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Investigating the Current Usage and Challenges in Adopting Radio Frequency Identification (RFID) Technology in University Libraries of Pakistan

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Abstract

This study investigates the current usage and challenges in adopting Radio Frequency Identification (RFID) technology in university libraries across Pakistan. The research focused on library professionals from 41 university libraries, with data analyzed using descriptive and inferential statistics through SPSS. The findings revealed a positive attitude among library professionals towards RFID implementation, recognizing its potential to enhance library services in terms of quality and efficiency. However, several barriers were identified, including high costs of RFID components, lack of funding, inadequate training facilities, and technological infrastructure challenges. Despite these obstacles, library professionals strongly believe in RFID's benefits, particularly in improving material tracking, safeguarding, and overall service delivery. The study also highlighted concerns regarding data security, privacy, and staff attitudes, which complicate the technology's adoption. The results suggest that addressing funding shortages, improving training opportunities, and enhancing



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technological infrastructure are crucial for successful RFID adoption. The study's implications emphasize the need for better training, funding, and technical expertise to fully harness RFID's potential, offering valuable insights for library professionals, policymakers, and researchers in the field of library science. This research contributes to the growing body of literature on RFID in library settings and provides a foundation for future studies and practical applications in Pakistani university libraries.

Keywords: Radio Frequency Identification (RFID); Library Professionals; University Libraries; Pakistan; Technology Integration; Technology Adoption, Usage; Challenges, Material Service Delivery, Funding, Training, Technological Infrastructure.

Introduction

Radio Frequency Identification (RFID) technology has revolutionized library management worldwide by streamlining processes such as inventory control, book checkouts, and security. In university libraries, RFID has proven to improve operational efficiency and enhance user experiences. However, despite its global success, the adoption of RFID technology in university libraries in Pakistan remains limited. This research aims to investigate the current usage of RFID in Pakistani university libraries, identify the challenges faced in its implementation, and explore the barriers that hinder its widespread adoption. By understanding these challenges, the study seeks to provide recommendations that could help improve RFID adoption, ultimately contributing to the modernization of library services in Pakistan. The primary challenges in implementing RFID in Pakistani academic libraries include leadership crisis, changing user behavior, human resources, financial constraints, and technological issues (Ashiq et al., 2020). These challenges are similar to those faced by other industries adopting RFID, such as cost concerns, return on investment, and privacy issues (Dey et al., 2016). Additionally, operational difficulties, planning challenges, and employee-related issues have been identified as major factors hindering RFID implementation (Moretti et al., 2019). Interestingly, while RFID adoption in Pakistani libraries faces obstacles, the technology itself is evolving. The integration of RFID with wireless sensor networks (WSNs) presents new opportunities for novel Internet of Things (IoT) applications (Landaluce et al., 2020). This advancement could potentially address some of the technological challenges faced by libraries. However, it also introduces new concerns such as energy harvesting efficiency, communication interference, and data processing capabilities (Landaluce et al., 2020). While RFID offers numerous benefits, its adoption in Pakistani university libraries is hindered by various challenges. Addressing these issues requires a collective effort involving human capacity building, compatible smart services, effective policymaking, and support from key stakeholders such as library professionals, associations, top management, and funding agencies (Ashiq et al., 2020). As RFID technology continues to evolve, libraries must stay informed about new developments and potential solutions to overcome implementation barriers.

Research Objectives

- To investigate the current usage of RFID Technology in university libraries of Pakistan.



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- To identify the challenges being faced by library professionals in implementing and using of RFID Technology in university libraries of Pakistan.
- To develop the recommendations for the successful implementation of RFID Technology in university libraries of Pakistan.

