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Application of Radio Frequency Identification Technology in libraries and information centres: An Indian perspective

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Application of Radio Frequency Identification Technology in libraries and information centres: An Indian perspective

Abstract

Purpose –The purpose of this paper is to investigate the present status of RFID application, benefits realised after implementing RFID, problems faced during RFID adoption and its implementation in the libraries and information centres of Northern India.

Design/methodology/approach – The survey method of research was adopted in this research. In order to assess the required information about the implementation of RFID technology from the librarian/Incharge of the library of the nine selected institutions of Northern India, the data was collected through a questionnaire method. Moreover, the respondents were also interviewed to obtain more information.

Findings – The present study shows that all the selected libraries in Northern India are in the initial stages of RFID implementation and they are realizing the benefits of its implementation which include reduction in queue at circulation desk /counter, extended hours of circulation without additional staff, library collection has become more secure, etc. At the same time, library staff is facing some problems with the use of RFID technology.

Research limitations/implications – The present study is limited to the Central, State and Deemed universities recognised by the UGC and IITs situated in Northern region of India which have implemented RFID in their libraries. Further, due to time and cost restrictions, it was not possible to cover all type of institutions.

Practical implications - It is hoped that the outcome of the present study will give some useful suggestions/recommendations to the librarians who have implemented RFID technology in terms of its better utilisation and at the same time, it will also help the librarians who want to implement RFID system in their libraries.

Social implications – Across the world, university libraries are increasingly adopting and implementing RFID solutions to provide better and efficient library services such as self checkout/check-in of library materials, security of library books and efficient tracking of library materials throughout the library. As a small number of libraries in India have introduced RFID, it is high time to study the application of RFID technology in libraries, keeping in view its problems and benefits.

Originality/value –After an extensive review of literature, it was found that only a few studies related to the use of RFID in Indian libraries has been undertaken so far. Hence, the present study is very timely and fruitful to examine the application of RFID technology in libraries and information centres of Northern India, as the libraries and information centres in this region are unexplored for such a study .

Keywords – Radio Frequency Identification, Radio Frequencies, RFID technology, Adoption, Academic libraries, University libraries, Libraries, India

Paper type– Original Research paper

1. Introduction:

Due to the low cost of the barcode technology, most of the libraries around the world are using it for circulation management. However, the main constraints related to barcode technology are: it always requires a line-of-sight, does not provide security of library collection, does not offer any benefit for collection management and is becoming very difficult for the libraries to satisfy the increasing demands of the users. Thus, comes up the need to implement new technology to improve the library circulation management, inventory and security of library collections. Librarians are always known as early adopters of technology (Kotecha, 2008) and the adoption of RFID technology by libraries promises a solution that could make it possible to inventory hundreds of thousands of items in their collections in days instead of months. In addition, it allows patrons to check out and return library collection automatically at any time of the day. Besides speeding up checkouts, keeping collections in better order and alleviating repetitive strain injuries among librarians, RFID promises to provide a better control on theft, non-returns and misfiling of a library's assets (Singh, Brar & Fong, 2006).

RFID is an automatic identification technology that put "tags" on objects (documents, people, animals, vehicles, containers, etc.) so they can be identified, tracked and managed automatically utilizing radio frequency equipment and supporting computer systems (Brown, 2007). RFID has become one of the most important application today. The widespread use of RFID by Wal-Mart (the world's largest retailer) and the United States Department of Defense has made other people, companies and groups aware of the benefits of using RFID. RFID has been applied in many areas such as logistics, supply chain management, warehouse management and logistics, medical implants, road tolling, building

access control, aviation security, luggage tracking at airports, Automated Vehicle Identification (AVI) systems, homeland security applications, libraries, etc. (Ahson & Ilyas 2008).

A large number of libraries in developed countries have adopted this technology. Observing the usefulness and efficiency of RFID, libraries in the developing countries like India have also started implementing RFID in libraries. After an extensive review of literature, it was found that only a few studies related to the actual use of RFID in Indian libraries has been undertaken so far (Bansode & Desle, 2009). It is, therefore, interesting to study Radio Frequency Identification Technology applications in library and information centres of Northern India in order to identify the benefits and various problems faced by the library staff while implementing this technology. This study aims to achieve the following objectives:

1. to determine the key factors and purpose of implementing RFID technology in libraries.
2. to identify the steps taken during RFID implementation.
3. to know the present status of RFID technology in libraries.
4. to identify the benefits realized by the libraries after the RFID implementation.
5. to determine challenges of implementing RFID technology in libraries.

