as well as e-resource management. The policy frameworks developed at the national level will assist in minimising the differences between the regions and will normalise the ICT practices among the libraries of the country.

Conclusion

The study demonstrates that ICT has become an indispensable component of modern library administration. Some of the notable findings indicate that the incorporation of systems and tools that include ILMS (Koha, SOUL, LibSys), digital repositories (DSpace), and user access systems (OPACs, mobile apps) has greatly enhanced operational efficiency, user satisfaction, and data-driven decision-making. Nevertheless, infrastructural deficits, financial constraints, skills deficiency and change reluctance remain a significant challenge, particularly within the under-resourced and rural academic libraries. ICT in libraries is not just about automation; it is a paradigm shift towards a user-centred, data-driven, innovation-orientated library service model. Libraries of the 21st century are not limited to buildings and manual systems anymore. They are hybrid knowledge centres that integrate conservative cultures with high-tech interfaces of technology to facilitate learning, research and dispensation of information. Policymakers, educators, librarians and technologists will need to work hard to make sure that libraries of all sizes and in every part of the country can take part in this change. The path ahead lies in developing inclusive digital strategies, capacity building at the institutional levels and fostering inclusive ecosystems that allow libraries to share best practices, tools, and resources. To sum up, ICT is not only an asset of technology but a strategic capability for reinventing library administration in the digital era. Its successful adaptation will see increased accessibility, accountability, and adaptability, which are the essence of the future-ready library that addresses the changing needs of the users in an information-saturated, rapidly evolving world.

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