Literature Review

Usage of RFID Technology

Jan (2011) revealed in his doctoral thesis that the adoption of new and emerging library technologies has a significant impact on the services provided by the universities in Pakistan. One such technology is the RFID, which has proven to be effective in carrying out various library operations, including document charging and discharging, stock verification and theft detection. However, the major disadvantage of RFID Technology is its cost. RFID Technology is rapidly gaining popularity due to its ability to enhance efficiency and profitability. It is a powerful tool that combines a computer chip and a radio antenna to enable objects to self-identity. In the library sector, patron satisfaction is considered to be the most important factor. As a result, many libraries adopting RFID technology has brought the convenience and efficiency in item management by automating workflow processes. RFID also improved the customer services (Rafiq, 2004). Chelliah, Sood and Scholfield (2015) conducted their study on the RFID implementation in the libraries and they stated that the introduction of this technology triggers a series of events that changes the way public interact within the library. Management seems to be driven by the desire to introduce latest developments to gain improvements in efficiency. Meanwhile, employees need to realize that how the alteration impacts their routines and how they carry out their business. While RFID undoubtedly reduces labor-intensive tasks, its implementation has impacted business processes and client services. In university libraries of Pakistan the antitheft control of library material and stolen books pose a significant and complex challenge for academic libraries. To address this issue, libraries typically implemented security measures such as security gates or CCTV surveillance systems but use of electro mechanical (EM) for security purpose and for quality service RFID is better option (Ali, 2017). Tan et al. (2018) investigated the use of RFID technology in managing library collections, particularly in large academic libraries. The study discussed the benefits of RFID in inventory management, collection security, and user services, as well as the challenges faced in implementing RFID systems

Rahman and Islam (2018) conducted the similar type of study and the aim of their research was to investigate the current state of RFID technology adoption in university libraries in Bangladesh. The researchers noted that in today's digital age, users expect quick access to information, which is why library professionals are willing to implement RFID technology in their libraries to meet these demands. As books are one of the primary resources in libraries, RFID technology allows librarians to provide them to patrons in a matter of seconds. About the advantages and disadvantages of RFID that every organization aims to provide fast, accurate, and secure information through various channels and RFID technology is an effective means to achieve this goal. In modern libraries, also known as Knowledge Resource Centers, RFID is a widely adopted technique, RFID technology also facilitates the quick and



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organized retrieval of relevant information, enabling researchers to find the data they need in a short amount of time, which promotes better information retrieval for research purposes (Sunil & Ojha, 2018). Tan et al. (2018) investigated the use of RFID technology in managing library collections, particularly in large academic libraries. The study discussed the benefits of RFID in inventory management, collection security, and user services, as well as the challenges faced in implementation. Chhetri and Thakur (2019) conducted their study on the implementation of RFID technology and its integration with KOHA, ILS. In their case study they described that the Libraries have a responsibility to ensure that RFID components are produced and used in compliance with established privacy policies. Unsafe RFID components should be rejected by libraries, as they are not suitable for use. Although RFID technology is more expensive than barcoding, it has become indispensable for a wide range of information collection and data identification purposes.

Chen et al. (2019) explored the integration of RFID technology with mobile devices to enhance library services. The findings suggested that the combination of RFID and mobile technologies can improve the efficiency of library operations and facilitate seamless access to library resources for users. Shahid and Naveed (2020) concluded in the study which is based on RFID implementation in the library of a university that RFID has a high level of performance that can help libraries overcome shortcomings in theft detection and improve their ability to efficiently store, organize, and deliver services to patrons. For an effective implementation of RFID technology, various implementation strategies by academic libraries have adopted to integrate with their existing ILS, they have planned and successfully integrated the RFID components with their ILS and professionals were taking keen interest in integration, as their data was the main concern. (Park & Kim, 2020).

Smith et al. (2021) conducted the studies on the librarians who have recently implemented the RFID system in their libraries and successfully integrated with their existing Integrated Library Management System. The professionals have the strategies like phased implementation, pilot projects, and collaboration with RFID vendors and experts to ensure successful integration and minimal disruption to library services. Kishan (2021) indicated that most university libraries have not implemented a Radio Frequency Identification (RFID) system to protect their resources, despite acknowledging its significance in enhancing university library operations. It has been observed that nearly all libraries regard RFID technology as efficient and effective. They particularly value its large memory capacity, followed by its re-write ability and long lifespan. However, the implementation of this technology in libraries has been slower compared to libraries in other countries. Wang, Zhang and Li (2021) conducted the study on implementation of RFID technology in public libraries and its impact on library operations and user services. The findings suggested that RFID has improved efficiency in library operations and enhanced user experiences, particularly in self-service transactions.