2. Review of related literature

Previous studies were reviewed in order to assess the implementation and use of RFID in libraries. Yorkovich (2001) revealed that with the use of Self Check System, users can check out the material themselves without the assistance of the library staff. He further highlighted that DLA is among the most revolutionary technology to affect the way libraries manage information and with the use of this technology, a library becomes a more efficient place to retrieve information. Fabbi et al. (2002) conducted a study on Implementation of 3M digital identification at UNLV Libraries and reported that with the implementation of 3M Digital Identification System at UNLV libraries, performance and efficiency of the library staff increased and users were able to find out the books which have been properly arranged on the shelves due to the capabilities of the Digital Library Assistant. Hopkinson & Chandrakar (2006) in their study found that RFID offered not just a solution to the security question, but also the possibility of self service and stock management facilities not available from traditional solutions. They revealed that RFID self service has became popular with library customers and has enabled significant changes in delivery of library service and its ease of use enabled self-service to account for around 50 % of total transactions. Selamat &

Majlis (2006) opined that self-check counter makes borrowing and returning book process more automated with less involvement of librarians; therefore librarians can focus on providing more effective work to better serve the library. Golding & Tennant (2008) observed that the books closest to the metal separator or to the metal upright were consistently misread. These books had to be physically removed from the shelves to obtain a reading. Ching& Tai (2009) observed that since the start of the UHF RFID pilot test in April 2008, check-outs of the Semi-Closed collection has increased by 50%. Cunningham (2010) highlighted no unified standards, high cost, security and integration with the library management system, etc as problems in implementation of RFID in libraries.

3. Methodology

As per the data collected through the websites of the universities and IITs in North India, it was found that out of the total nine academic institutions, five state university libraries, two deemed university libraries and two IIT libraries in the Northern India have implemented RFID and thus were selected for the present study. The scope and coverage of the present study is limited to the following nine institutions of Northern India where RFID technology has been adopted:

1. Gautam Buddha University (Greater Noida).
2. Indian Institute of Technology (Roorkee).
3. Indian Institute of Technology (Delhi).
4. Indian Law Institute (New Delhi).
5. Panjab University (Chandigarh).
6. Punjabi University (Patiala).
7. Ram Manohar Lohiya Law University (Lucknow).
8. University of Jammu (Jammu).
9. University of Kashmir (Srinagar).

Questionnaire method was used to collect the data and the data was collected from the librarians by visiting the libraries. Interview and observation method were also adopted wherever required to make data and information more authentic.

4. Analysis

The data collected from the librarians with the help of the questionnaire has been analyzed below:

4.1 Key factors for RFID adoption

As shown in Figure 1, the findings reveal that "top management support" (i.e., financial, technical, infrastructural, institutional and administrative, etc.) and "perceived RFID benefits" (i.e., self-issue/return, security of library collections, inventory control, etc.) are the most important key factors for RFID adoption. The least preferred key factor for RFID adoption in libraries is the "user demand".

