RFID TECHNOLOGY IN LIBRARIES: A CASE STUDY OF ALLAMA IQBAL LIBRARY, UNIVERSITY OF KASHMIR

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The objective of this paper was to assess the usage and effectiveness of RFID technology in Allama Iqbal Library. Care has been taken to examine the post RFID benefits and benefits of Virtua software used for installing RFID. Further, threats and other risks of RFID have also been highlighted. A structured questionnaire was used as the key instrument for data collection. Interviews and observations were also conducted wherever the questionnaires failed. The library is at the forefront in successfully implementing RFID technology thus reducing the time and staff required for circulation of books and, simultaneously, increasing book transactions per hour. The study reveals that majority of users (80.70%) are using self check-in/out while a small percentage (19.29) still relies on manual issue and return. Though a fully RFID enabled library system is in place, the manual circulation counter has not been abandoned. An important finding is that the inventory control never conducted prior to RFID was carried out easily by hand held inventories within a short time. Since the study is about the latest developments of automation of a leading library; it will be helpful for other university/college libraries of Jammu and Kashmir in particular and India in general to modernize their services and operations by implementing RFID technology.

INTRODUCTION

Application of information technology in libraries has always been a boon to enhance the quality and delivery of information services to the users [1]. One such technology is the Radio Frequency Identification (RFID) technology. RFID is a blend of radio frequency based technology and microchip technology in which information is contained on a microchip in the form of tags which are fixed to books and is read using radio frequency technology regardless of book orientation or arrangement. It does not require line of sight or a fixed place to read tags as traditional theft detection systems do and the distance from an item is not a critical feature except in case of extra wide gates [2]. RFID is also regarded as smart shelves and smart dump-bins that are technically feasible in large library setup with adequate budget provisions. Simply RFID is an identification technology that does the same job as barcodes do, but provide potentially a lot more benefits [3]. In other words, it can be stated that RFID is the detection technology that performs the same tasks as barcodes; however, it offers many advantages.

RFID has been the focus of British and Scottish scholars since World War II when they studied radio transmission system for IFF (Identification of Friend or Foe) system to differentiate friendly aircraft from German planes [4]. British and American planes were installed with an IFF system, which broadcast a signal back to inform the radar crew on the ground that this was an allied aircraft. RFID technology is based on the same concept [5].

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However, it is no longer limited to supply chains or logistic applications in defence aircrafts and other industries; some of its applications like theft detection and book checking out are also applicable in libraries. The advent of RFID tags made of low cost integrated circuits enabled large-scale use of this technology. There are different types of tags but passive RFID tags are most suitable for library self-checkout system, since no battery is needed [6]. However, it has been seen that libraries began to use RFID as a substitute to their electromagnetic and barcode systems since late 1990s [7].

In the Developing World including India, RFID technology in university libraries is still in its infancy. Libraries have to look for creative solutions to remain relevant to the needs of users and RFID is rapidly becoming popular for efficient management in large libraries [8]. Significantly, the use of RFID reduces the time required for circulation and stock-verification operations. The most remarkable time savings are attributable to the fact that information can be read from RFID tags much quicker than from barcodes and that several items in a stack can be read simultaneously [9]. RFID is mainly intended for change from partially automated to fully automated library systems and also offers great potential for broadening access to library services and security in ways never perceived earlier [10]. It is said that larger the collection a library possess, the more worthwhile it is to install RFID.

Just as computerization, RFID technology too began quite late in Indian libraries as compared to American and European libraries. There are only a handful of Indian libraries including National Law Institute Library; National Library; National Social Science Documentation Centre (NASSDOC), Central Library; Allama Iqbal Library; Jammu University Library; A C Joshi Library, Panjab University; Dr. Tulsidas Library, Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh; Pandit Deendayal Petroleum University, Ahmadabad; Nirma University, Ahmadabad; Chandragupta Institute of management, Patna; IIM Shillong; Jawaharlal Nehru Centre for advanced scientific research, Bangalore, etc. that have implemented RFID technology. However with the advent of indigenous and international RFID compatible library software, there is presently an increasing trend towards implementing RFID in Indian libraries.