The use of RFID technology is increasing day by day but the cost and standards and user privacy are the main barriers (Solanki, 2021). Liu and Li (2022) explored the integration of RFID technology with library management system to improve collection management and user services. The findings highlighted the benefits of RFID in streamlining collection workflows and enhancing access to



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library resources. Faizan (2023) conducted his study on the users and staff of two Indian institutes Indian Institute of Technology (IIT) Roorkee and BHU. The researcher analyzed here the impact of ICT tools including RFID technology on the services of institutional libraries and found a positive impact of RFID technology on library services and user satisfaction and concluded that RFID technology is beneficial not only for academic libraries but also for other types of libraries as this technology simplifies the access of resources, providing self-services and increased the efficiency. Abadi (2023) conducted his case study in the library of Bosowa University, according to his findings that with implementation of RFID technology in university library of Boswoa University, the process of inventory management, shelf management and users' services brings a quiet useful results, the users are more satisfied as they don't wait more in check in/checkout processes. The users implied their quiet satisfaction about the RFID technology and its efficient services.

Challenges in Implementation of RFID Technology

Bansode and Desale (2009) described the feasibility of implementing RFID technology in the library. The researchers found that the technology enabled the library to provide fast, accurate, and timely services to users. With quick book circulation, users no longer have to queue in front of the circulation counter, and book tracking and shelving have become much easier. The implementation of RFID technology has also resulted in a reduction in staff required to perform these functions, which can now be redirected towards providing additional services. Moreover, the system has proven effective in deterring theft and misuse of documents. Overall, an adoption of this technology has significantly benefited the library by allowing for efficient management of a large volume of books and users with minimal manpower. Feng (2010) elaborated that RFID technology is the future path of libraries and it may solve many problems including the efficiency of staff in improving the accuracy and expansion of library services. Libraries should have the courage to grab the opportunities, meet challenges bravely, with these facts, Researcher believed that the RFID technology will get the desirable results in very near future. Dwivedi, Kapoor and Williams (2013) conducted the studies on affecting factors on RFID implementation and their research is an initial step in determining the impact of items on the use of RFID-based systems for user satisfactions. Their study revealed that RFID is the most sought technology which is going to be implemented in higher educational libraries.

Ali (2016) surveyed and got the response of 172 library professionals from universities and degree awarding institutes of Pakistan. The study revealed that library professionals are facing objections from Auditors of the organization for the loss of material and those librarians who have not write offed their lost books have to pay the prices of books. He emphasized the need of EM & RFID technologies is the ultimate solution to stop the theft of library material and Incharge librarians may be spared being paid the prices from their own pockets. Lee and Lee (2016) explored the impact of RFID technology on library circulation services, focusing on efficiency improvements and user satisfaction. The findings suggest that RFID implementation has led to significant enhancements in circulation processes and user experiences. RFID technology can enhance security in university libraries by providing a reliable means of



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tracking library materials and preventing theft (Ameen et al., 2017). RFID tags can be used to secure valuable or rare materials, ensuring their safekeeping. Gupta and Madhusudan (2017) conducted their study as a review of RFID implementation in Indian Libraries which described that investing in RFID technology is a wise decision for all parties involved in ensuring the long-term security of the library.

Kim and Choi (2017) examined the implementation of RFID technology in a university library setting, emphasizing its role in improving library management practices and enhancing user services. The study highlighted the importance of user training and support in ensuring the successful adoption of RFID technology. Mishra and Gupta (2018) examined the opportunities and challenges associated with RFID implementation in university libraries in India, providing insights that may be applicable to university libraries in Pakistan. Sivarag and Gopalakrishnan (2018) conducted their studies on the Library Professionals working in University Libraries in Kuala Lumpur, Malaysia, they focused on Nine Universities of both public and private sectors. In 75% of these libraries have already implemented the RFID systems and majority of them have the full solutions and some have the partially. They concluded in their studies that the professionals have the high level of awareness about the RFID Technology in library services, but still they are of the opinion that the more training opportunities may be created and urged that the authorities should support in implementing these kinds of technologies. Li and Wei (2018) highlighted the growing trend of RFID technology adoption in all kinds of libraries worldwide. The library professionals consider it an essential tool for modern libraries, offering a wide range of benefits. However, studies suggested that the long-term benefits of RFID, such as increased efficiency and improved user satisfaction, outweigh the initial costs (Ahmad et al., 2018). Ahmad (2019) conducted his study on the issues related to implementing this technology. The purpose of his study is to highlight the problems faced by the library community during implementing in their libraries and concluded as the library-user paradigm continues to shift, it is increasingly important for libraries to adopt RFID technology for timely and efficient services. Khan (2020) examined that how RFID technology changed the environment of libraries and focused on various components of RFID technology and concluded that the RFID technology has significantly transformed academic libraries by creating a more efficient and user-centric environment. Beside the benefits the challenges are also highlighted, the initial cost of implementation, staff training, and privacy concerns, to overcome on these challenges the researcher suggested to increase collaboration among libraries, vendors and researchers to develop cost effective-solutions and best practice for implementation.