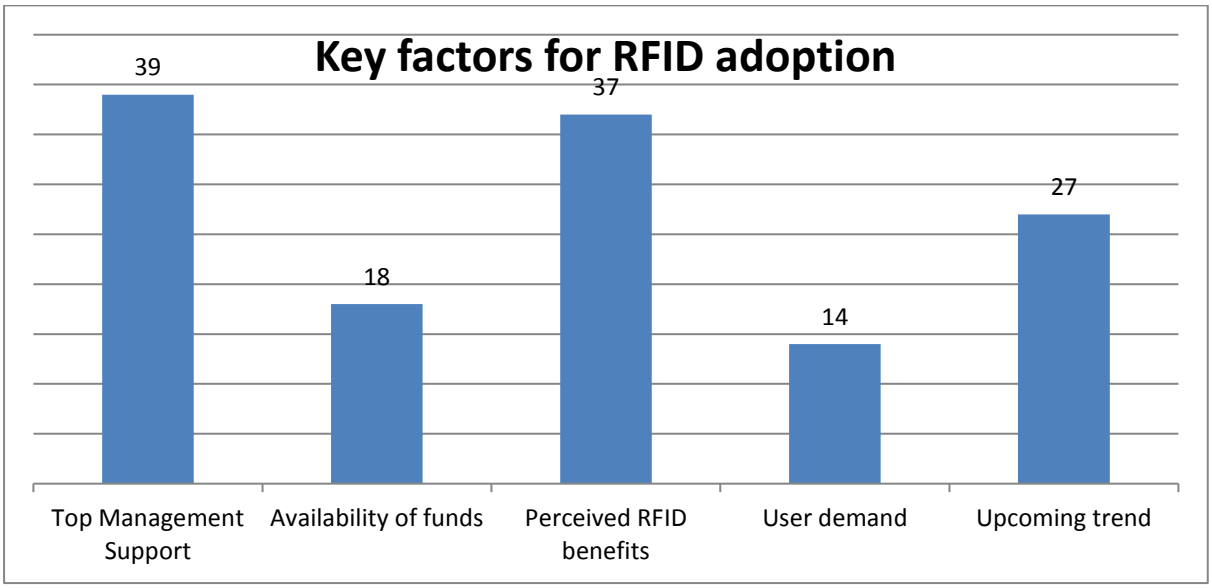

Figure 1: **Key factors for *RFID adoption***

4.2 Purpose of Implementing RFID technology in Libraries

Figure 2 indicates that amongst the purpose for implementing RFID technology in selected nine libraries, the respondents have selected "self- issue/return" as a most preferred purpose, followed by "faster issue/return" of books through RFID assisted circulation desk. The least preferred purpose for implementing RFID technology is "better inventory control". It was also observed during the personal visit to the participating libraries that all the libraries are in the initial stage of RFID implementation and their main focus is to run the Self-check-in /check-out system smoothly. After certain period of time (i.e., 3-5 years), they might consider using Digital Library Assistant for inventory control in their respective libraries. During the discussion with the library professionals of Gautam Buddha University (Greater Noida), it was observed that the staff crunch is also one of the main purpose for implementing the RFID technology.

4.3 Initiation of RFID project

RFID project was first initiated by University of Jammu (Jammu) in 2004, followed by Indian Law Institute (New Delhi) which initiated the project in 2006. Table 1 clearly indicates that three libraries (i.e., 33.3%) initiated this project during 2008 - 2009. The remaining four libraries (i.e., 44.4%) initiated RFID project in 2010. It is clear that five libraries (i.e., 55.5%) started using RFID within the same year the project was initiated, while remaining four libraries (i.e., 44.4%) took about 12-18 months to start the RFID facility in their libraries.

Name of the institution	Year in which RFID project was initiated	Year in which RFID facility started in library
IITR	2010	2010
PUC	2009	2010
KU	2008	2008
ILI	2006	2006
IITD	2010	2011
PUP	2010	2011
JU	2004	2005
GBU	2010	2010
RMLNLU	2008	2008

Table 1: Period of the project initiation and implementation

(IITR=Indian Institute of Technology (Roorkee), PUC=Panjab University (Chandigarh), KU=University of Kashmir (Srinagar), ILI=Indian Law Institute (New Delhi), IITD= Indian Institute of Technology(Delhi), PUP= Punjabi University (Patiala), JU=University of Jammu (Jammu), GBU= Gautam Buddha University (Greater Noida), RMLNLU= Ram Manohar Lohiya Law University (Lucknow)

4.4 Funds for RFID project

Since the funding for RFID project is the key to implement the technology in the library, the librarians were asked about the source of funding for RFID project. Table 2 shows that, out of total nine selected libraries under study, seven libraries (i.e., 77.8%) received special grant for RFID project from their parent institution, whereas two libraries (i.e., 22.2%) spent funds out of regular library budget for this project. However, the above table reveals that no grant was either provided by the state or central government for the RFID project. Six libraries (i.e., 66.7%) do have a recurring budget provision of Rs. 1 lakh to 2.5 lakh for AMC, purchase of tags, etc.