LITERATURE REVIEW

Some of the relevant studies have been reviewed below:

Koneru in his study revealed that the majority of libraries are still underprepared to fully implement RFID technology; RFID technology is still considered by many as a tool for flow management. He further states that RFID offers better inventory control and many other benefits; it also brings with some technical challenges, which librarians should consider before implementation [11]. Kern & Coyle reported that before RFID implementation, labour costs and book theft were at alarming rate. But, RFID implementation enhanced user satisfaction and also minimized book theft [12] [13]. Ayre also described circulation system as time consuming, labour intensive and involvement of much paper documentation before RFID implementation. But once RFID technology was put into practice it reduced staff intervention in circulation transactions and also facilitated better inventory control. Needless to mention that it also enhanced usage of library resources and user satisfaction [14].

Ward and Kranenburg described identification and tracking movement of books as one of the most prominent applications of RFID technology in libraries [15]. Contrary to previous studies, Butters reveals the threats of RFID system in libraries. Remarkably, he investigated their technical feasibility and presented a clear picture of what may and what may not be done to alleviate the threats that exists. He also examined the current RFID standards in the context of privacy and their limitations [16].

In their study, Curran and Porter suggested that a library prototype RFID should be implemented which will speed up the current user book search and identification process [17]. The Northfolk Massachusetts Public Library conducted a random survey to track some of their missing documents which led to a full scale inventory; the library had to shut the doors to its users for about half a week. To keep the library open, they installed an RFID express self check-out 'kiosk' that was able to do the inventory within a little time [18]. Yu however, revealed the cost as the biggest challenge for implementing RFID technology in libraries

[19]. A study by Kumar also reveals that RFID technology in libraries has enhanced inventory check and user satisfaction [20]. The studies of Shahid & Hopkinson and Chandrakar revealed that RFID helps save the precious time of staff consumed in scanning bar-codes for circulation of library resources [21] [22]. This study also correlates with an earlier study conducted by Kern.

In another study, Hadro described that RFID technology involves a huge investment; therefore, costs and benefits of this technology should be studied carefully before implementation. However, he also stated that costs of RFID equipments have sharply come down with further developments in technology [23]. Interestingly, Tseng and Kuo say that automated library equipped with RFID and self-checkout system has fulfilled majority of the needs of techno-oriented users. A finding of their study suggests that unfamiliarity of users is a major problem in operating automated circulation system. They also revealed that Ximen Open Book Intelligent Library circulates and helps in self-check out without human intervention [24]. Yet some more studies by Engel & Bansode and Desale reveal that RFID beats bar-code readers as it speeds up circulation transaction and tracking books. It also simplifies charging/discharging activities, provides high speed inventory and machine identification of books as seen in earlier studies [25] [26].

Mehrjerdi reviews the fundamentals of RFID systems, identifies both risks and key benefits and uses of RFID in libraries [27]. Dwivedi, et. al. indicate that libraries adopt RFID as a substitute for barcode systems for identification and tracking of documents. They found that factors like system quality, quality delivery of information, use and user satisfaction can persuade users towards libraries for RFID enabled services. Describing RFID as the fastest, easiest and most efficient way to locate and manage library materials at low cost. Renold suggested an internet based RFID technology to form an internet based library management system in which RFID reader Motorola MC 9090 (hand held inventory) can be used for inventory control. He also revealed that RFID identified the problems like locating misplaced/ mis-shelved materials and simultaneously reduced manual work and enhanced ease of access [28]. Some of his findings, that RFID involves low cost; however, contradict with those of earlier studies by Yu and Hadro.

Butters, Bahri and Ibrahim suggest that lack of knowledge as the big challenge in optimizing the use of RFID technology. Besides being dependent on vendors at various stages of implementation, RFID system had many problems like privacy, security and change in library setting and setting tagging stations, which frustrate librarians and pose huge risk for successful implementation [29]. After examining the different factors that affect the self- service check out applications, Hui, et. al. recommended a set of parameters for successful RFID project. These parameters include fixed orientation of books (i.e. at 0 degree), using of metal shielding to cover the entire check-out station, prevention of signal leakage and tag position affixed to a book to keep signal reading performance intact. This study has its own limitations as it is related with implementation part only. Though the findings of Ajami also revealed RFID as costly venture, it outweighs its disadvantages by improved safety, reduced medical records errors, minimized waiting time consumed in paper based documentation, streamlined automation and identification process, besides easy and fast access to users [30].