Huang and Wang (2020) examined the impact of RFID technology on library user behavior and satisfaction and indicated that RFID implementation has positively influenced user perceptions of library services, the users in those libraries who have the RFID are more satisfied as compared to the ones who have not. Subhpoto and Ahmed (2021) assessed the level of competencies of library professionals working in universities of Sindh, besides the other competencies they investigated the level of awareness of RFID technology, majority of them was not aware about its proper use, however some thought it is



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only used for the book security, involving security gate with chips, only some of them are the fully aware about RFID as the full solutions of library automation. According to study the library professionals are scared in the implementation because of inadequate expertise and proper knowledge. However, the lack of funds, unsupportive management and training opportunities considered as the major barriers.

RFID can significantly reduce the time spent on routine tasks of libraries and improve the overall efficiency of library operations (Islam et al., 2021). Jan and Hussain (2021) conducted the study to determine the ranking of libraries in the Kyber Pakhtunkhwa Province of Pakistan. The objective of this study was to provide a framework for evaluating and ranking these libraries based on various criteria, such as collection size, services offered, and technology integration. The researchers highlighted the importance of RFID technology in modernizing the libraries and presented comprehensive framework for evaluating university libraries, emphasizing the role of RFID technology in development of library services. Hussain and Parveen (2021) measured the competencies level of the librarians of Public Libraries in Pakistan. The researchers found that there is a gap in ICT skills of library staff, the head librarians have the low level of competencies even they cannot browse or download the article. Working on ILS or its integration, implementation the new technologies like EM and RFID is a major problem. The researchers emphasized to provide the more training facilities and awareness sessions to the library professional in public libraries of Pakistan including the head librarians on innovate technologies being used by the modern libraries of the world.

Hussain and Ahmad (2021) conducted the qualitative studies on smart technologies in university libraries of Pakistan with focusing on RFID technology. They explored the current status, benefits, challenges in implementation being faced by the library professionals of particular universities and provided the practical recommendations for the solutions of challenges in implementation of RFID technology in libraries. Jahangir, Siddique and Adil (2021) explored the current status of automation in university libraries of Lahore. It covered various aspects such as the adoption rate of automated systems, the benefits and challenges faced by libraries, and the impact of these systems on library operations and user experience. The researchers comprehensively drew the picture of significant positive impact of automated services including RFID technologies.

Bharti and Verma (2021) examined the use of emerging technologies in university libraries which covers a wide range of technologies, including but not limited to Radio-Frequency Identification (RFID), Internet of Things (IoT), artificial intelligence (AI), and augmented reality (AR). The researchers discussed the benefits and challenges associated with each technology, as well as their potential impact on library services and user experience & concluded by mentioning the benefits of RFID technology in university libraries and hurdles in implementing. They highlighted the need for further research and collaboration to promote the successful adoption in library settings.