Name of the institution	**Source of funding**			**Initial budget in Rs.**	**Recurring Budget/ Year in Rs.**
	Regular budget	**Special Grant**	**Grant from Central/**		

			State govt.		
IITR	-	Parent Institution	-	1 crore	1 Lakh
PUC	-	Parent Institution	-	1.75 crore	-
KU	-	Parent Institution	-	50 lakh	2.5 lakh
ILI	-	Parent Institution	-	10 lakh	90,000
IITD	Yes	-	-	65 lakh	-
PUP	-	Parent Institution	-	32 lakh	Rs. 2 lakh
JU	-	Parent Institution	-	80 lakh	1 lakh for RFID tag
GBU	-	Parent Institution	-	Not mentioned	Not mentioned
RMLNLU	Yes	-	-	16 Lakh	1 Lakh

Table2 : Funds for RFID project

4.5 Steps taken for implementation of RFID technology

Table 3 depicts that all the nine selected libraries in Northern India had arranged presentations from the vendors about the RFID technology. Before implementing RFID technology in their respective libraries, five librarians (i.e. 55.5%) visited other libraries which have implemented this technology to see how the system is working. During the interview with the librarians, it was informed that the RFID implementation committee of Panjab University (Chandigarh) visited University of Jammu (Jammu) before implementing RFID technology. The library staff of Indian Institute of Technology (Delhi) and Gautam Buddha University (Greater Noida) visited British Council library before implementing the RFID technology in their respective libraries.

Name of the institution	**RFID Steps Undertaken**					
	Presentations	**Visit to other Institutions**	**RFID Tender**	**Pilot project**	**Training**	**Tagging of library documents**
IITR	Yes	No	Yes	Yes	Yes	RFID vendor and Library Staff
PUC	Yes	Yes	Yes	Yes	Yes	RFID vendor and Library Staff
KU	Yes	Yes	Yes	Yes	Yes	Library Staff
ILI	Yes	No	Yes	No	Yes	RFID vendor and Library Staff

IITD	Yes	Yes	Yes	Yes	Yes	Library Staff
PUP	Yes	No	No	Yes	Yes	Library Staff
JU	Yes	No	Yes	Yes	Yes	RFID vendor and Library Staff
GBU	Yes	Yes	Yes	No	Yes	RFID vendor and Library Staff
RMLNLU	Yes	Yes	No	No	Yes	Library Staff
Total	09 (100%)	05 (55.5%)	07 (77.8%)	06 (66.7%)	09 (100%)	-

Table 3: Steps taken for implementation of RFID technology

Table 3 also indicated that seven libraries (i.e., 77.8%) invited tenders for the supply, testing and installation of RFID technology. While discussion with the librarians, it was found that some of the eligibility criteria for participating in the tender document included company's presence in India, 3-5 library installation sites, Original Equipment Manufacturer (OEM) of RFID hardware components or an Authorized Distributor of OEM of RFID hardware component or a System Integrator having experience in RFID solutions, etc. Six librarians (i.e., 66.7%) mentioned that before going for full scale RFID implementation, they carried out a pilot project for about 1000-5000 books to know how the RFID system works in a library, different types of problems faced, awareness amongst the library staff about the technology, etc. The main objective for running pilot project was to fix the problem encountered initially so that the project gets implemented within its time and staff also gets some experience. All the nine selected institutions reported that the vendors had provided training for installation and use of RFID components. Retrospective tagging of library documents is a very tedious and time taking process. When the librarians were asked as to who carried out the retrospective conversion of tagging of library documents, five librarians (i.e., 55.5%) responded that both the RFID vendors and the library staff carried out this work and remaining four librarians (i.e., 44.4%) responded that it was done by the library staff.

4.6 Networking system used for RFID

Libraries use different kinds of network (i.e., LAN and Wi-Fi) for communication between RFID components and LMS. Local Area Network (LAN) is the most important set-up, which is used to provide a wider access to the library services at a very high speed.

The analysis in table 4 reveals that six libraries (i.e., 66.7%) are using LAN for communication between RFID components and LMS, whereas two libraries (i.e., 22.2%)

have WI-Fi- network for communication between LMS and RFID hardware and software. Only one library (i.e., IIT, Roorkee) is using both types of networks (i.e., LAN as well as Wi-Fi) for communication.

Name of the institution	Networking System		
	LAN	Wi- Fi	Both LAN and Wi-Fi
IITR	-	-	Yes
PUC	Yes	-	-
KU	Yes	-	-
ILI	Yes	-	-
IITD	-	Yes	-
PUP	Yes	-	-
JU	Yes	-	
GBU	Yes	-	-
RMLNLU	-	Yes	-
Total	06 (66.7%)	02 (22.2%)	01 (11.1%)

Table 4: Networking system used for RFID

4.7 Library Automation Software and RFID Protocol

It is a futile exercise to think about the RFID technology without the Library Management Software as it is the heart of an RFID application system. It is the communication gateway among the various components of the RFID system. The analysis of data in table 5 reveals that a large number of libraries (i.e., 77.8%) have adopted "LibSys" software which is developed by the LIBSYS Ltd, Gurgoan, whereas Panjab University (Chandigarh) and University of Kashmir (Srinagar) is using SLIM-21 and Virtua LMS respectively. Earlier the Panjab University library was using TechLib plus LMS software, but it did neither have SIP2 nor NCIP protocol required for communication with RFID components (i.e., Self-check out and Book drop) Hence, they decided to shift to SLIM-21 LMS. Now, it is being used with some customization as per the requirements of the library. It is clear from the table that all the nine libraries (i.e, 100%) use SIP 2 protocol for communication between LMS and RFID components.