SCOPE

This study highlights the issues and challenges of RFID implementation faced by Indian libraries. Though there are many large academic and special libraries in India, only a handful of them have till date effectively installed RFID technology. In order to pave the way for RFID implementation in other college and university libraries in Jammu and Kashmir, the investigator selected Allama Iqbal Library of the University of Kashmir, Srinagar which is one of the first ISO certified university libraries in India that has successfully implemented RFID [31]. To implement this technology, a number

of compatible foreign and Indian software packages are available in the market. However, this study covers one of the leading international software packages namely Virtua developed by VTLS based in Blacksburg, Virginia, USA [32].

OBJECTIVES

The basic objective is to assess the status, usage and effectiveness of RFID implementation in the Allama Iqbal Library. However, the following objectives were given special attention:

- To highlight the components of RFID technology and their status of operation.

- To find out the extent of use of self check-in/out machines as against manual circulation.

- To examine the pre and post RFID technology impact on circulation transactions and usage of library resources.

- To determine library users' satisfaction with RFID implementation.

METHODOLOGY

The study has been divided into different sections like RFID components, impact on rate of transaction of books before and after RFID implementation and users' satisfaction with RFID technology. All the features have been highlighted to carry out the micro analysis keeping in view the features relevant to self check-in/check-out

subsystem of Virtua software. Being descriptive in nature, the investigator adopted survey method which is a systematic collection of data/information, from a certain population of respondents for understanding or predicting some particular action/behaviour of entire population of interest. In this method, the researcher is concerned with the art and science of asking questions and/or observing behaviour to obtain information. Significantly, care has been taken to have a representative sample of total population of users, though the random sampling technique was adopted. Notably, a sample of 10% of total population was selected for the study.

Owing to the least circulation transactions as shown statistically below because of the long vacations during the bone chilling winters when almost all academic activities cease to operate as against the increased circulation transactions during summers as shown in table-5 when the academic activities are in full swing, the analysis of this study has been confined to the circulation activities for the summer months only as discussed in table-5. The investigator has also considered the highest number of transactions in pre and post RFID implementation during the select months, keeping in view the user satisfaction and benefits of Virtua software installed for RFID compatibility as against the SOUL software.

Table 1: Circulation Transaction During Winters (Pre and Post RFID Implementation)

S. No	Pre RFID transaction of books during a day				Post RFID transaction of books during a day			
	Date	Issue	Return	Rate of transaction per hour	Date	Issue	Return	Rate of transaction per hour
1	November 17th, 2007	11	5	1.37 Issue 0.62 Return	November 5th, 2014	14	8	1.75 Issue 1.00 Return
2	December 21st, 2007	9	6	1.00 Issue 0.66 Return	December 13th, 2014	8	7	1.00 Issue 0.87 Return
3	January 13th, 2008	16	8	2.00 Issue 1.00 Return	January 23rd, 2014	26	10	3.25 Issue 1.25 Return
4	February 5th, 2008	21	17	2.62 Issue 2.12 Return	February 25th, 2015	19	11	2.37 Issue 1.37 Return
5	March 19th, 2008	35	13	4.37 Issue 1.62 Return	March 24th, 2015	13	14	1.62 Issue 1.75 Return
6	April 24th, 2008	39	23	4.87 Issue 2.87 Return	April 29th, 2015	48	32	6.00 Issue 4.00 Return

Data Collection

There are three most commonly used tools/instruments for data collection in survey research, the questionnaire method, interview method and observational method. Being most popular in social sciences, questionnaire method has been adopted here. A set of two well designed questionnaires (one for staff and the other for users) were framed accordingly. After the required procedural formalities, the researcher courteously approached the staff for their views about the challenges of RFID implementation and installation issues. The opinion of users about their satisfaction with pre and post RFID implementation was also given due consideration. The whole process lasted for about one month. Keeping the limitations of questionnaire method in mind, the author personally observed the status of RFID implementation particularly of self check-in and self check-out machines. A book was personally scanned, issued and returned on self check-in/check-out machine and dropped in the book drop box kept for the purpose. This was later on verified after checking the account details of the borrower.

In the light of unclear responses in some questionnaires, interviews related to user-friendliness, technical complexity, compatibility and installation issues, inventory control, customization and security of library materials were also conducted.