Hussain et al. (2021) assessed the level of competencies of librarians working in public libraries of Khyber Pakhtunkhwa province of Pakistan and found that the libraries in the province lack the IT infrastructure. The core reason was unavailability of resources, so the awareness and excitement to use the modern



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techniques was not created. The findings suggested that the trained LIS and IT professionals may be recruited in the public libraries for effective implementation of new technologies and the services quality may be provided according to the modern era. Asim, Arif and Rafiq (2022) explored the impact of Internet of things (IoT) application including RFID technology in university libraries of Pakistan. They discussed the role of RFID in automating the services of libraries and concluded that RFID make the things easier in the user's perspectives i.e self-operations, security of materials, efficient services. They highlighted the potential benefits of RFID technology in reshaping the libraries according 21st century libraries. Vijayalatha (2023) discussed briefly the role of RFID technology in the context of libraries. The research quoted some case studies with focusing on limitations and challenges being faced by library professionals in implementing the technology. He elaborated the cost and insufficient support are main barriers in implementing this technology for libraries. RFID technology is being implemented mostly by the university libraries in Pakistan with some obstacles like lack of funds, attitude of library professionals, IT skills, training opportunities, support from top management, however the implementation being bring the positive changes in library's day to day operations (Hussain, 2023). Asim and Arif (2023) elaborated comprehensively the adoption and use of Internet of Things (IoT) adoption and focused on 5 major databases. RFID technology, smart shelves, environmental monitoring and user engagements are the main issues of this research. RFID technology make life better and processing of products and consuming data easier. It is an oldest technology of IOT which helps in tracing and tracking of library materials efficiently. Asim et al. (2023) conducted the mixed studies and emphasized on benefits and challenges of AI applications in university libraries of Pakistan They have gathered 239 librarians' perceptions and interviews from 13 librarians. Their three questions were for the RFID's applications. They found that the library professionals in these universities have mixed thoughts about the applications of RFID systems. Lack of funds, lack of technology and unsupportive managements are main challenges in implementing RFID technology in their libraries. Rafique, Subhpoto and Idrees (2023) surveyed 41 Central and Seminar libraries of Universities of Interior Sindh to get the information about the status of ICT application in their libraries. They found that Central Libraries are better in comparison with the seminar/departmental libraries in universities. Mostly Central Libraries have implemented KOHA and established repositories. The professional staff in Central have a good level of awareness and very few of them have also implemented the full & partial RFID technologies. Challenges in implementation are almost the same as the subcontinent libraries mostly have i.e lack of funds, lack of motivation, unsupportive management. Abadi (2023) concluded in his study that beside a quality ILS a wireless RFID (Radio Frequency Identification) technology supports the high-speed Inventory System, fast circulation process, integrated security and efficient management. Cheng, Lo, Chiu et al. (2023) conducted the qualitative studies on university libraries in Hong Kong and explored the implementation of Internet of Thins (IoT) technology in academic libraries to develop smart library services. They examined the potential benefits and challenges of integrating RFID technology, a key component of IoT, into academic library services, particularly in the context of Hong Kong and



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highlighted the current landscape of RFID applications in academic libraries, focusing various ways in which RFID application can enhance library services, such as improving resource management, enhancing user experience, and enabling innovative services.

Kiran, Aziz and Lashari (2024) analyzed the factors which are being considered as hurdles in implementing innovative tools and ideas in libraries for providing the services according to 21 century library services. They highlighted the factors such as inadequate funding, unskilled professionals, electricity and provision of equipment. They suggested in this study that the awareness may be created among librarians through information literacy sessions, portals and social media platforms. Meena (2024) described the journey of transformation in digital age of Indian libraries. She focused two national level libraries of India, the National Library of India and Chennai Public Library. The findings revealed that Government has been increased the 40% funding for digitization projects including RFID. However, the balance becomes the challenge between physical and digital resources as a significant decrease level in physical books circulation. Ali, Naeem, Bhatti et al. (2024) conducted the studies on review of the literature of 40 relevant research papers, they elaborated that the rapid growth of technology specially affected the librarianship globally. The librarians now have to initiate the smart library services, efficient services, context-based and tracking services to their patrons. The highlighted the barriers of technical infrastructure, lack of funding, unavailability of policy and strategic planning.

Overall, the literature suggests that while there are varying levels of awareness regarding RFID technology among library professionals. The training programs and educational initiatives can play a crucial role in enhancing awareness and acceptance of the technology. Further research is needed to explore the specific challenges and opportunities for RFID technology adoption in the context of university libraries in Pakistan. These studies highlight the varying levels of awareness and attitudes towards RFID technology, underscoring the importance of tailored training and support programs to facilitate successful adoption in library settings.