Name of the institution	Library Software	RFID protocol
IITR	Libsys	SIP 2
PUC	Slim-21	SIP 2
KU	Virtua	SIP 2
ILI	Libsys	SIP 2
IITD	Libsys	SIP 2
PUP	Libsys	SIP 2
JU	Libsys	SIP 2
GBU	Libsys	SIP 2

RMLNLU	Libsys	SIP 2

Table 5: Library automation software and RFID protocol

4.8 Present status of RFID components in libraries

Table 6 depicts that University of Kashmir (Srinagar) has tagged maximum number of books (i.e., 3,50,000), followed by Panjab University (Chandigarh) and Punjabi University (Patiala) both of which have tagged 3,00000 books each. Indian Institute of Technology (Roorkee) and Indian Institute of Technology (New Delhi) have tagged 2,50,000 and 1,75,000 books respectively. Two institutions (i.e., Ram Manohar Lohiya Law University, Lucknow and Gautama Buddha University, Greater Noida) have tagged 20,000 and 50,000 collection respectively. Seven libraries (i.e., 77.8%) have both Self-check out and Self-check-in/book drop system (which allow patrons to check out/check-in items without any assistance from the library staff) in their respective libraries. Only two libraries (i.e., Indian Law Institute (New Delhi) and Ram Manohar Lohiya Law University (Lucknow) do not have Self-check out/ chek-in system in their respective libraries. In these two institutions, circulation work is being performed by library staff with the use of RFID system only at the staff end. All the libraries have Staff workstations. Conveyor and Sorting systems (which can move library material and arrange them by category into separate bins or onto separate carts) are not being used by the any library so far.

Table 6 also indicates the availability of Digital Library Assistant/Shelf Management Reader in the participating libraries. It indicates that six libraries (i.e., 66.7%) do have Digital Library Assistant/Shelf Management Reader. All the nine libraries (i.e., 100%) have security gates positioned near the library exit, which read the security setting stored in RFID tags and determine whether or not an item should be permitted to leave the library.

Name of the institution	RFID components						
	Collection tagged	Self-issue System	Self-return system/ Book Drop	Digital Library Assistant	Staff Workstation / Programming Station	Sorting Equipment	Security Gate
IITR	2,50,000	Yes	Yes	Yes	Yes	No	Yes
PUC	3,00000	Yes	Yes	Yes	Yes	No	Yes
KU	3,50,000	Yes	Yes	Yes	Yes	No	Yes
ILI	80,000	No	No	No	Yes	No	Yes
IITD	1,75,000	Yes	Yes	Yes	Yes	No	Yes
PUP	3,00000	Yes	Yes	No	Yes	No	Yes
JU	1,00000	Yes	Yes	Yes	Yes	No	Yes
GBU	50,000	Yes	Yes	No	Yes	No	Yes

RMLNLU	20,000	No	No	Yes	Yes	No	Yes
Total		07 (77.8%)	07 (77.8%)	06 (66.7%)	09 (100%)	-	09 (100%)

Table 6: Present status of RFID components in libraries

4.9 Advantages of Self check out/Check –in /Book Drop/Security gates

Table 7 reveals the advantages of Self- check out/Check–in /Book Drop system in nine selected libraries in Northern India. The data indicates that the libraries at Indian Law Institute (New Delhi) and Ram Manohar Lohiya National Law University, (Lucknow) are not providing Self-Check out/ Book Drop facility in their respective libraries. Instead, they are using RFID assisted Staff workstation for circulation work and issue/return work is being done by library staff only. It was noticed during the visit to University of Jammu (Jammu) that RFID components like Self-Check out/ Self Check-in, Book Drop, security gates were not found to be working, although the same were functional initially as informed by the library staff.