The author also cross-checked the authenticity of responses through annual reports, brochures, and websites of Virtua software and University of Kashmir, etc. Pertinently, some cross checks were also held in a detailed discussion with the then CEO of Virtua software based in Virginia. Notably, the issues like UNICODE feature, 3M machine which has some limitations (height of the machine in particular) in curbing the menace of mischievous borrowers, etc. were also discussed.

Administration of Questionnaires

Despite being the most popular data gathering technique, questionnaires produce very low response rate unless administered personally. Consequently, the author personally distributed questionnaires among the users and the concerned staff of the select library. A total of 555 questionnaires (10 percent of the total population) were administered in the month of May, 2016 for a population of 5550 users comprising 4750 students, 400 research scholars and 400 faculty members. As mentioned earlier, during the months of May to October academic activities in Kashmir University remain at peak. The total response rate (given in table-2) is found 90.63%. It further needs to be pointed out here that 40 questionnaires constituting (8.42%) in student category, 12 questionnaires (30%) in faculty members' category have not been returned, despite the several requests made by the author. In case of filled-in questionnaires, 19 in student category and 2 in faculty members category have been rejected, because of the crooked data provided.

Table 2: Sample Distribution (Figures within the parenthesis represent %age)

Categories	Kashmir University			
	Number of Respondents			
	Students	Research Scholars	Faculty Members	Total
Administered Questionnaires	475	40	40	555
Questionnaires Received	435 (91.57)	40 (100)	28 (70)	503 (90.63)
Questionnaires Analyzed	416 (86.30)	40 (8.29)	26 (5.39)	482 (86.84)

In addition, a self-designed coding sheet was used and statistical counting was done for each response. The data obtained through questionnaires have been cross checked with interview and observation data as has been stated above. Finally, the data have been organized, analysed, compared, consolidated, tabulated and interpreted by using tables, percentages and statistical techniques. The software package MS-Excel has been used to verify the validity of results. In the light of above data, useful findings and recommendations have been derived thereof.

SOFTWARE PACKAGE USED FOR AUTOMATION

The library started with CDS/ISIS software in 1997, but migrated to SOUL (Software for University Library) in 2003. However, due to the incompatibility with UNICODE feature to deal with the large collection of multi-lingual resources and also lack of RFID compatibility in the then version of SOUL, the library switched over to Virtua software in 2008 to overcome these drawbacks (Kashmir University, 2009). Notably, Virtua is one of the leading international library management software and is compatible with all international standards.

ANALYSIS, DISCUSSION AND FINDINGS

To assess the usage and effectiveness of RFID implementation, the researcher had thorough deliberations with the librarian and staff of the library innovation and support system Section which looks after the entire automation system of the library to have the authentic information. After correlating with the interviewed data, the finalised data was presented and analyzed in following tables each of which is discussed one by one:

RFID Components Implemented

The migration from SOUL software to Virtua integrated library management software has benefitted Allama Iqbal Library and its users in many ways. Significantly, the prolonged process of circulation activities, staff effort, inventory control and other tedious processes like checking at the entrance of the library have been largely brought under control. All these features and facilities as shown below in table-3 were not available in the then SOUL software. This may be one of the profound reasons that Allama Iqbal Library switching over to Virtua software which effectively supports such features. Besides, Virtua also enabled automated circulation of multi-lingual resources which was not possible earlier. The beauty of Virtua as described by the librarian is that they successfully conducted complete inventory control with minimal effort of staff and in least possible time. All these benefits were possible by the installation of Virtua followed by the successful RFID implementation in various operations and services. Though library had already automated various operations and services, however, self check-in/out, book drop boxes, stock tacking and seamless circulation were a daydream in the then used SOUL software.

Table 3: RFID Components Implemented

S. No.	Features	Availability in Virtua	Status in Allama Iqbal Library
1	Self check-in/out	Fully supported	Successfully installed and effectively in operation
2	Scanners	Fully supported	Fully functional
3	Book drop boxes	Yes	Functioning effectively since its installation
4	RFID gates	Fully supported	Functioning effectively since installed in 2008
5	Stock tacking/verification	Fully supported	Held once through Hand held Inventory in 2009
6	Tagging stations	Fully supported	Tagging done through Virtua since its installation
7	Bar code readers	Fully supported	Fully functional

Self Check-Out/Check-In

The self check-out /check-in facility relieved the library staff from the laborious circulation activities of books. Appreciably, it saves a lot of time of users as they need not to wait in long queues at circulation desk for routine issue and return activities. In this way, it enhances the user satisfaction in circulation control of the library.