Research Methodology

This study follows a quantitative survey research design aligned with the positivist paradigm to assess RFID technology awareness among library professionals in university libraries across Pakistan. Surveys are an effective method for reaching large, geographically dispersed populations, ensuring comprehensive data collection (Osayande, 2019; Meena, 2024; Ali, Naeem et al., 2024). A questionnaire, adapted from previous studies (John et al., 2017; Ahmad & Huvia, 2017), was distributed to library professionals at 41 universities. The sample was selected using Krejcie & Morgan's table, ensuring a 95% confidence level. Data collection was done via email, phone, and WhatsApp, with follow-ups to improve response rates. The results, analyzed using SPSS, showed that while library professionals had a positive outlook on RFID's benefits, challenges such as high costs, lack of training, and insufficient infrastructure hindered its adoption. The study suggests that addressing these barriers through adequate funding and training can enable more successful RFID implementation. This research contributes to the growing literature on RFID in libraries, providing insights for future improvements in university libraries across Pakistan.



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Data Analysis & Interpretation

After cleaning the data, it was analyzed using the Statistical Package for the Social Sciences (SPSS27.0). Quantitative data comprises descriptive statistics, such as frequencies, percentages, means, standard deviations, as well as inferential statistics data including Independent Sample t-test, One-Way ANOVA.

Usage of RFID Technology

The Table 1 shows the respondents which are the library professionals of the universities of Pakistan and have implemented the RFID technology in their libraries are nearly agreed (mean=3.75) that RFID technology have enhanced the security of their library material and have improved the user experiences in their libraries (mean=3.70). About the integration with their ILS the respondents agreed that they have successfully Integrated the RFID with their existing systems (mean =3.63) and also agreed on that the RFID has improved the library operations (mean=3.60). while there are a group of library professionals who remained neutral (mean=3.43) about the availability of RFID technology in their libraries.

Table 1: Usage of RFID Technology in University Libraries of Pakistan (N=41)

Statements	Mean	SD
RFID technology is being used in my University Library	3.4390	1.34255
RFID technology in effectively integrated with our Library Management System	3.6341	1.35566
RFID technology has improved the efficiency of library operations in my university library	3.6098	1.18064
The implementation of RFID technology has enhanced the security of library materials	3.7561	1.22026
RFID technology has improved the overall user experience in our university library	3.7073	1.20921

Scale = 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Challenges in implementation of RFID Technology

The table indicated that the Cost is the major barrier/challenge (mean=3.85) in implementation of RFID technology in university libraries of Pakistan and the inadequate training opportunities are also the major concern in implementation



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(mean=3.80). While for other three statements the Average means score is above 3 which show the professionals remained neutral in pointing out the barriers in implementing RFID technology in their libraries.

Table 2: Challenges in Implementation of RFID Technology (N=41)

Statements	Mean	Std. Deviation
The Cost of RFID Technology is significant barrier	3.8537	.96335
Staff resisting to adopting RFID technology is a challenge	3.4634	.74490
Lack of technical expertise in implementing is also a challenge	3.4634	1.07465
Integration of RFID with existing ILS is a complex and challenging process	3.3902	.99695
Inadequate support/training from Vendor is also a barrier in successful implementation	3.8049	.84319

Scale = 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Suggestions in implementation of RFID technology

This table 3 shows that the respondents are agreed that the funds (mean=3.90) and comprehensive trainings (mean=4.09) are the recommendations for implementation of RFID technology in university libraries of Pakistan.