It is clear from table 7 that seven librarians (i.e., 77.8%) observed reduction in queue at circulation desk /counter, six librarians (i.e., 66.7%) informed that library is now providing extended hours of circulation without additional staff. Seven librarians (77.8%) indicated that with the implementation of RFID system, library staff is now free to provide more users' centric services. Seven librarians (i.e., 77.8%) indicated that it saves time of the library staff. Seven librarians (i.e., 77.8%) reported that number of staff required to manage circulation desk has reduced, five librarians (i.e., 55.5%) indicated that with the implementation of RFID, circulation of library documents has increased. All the nine librarians (i.e., 100%) reported that with the implementation of RFID technology, library collection has become more secure.

Name of the institution	**Advantages**						
	Reduction in queue at circulation desk	**Extended hours of circulation services**	**To provide more users' centric services**	**Save time of the library staff**	**Reduction of staff at circulation desk**	**Increased Issue/return of library documents**	**Security of Library collection**
IITR	Yes	Yes	Yes	Yes	Yes	No	Yes
PUC	Yes	Yes	Yes	Yes	Yes	Yes	Yes
KU	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ILI	-	-	-	-	-	-	Yes
IITD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PUP	Yes	Yes	Yes	Yes	Yes	Yes	Yes

JU	Yes	Yes	Yes	Yes	Yes	No	Yes
GBU	Yes	No	Yes	Yes	Yes	Yes	Yes
RMLNLU	-	-	-	-	-	-	Yes
Total	07	06	07	07	07	05	09
Percentage	(77.8%)	(66.7%)	(77.8%)	(77.8%)	(77.8%)	(55.5%)	(100%)

Table 7: Advantages of Self check out/Check –in /Book Drop /Security Gates

4.10 Problems faced with the Self Check out/Check-in, Book Drop / Security Gates

In order to know various problems faced by the librarians with the use of RFID components (i.e., Self-Check out/Check-in, Book Drop System, Security Gates, etc.), participating librarians were provided eight options. "Any other" option was also provided for any other problem that was not listed.

Table 8 shows the problems faced by the participating librarians with the Self Check out/Check-in, Book Drop System/ Security gates in nine selected libraries in Northern India. The table shows that five librarians (i.e., 55.5%) informed that books returned through book drop get damaged more, the same percentage of librarians (i.e., 55.5%) informed that library staff has to perform the manual cross checking of books returned through book drop. Four librarians (i.e., 44.4%) faced problem of issuing multiple books at a time through self-check system. Three librarians (i.e., 33.3%) indicated that the users sometime complain about the books or other documents which do not have the RFID tags, three librarians (i.e., 33.3%) faced problems where bibliographic details of the books were not entered correctly. No librarian has mentioned that he/she has ever faced problem of issuing or returning books in other than English language through RFID. It is clear from the above table that five librarians (i.e., 55.5%) did faced problem of removal of RFID tags by the users. Four librarians (i.e., 44.4%) also faced problem of false alarm near the security gate.

Name of the institution	Problems Faced							
	Books returned through Book drop get damaged more	Manual cross checking of books	Issuing multiple books at a time	Documents do not have an RFID tag	Incorrect Bibliogra-phic details	Books other than English language	Problem of removal of RFID tags by the users	False alarm near the security gate
IITR	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
PUC	Yes	Yes	Yes	No	No	No	No	No
KU	Yes	Yes	No	No	No	No	Yes	No
ILI	-	-	-	-	-	-	Yes	No
IITD	Yes	Yes	No	No	No	No	Yes	No
PUP	No	No	No	Yes	No	No	No	No
JU	No	Yes	Yes	No	Yes	No	No	Yes
GBU	Yes	No	Yes	Yes	Yes	No	Yes	Yes
RMLNLU	-	-	-	-	-	-	No	Yes
Total	05	05	04	03	03	Nil	05	04
Percentage	(55.5%)	(55.5%)	(44.4%)	(33.3%)	(33.3%)	-	(55.5%)	(44.4%)

Table 8: Problems faced with the Self Check out/Check-in, Book Drop / Security Gates

4.11Challenges of implementing RFID Technology in libraries

There are many barriers to RFID adoption and its implementation in the libraries. Some of the barriers as indicated in review of literature which include high cost of the technology, lack of senior management support, hesitance of staff towards implementation of new technology, lack of ICT expertise amongst library professionals, implementation challenges, compatibility with LMS/Integration challenges, lack of proper RFID standards and protocols, lack of RFID vendors in India, user privacy, etc. The participating librarians were asked to indicate any problem/s they faced during the adoption and implementation of RFID technology.