Allama Iqbal Library is giving the facility of self check-out/check-in through 3M machine. It was found that a substantial(86.05%) percentage of students comprising post graduate and graduate, 80% research scholars and 69.23% faculty members do their self- issue and return of books via self-check-out and check-in system. However 13.94% students, 20% research scholars and 30.76% faculty members still rely on staff at the circulation counter for this service. These findings also correlate with the studies conducted from time to time by several scholars like Kern, Coyle, Ayre and Kumar.

As the data suggest, there is a great enthusiasm among the user community for self check-out/check-in system. Moreover, the student category is seen more using this facility followed by research scholars and faculty members. Besides having book drop facility at different prominent locations in the central library, the library is soon starting the self-check-out/check-in stations in the student hostels also. However, the risks and threats like mischievous users who return only RFID tagged book jackets and keep the rest of book illegally cannot be ignored. It was also found that the height of RFID sensor gate can easily be manoeuvred by tall techno-savvy users as the machine is just over 5 feet in height and such users can easily up their arms with book in hand to hoodwink the alarm which the machine sounds against an unauthorised transactions. Another serious risk is that a user can put his RFID smart card (library membership card) firmly on RFID tag and can easily exit the RFID gate with book in hand and with no beep in the gate, thus posing apprehension of theft of important library resources. In addition, during the emergencies like erratic power supply, database corruption and other disasters, RFID technology breaks down and thus pushes the whole system to a standstill. Nevertheless, the benefits of RFID implementation have outweighed the disadvantages since the usage of library resources have increased manifold.

These finding also correlate with the study of Ajmai who has also revealed that the advantages of RFID implementation cannot be overlooked for only a few disadvantages. However, these findings partially contradict the study of Kern and Coyle who claimed that RFID lessens and identifies the risks of theft.

Besides other services, Allama Iqbal Library is also providing remote access facility to various e-resources and video-conference facility to its users. It also maintains biometric machine for marking attendance of the library staff. In addition, CCTV (Close Circuit Television) is also functional since 2008. As mentioned previously, all these features were not possible in the then version of SOUL software used earlier by the library.

Table 4: Self Check-Out/ Check-In (Figures within Parenthesis Represent %age)

Status	Kashmir University			
	Students N=416	Research Scholars N=40	Faculty Members N=26	Total N=482
Self Check-In/Check-Out via Software	358 (86.05)	32 (80)	18 (69.23)	389 (80.70)
Check-In/Check-Out by Staff	58 (13.94)	8 (20)	8 (30.76)	93 (19.29)

Pre and Post RFID Implementation Impact on Circulation of Books and their Usage

Apart from the other benefits such as complete inventory control, book drop boxes, RFID enabled sensor gate to curb the book theft, production of smart cards, patron account statistics, CCTV, user satisfaction, etc. as described in 7.1, and table-3 above, 7.3 below and elsewhere in the study, there has been a dramatic increase in the circulation of library resources after the RFID implementation at Allama Iqbal Library. It is revealed that the users have been by and large benefitted by this technology. The data depicted in table-5 suggests that circulation and utilization of library resources have increased manifold after RFID implementation. Users are much enthusiastic in using the self issue and return system than relying on staff as RFID implementation has enhanced the transaction rate of

books per hour to a great extent as shown below. This is largely because of the fact that RFID has more powerful features than manual circulation counter. Furthermore, users need not to stand in queues at circulation counter as was the practice of issuing or returning the books before RFID implementation. It thereby saves a lot of their precious time. Remarkably, RFID has saved a lot of time and exercise of staff consumed in circulation activities. The saved time and effort is being utilized in bettering other operations and services as described by the librarian.

These findings also correlate with most of the previous studies as discussed in the literature review. The studies of Kern, Engel, Bansode and Desale & Tseng and Kuo especially correlate with the findings of this study.