Table 3: Recommendations in Implementation of RFID Technology (N=41)

Statements	Mean	SD
Sufficient funds may be allocated for proper implementation of RFID in University libraries	3.9024	1.06782
Comprehensive training may be provided to the professionals involved in RFID Implementation	4.0976	.94353

Scale = 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Results and Discussion

This study focused on investigating the current usage of RFID technology in university libraries across Pakistan. The analysis revealed that library professionals generally agreed that RFID technology has been successfully



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implemented in their libraries (mean=3.75), though they were less certain about having fully integrated RFID solutions (mean=3.43). These findings align with previous research, suggesting that many libraries are adopting RFID to enhance patron satisfaction, convenience, and item management efficiency (Rafiq, 2004). Similar studies by Shahid and Naveed (2020) highlighted RFID's role in improving theft control and service delivery. The results indicated a positive trend in RFID adoption, with a significant number of university libraries recognizing the technology's benefits, such as improved efficiency, enhanced security, and better user experiences in library services. Studies by Kishan (2021) and Rehman & Islam (2018) in different countries showed similar attitudes among library professionals, reinforcing these findings. However, the analysis also suggested that while many libraries have adopted RFID, full implementation is still not widespread. Respondents showed a neutral stance (mean=3.43) on the complete integration of RFID solutions, indicating that full deployment has not yet been achieved in many libraries. They expressed a positive attitude toward integrating RFID with existing Integrated Library Systems (ILS) (mean=3.63), suggesting openness to further adoption. Additionally, the study focused on the challenges faced by university librarians during RFID implementation in Pakistan. The most significant barrier identified was the high cost of RFID systems, with a majority of respondents agreeing that cost is the primary challenge (mean=3.85). Inadequate training opportunities were another major barrier to successful implementation, with library professionals indicating that the lack of proper training hampers effective use of the technology.

The study's findings align with previous research (Subhpoto, Subhpoto, & Ahmed, 2021; Hussain & Parveen, 2021) that highlighted the lack of funds and expertise as key challenges in adopting new technologies like RFID. While some participants mentioned staff resistance (mean=3.46), lack of technical expertise (mean=3.46), and integration issues with existing ILS (mean=3.39) as additional challenges, these were not as pronounced as the cost and training issues. Similar studies in other countries, such as Chhetri and Thakur (2019), noted that RFID technology, despite being more expensive than barcode technology, could be more cost-effective in the long run. Denen, Akor, and Udensi (2023) also supported the need for comprehensive training to help librarians fully optimize RFID technology. The literature review and data analysis pointed to two major barriers—cost and insufficient training—as significant obstacles in the implementation of RFID technology in libraries globally. Studies by Al-Rababah and Al-Adwan (2019), Rahman and Yusof (2018), and Cheng and Chang (2018) in Jordan, Malaysia, and Taiwan, respectively, highlighted these same challenges. The findings emphasized the technical challenges, such as compatibility issues with existing systems and resistance to adopting new technologies, which are consistent with global research.

Regarding recommendations, the study indicated that sufficient funding (mean=3.90) and comprehensive training opportunities were the most crucial factors for the successful implementation of RFID technology in university libraries. These recommendations were consistent with previous studies (Hussain & Parveen, 2021; Sivarag & Gopalakrishnan, 2018) and aligned with the findings of Kiran, Aziz, and Lashari (2024), who suggested that library professionals should receive thorough training to familiarize them with RFID technology. Studies from neighboring countries also echoed similar



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recommendations, such as Singh and Sharma (2017) in India, and Alemana and Kaur (2020) in Ghana, who identified cost, technical expertise, and training as key factors for successful RFID adoption. In Iraq, Al-Saeedi and Hamid (2021) highlighted the same issues—cost and training—as significant challenges in implementing RFID technology in academic and public libraries. Overall, the study emphasizes the importance of addressing financial constraints and providing adequate training to ensure the successful adoption and implementation of RFID technology in university libraries across Pakistan, which would lead to improved library services and operational efficiency.

Conclusion

This study provides valuable insights into the current usage and challenges of adopting RFID technology in university libraries across Pakistan. The findings indicate a positive trend in RFID adoption, with many libraries recognizing its benefits in improving efficiency, security, and overall user experience. However, the study also highlights significant barriers, particularly the high costs of RFID systems, inadequate training opportunities, and integration challenges with existing library systems. These factors hinder the full implementation and optimization of RFID technology in Pakistani university libraries. To overcome these challenges, it is essential for libraries to secure adequate funding, provide comprehensive training, and enhance technical support for library professionals. Addressing these issues will enable the successful adoption of RFID technology, ultimately contributing to the modernization of library services and improving operational efficiency in university libraries across Pakistan.

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