Table 9 depicts that eight librarians (i.e., 88.9%) indicated "high cost" as the major barrier while implementing RFID technology. Five librarians (i.e., 55.5%) highlighted "resistance from the staff" and "lack of RFID standards and protocols" as important problem in implementing RFID technology. Four librarians (i.e., 44.4%) stated "lack of ICT expertise amongst library professionals" and "LMS- RFID Integration" as barriers in implementing RFID technology in libraries. Three librarians (i.e., 33.3%) indicated "Lack of management support" and the same number of librarians felt "lack of RFID vendors in India" as a problem in RFID implementation. Only two librarians (22.2%) mentioned that "user privacy" is a problem while implementing RFID technology in their respective libraries.

Problems faced	**No. of Libraries**	**Percentage**
High cost of the technology	8	88.9%

Resistance from the staff	5	55.5%
Lack of ICT expertise amongst library professionals	4	44.4%
Lack of management support	3	33.3%
LMS- RFID Integration	4	44.4%
Lack of RFID standards and protocols	5	55.5%
Lack of RFID vendors in India	3	33.3%
User Privacy	2	22.2%

Table 9: Problems faced during RFID implementation

5. Conclusion and Suggestions

The analysis of data shows that all the selected libraries in Northern India are in the initial stages of RFID implementation and they are realizing its benefits which include reduction in queue at circulation desk /counter, providing extended hours of circulation without additional staff, library staff is free to provide more users' centric services, saves time of the library staff, number of staff required to manage circulation desk has reduced, circulation of library documents has increased, library collection has become more secure, etc. after implementing RFID technology. At the same time, library staff is also facing some problems with the use of RFID technology. A majority of librarians indicated "high cost", resistance from the staff and "lack of proper RFID standards and protocols" as a problem in implementing RFID technology. On the basis of the observations and findings of the present study, following suggestions are given:

1. Although majority of libraries do have a recurring budget provision for AMC of RFID hardware/software and purchase of new RFID tags, yet the amount is quite low. Therefore, it is suggested that all the libraries should have a proper budgetary provision for AMC of RFID Hardware/Software and purchase of new RFID tags in their library budget with an increase of 5-10% annually.

2. All the libraries selected under the study have implemented RFID technology before the publication of ISO 28560 (i.e., before April 2011). They are using a proprietary data model, i.e., their present system may not be interoperable with other RFID vendors. Therefore, it is suggested that the libraries which are planning to implement RFID in their libraries must use RFID tags that are ISO 28560 compliant in addition to ISO 15693, ISO 18000-3 and other global standards and protocols given by NISO.

3. To overcome the problem of false alarm at the security gates, it is suggested that the librarians should discuss security gate positioning and tag detection rates with the suppliers. It is recommended that security gates should be placed at least 3-4 feet away from metal door frames and 8-10 feet away from computers. It is also recommended that gates should be covered with wooden frames to avoid metal interference.

4. To overcome the problem of power failure, it is suggested that all the libraries should have UPS connected to all the RFID components and ILS server. They may also have generator facility or any other backup system to run the RFID system smoothly in case of power failure.

5. While doing retrospective tagging of library collection, it is suggested that library staff should use some method of marking the tagged collection so that these can be easily identified. It will save the time of the library staff to identify the untagged documents. Retrospective tagging of library collection can be carried out on rent or lease programming stations from the vendors.

6. None of the libraries selected under study considered RFID technology as a tool for collection development in their respective libraries. Therefore, it is suggested that all the libraries should use RFID technology for collection development as well.

7. Regarding protection of user privacy, libraries should follow ALA guidelines and store no personal information on RFID tags. It is also suggested that libraries should only store accession number of the document on RFID tags as storing additional information of the documents (i.e., title, author, ISBN etc.) of the books will slow the programming operation and also has potential for compromising patron privacy.

8. It is suggested that libraries should use the most secure connection for communications between LMS and RFID components to prevent unauthorized monitoring and access to personally identifiable information.

9. It is suggested that libraries should ask RFID suppliers about the RFID tag life expectancy to ensure that RFID tags should have adequate re-write cycles and durability.

10. It is recommended that smaller and new libraries should adopt RFID at an early stage since initial costs and resources involved in adoption and implementation of this technology is lower as compared to significant benefits it provides.

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