Table 5: Circulation Transaction and Usage of Library Resources During Summers (Pre and Post RFID Implementation

S. No	Pre RFID Transaction of Books During a Day				Post RFID Transaction of Books During a Day			
	Date	Issue	Return	Rate of Transaction per Hour	Date	Issue	Return	Rate of Transaction per Hour
1	May 7th, 2008	118	59	9.83 Issue 4.91Return	May 7th, 2015	188	196	15.66 Issue 16.33 Return
2	June 12th, 2008	51	55	4.25 Issue 4.58 Return	June 12th, 2015	207	219	17.25 Issue 18.25 Return
3	July 15th, 2008	86	53	7.16Issue 4.41 Return	July 15th, 2015	122	106	10.16 Issue 8.83 Return
4	August 5th, 2008	163	147	13.58 Issue 12.25 Return	August 5th, 2015	199	209	16.58 Issue 17.41 Return
5	September 9th, 2008	15	101	1.25 Issue 8.41 Return	September 9th, 2015	168	109	14 Issue 9.08 Return
6	October 19th, 2008	77	45	6.41 Issue 3.75 Return	October 29th, 2015	189	127	15.75 Issue 10.58 Return

Note: The library timings for issue and return during summers are 8:00 AM to 8:00PM thus totalling a daily work of 12 hours and during winters it is 9AM to 5PM thereby totalling a daily work of 8 hours.

Satisfaction of Users with RFID Technology

It is rightly said that the effectiveness and success of any library system is directly proportional to the level of satisfaction of end users of that system. In this connection, the services provided through RFID technology in Allama Iqbal Library reveal that 27.88% students, 30% research scholars and 26.92% faculty members are strongly satisfied

with the self check-out/in services. This may be due to the fact that RFID implementation has minimized the laborious exercise at circulation desk, and users have free hand to issue and return the library resources.

The collected data further reveals that a majority of users with 60.85% students, 61.77% research scholars and 67.5% faculty members rate

their satisfaction under satisfied category. However, a moderately low percentage of users with 6.73% students, 2.5% research scholars and 3.84% faculty members are neither satisfied nor dissatisfied in this background.

In contrast to above, a small percentage of 2.40% students have been found dissatisfied with the services provided through RFID technology. Nonetheless, a meagre percentage of 1.20% students are strongly dissatisfied with RFID technology, whereas none among the research scholars and faculty members hold this view. This viewpoint may be of the users who are either unfamiliar/uncomfortable with computers or are techno-fears or digital illiterates. This finding also correlates with Tseng and Kuo whose study also revealed the un-comfort ability and unfamiliarity of users as the major problems in using RFID enabled circulation.

The findings suggest that a majority of users are satisfied with RFID technology. As an interview method, when a cross section of users was interacted, it was observed that RFID technology has fastened and eased the circulation of library resources. In case of issue and return by staff, the

users opined that when they approached the staff of circulation section, they quickly issued and returned their items through automated scanners and bar-codes.

Pertinently, a large section of users opined that they are creatively utilizing the saved time that was earlier consumed in long queues at the circulation counter. The RFID has easily and quickly enabled self-check-outs and check-ins through machines kept at different prominent places.

These findings also correlate with studies of Kern, Ayre, Kumar, Yu and Dwivedi. They also found that RFID technology has minimized the time and efforts of staff consumed in scanning bar-codes for circulation of resources. They also claimed that RFID implementation enhanced the satisfaction level of users on library services to a great extent.

In addition to above, some users further elucidated that the facility of self check-out and check-in machines lets them to check their account statistics and enables to get a computerized receipt of the returned books for their record which was not possible earlier.

Table 6: Satisfaction of Users with RFID Technology

Level of Agreement	Kashmir University			
	STU N=416	RS N=40	FM N=26	Total N=482
Strongly Satisfied	116 (27.88)	12 (30)	7 (26.92)	135 (28)
Satisfied	257 (61.77)	27 (67.5)	18 (69.23)	302 (62.65)
Neither Satisfied nor Dissatisfied	28 (6.73)	1 (2.5)	1 (3.84)	30 (6.22)
Dissatisfied/ Unfamiliarity	10 (2.40)	0 (0)	0 (0)	10 (2.07)
Strongly Dissatisfied	5 (1.20)	0 (0)	0 (0)	5 (1.03)

Note: STU = Students, RS = Research Scholars and FM = Faculty Members.

CONCLUSION

Though there have been many benefits of RFID implementation in Allama Iqbal Library of the University of Kashmir , however, limitations like tearing off of RFID tags by mischievous users that are pasted on books are not ruled out.

Another shortfall has been the height of RFID gate as tall mischievous users holding a book with arms up can easily cheat the alarm raised by the RFID gate. Thus a very rare and costly book can easily be stolen with no whereabouts. The requirement of technical expertise is being viewed as another barrier of this technology as

a large number of students who come from far off and remote areas where the knowledge about the usage of digital and modern gadgets is yet to gain ground fully. This category of users has not been found using RFID enabled services to its full extent. Annual maintenance and other factors like financial constraints have been found other burdens of this technology particularly for the libraries with inadequate budgets.

However with the paradigm transition from library to user, it becomes imperative for libraries to implement RFID technology to fulfil the users' demands effectively and efficiently. Notwithstanding the fact, only few university libraries in India have implemented this technology, though many of them possess affordable budget. In this direction, Allama Iqbal Library is acknowledged as one of the first university libraries in India that has successfully implemented RFID technology. All the major RFID components as shown in table-3 and supported by Virtua software have been successfully and effectively implemented. It has been found that a majority of the users amounting to 80% are effectively using self-check-in/check-out machines for issue and return while about 19% still rely on help from staff for circulation transactions. Interestingly, users have been seen quite enthusiastic to use the self check-in/out machines. Further, the rate of transaction of library resources has also increased greatly after RFID implementation.

Bulk of users (i.e. 62.65%) have been found satisfied with RFID technology, while 28% users are strongly satisfied in this direction. A thin minority are either dissatisfied or unfamiliar or are uncomfortable with the RFID enabled services.

Another post RFID implementation benefit has been the easy inventory control conducted with the help of hand held inventories in a short duration which was never done before. Though RFID enabled issue and return is fully operational, however, the manual circulation counter has not been completely abandoned due to the erratic power supply particularly during winters and because of the

category of users who are not still comfortable with RFID system.

It can also not be ruled out that in developing countries high costs and lack of knowledge about the maximum usage of digital gadgets are still viewed as major challenges of RFID implementation and modernization of other library operations and services. Nevertheless with the declining costs of RFID equipments particularly during the last five years, there is an increasing trend towards RFID implementation in Indian libraries. Undoubtedly there are also some limitations as mentioned elsewhere in the study; however, the definite benefits of RFID cannot be overlooked to fully automate the library services to meet the demands of techno-oriented users in an effective way. It is also expected that there will be a great enthusiasm and mass implementation of RFID technology in near future, because of the change in policy by the State Governments and University Grants Commission for providing adequate funds for automating Indian college and university libraries.

REFERENCES

[1]   Kajewski, M. A. Emerging technologies changing public library service delivery models. *APLIS*, 19(4), 2006, 157-163.

[2]   Dwivedi, Y. K., *et al.* RFID systems in libraries: an empirical examination of factors affecting the use and user satisfaction. *International Journal of Information Management,* 32(2), 2013, 367-377. DOI:http://dx.doi.org/10.1016/j.ijinfomgt.2012.10.008

[3]   Pandey, P. & Mahajan K. D. *Application of RFID Technology in Libraries and Role of Librarian*. 2010. Retrieved from: http://eprints.rclis.org/15253/3/RFID.pdf (accessed 24 December, 2015).

[4]   Melanie, R. R., Bruno, C., & Andrew, S.T. The evolution of RFID Security. *IEEE Pervasive Computing*, 5(1), 2006, 62-69.

[5]   Roberti, M. The history of RFID technology. *RFID Journal,* 2005. Retrieved from: http://www.rfidjournal.com/article/view/1338/1 (accessed 12 November 2015).

[6]   Hui, W. *et. al*. EPC RFID technology for library applications. *Measurement and Control,* 46(1), 2013, 26-30.

[7]   Mulla, K.R. & Chandrashekara, M. (2006). Application of RFID in libraries for physical information security – a view. *Proceedings of 4th International Convention CALIBER-2006,* Gulbarga, 2-4 Feb, 2006. Retrieved from: http://ir.inflibnet.ac.in/bitstream/1944/1100/1/56.pdf (accessed 29 December 2015).

[8]   Elisha, O. M. Adoption of radio frequency identification technology in university libraries: A Kenyan perspective. *The Electronic Library*, 31(2), 2013, 208-216.

[9]   Margam, M. RFID technology implementation in two libraries in New Delhi. *Program: Electronic Library and Information Systems,* 44(2), 2010, 149-157.

[10]   Martin, Z. Radio Frequency Identification (RFID): Time to take another look. *OCLC's Systems and Services: International Digital Library Perspective*, 27(2), 2011, 146-154.

[11]   Koneru, I. RFID technology: a resolution in library management. *Proceedings of the 2nd International Convention CALIBER-2004*, New Delhi, 2004, 11-13.

[12]   Kern, C. Radio-frequency-identification in libraries. *The Electronic Library*, 22(2), 2004, 317-324.

[13]   Coyle, K. Management of RFID in libraries. *Journal of Academic Librarianship*, 31(5), 2005, 486-489.

[14]   Ayre, L. B. *RFID background for library workers.* 2006.

        Retrieved from: www.galecia.com/uploaded/docs/rfid_background.pdf (accessed 15 November 2015).

[15]   Ward, M. & Kranenburg, R.V. RFID: frequency, standards adoption and innovation. *JISC Technology and Standards Watch*, 2006. Retrieved from: www.jisc.ac.uk/uploaded_documents/TSW0602.pdf (accessed 12 November 2015).

[16]   Butters, A. RFID systems, standards and privacy within libraries. *The Electronic Library*, 25(4), 2007, 430-439.

[17]   Curran, K. & Porter, M. A premier on radio frequency identification for libraries. *Library Hi Tech*, 25(4), 2007, 595-611.

[18]   American Libraries. Case Study RFID system speeds inventory. *American Libraries*, 39(1/2), 2008, 84.

[19]   Yu, S.C. Implementation of an innovative RFID application in libraries. *Library Hi-Tech*, 26(3), 2008, 398-410.

[20]   Kumar, R. Role of RFID in academic libraries. *Proceedings of the 6th International CALIBER-2008,* Allahabad: *University of Allahabad,* 28-29 Feb, 2008, 120-126.

[21]   Shahid, S. Use of RFID in libraries: a new approach to circulation, tracking, inventorying and security of library materials. *Library Philosophy and Practice*, 8(1), 2005. Retrieved from: http://unllib.unl.edu/LPP/shahid.htm (accessed 29 November 2015).

[22]   Hopkinson, A. & Chandrakar, R. Introducing RFID at Middlesex University learning resources. *Program: Electronic Library and Information Systems*, 46(1), 2006, 89-97.

[23]   Hadro, J. Revisiting RFID in libraries. *Library Journal*, 134(1), 2009, S1-S2.

[24]   Tseng, S. & Pin-dar K. A Study on the Patronage of Intelligent Library: The Ximen Intelligent Library of the Taipei Public Library System. *New Library World*, 10(9/10), 2009, 410-429.

[25]   Engel, E. *RFID implementation in California libraries: Costs and Benefits.* 2006. Retrieved from: www.kcoyle.net/RFIDCostsBenefits.pdf (accessed 23 November 2013).

[26] Bansode, S. Y. & Desale, S. K. Implementation of RFID technology in the University of Pune Library. *Program: Electronic Library and Information Systems*, 43(2), 2009, 202-214.

[27] Mehrjerdi, Y.Z. RFID: the big player in the libraries of future. *The Electronic Library*, 29(1), 2011, 36-51.

[28] Renold, A. P. & Rani, R. J. An internet based RFID library management system. *Proceedings of the 2013 IEEE Conference on Information Communication Technology (ICT 2013),* JeJu Island, 2013, 932-936.

[29] Bahri, S. & Ibrahim, A. RFID in libraries: A case study on implementation. *Library Hi Tech News,* 35(5), 2013, 21-26.

[30] Ajami, S. & Carter, M. W. The advantages and disadvantages of radio frequency identification (RFID) in health-care centres; approach in emergency room (ER). *Pakistan Journal of Medical Sciences,* 29(1), 2013, 443-448.

[31] Kashmir University. *Allama Iqbal Library*. 2009.
Retrieved from:
http://www.kashmiruniversity.net/library.asp x (accessed 28 November 2015).

[32] VTLS. *Products*. 2011.
Retrieved from:
http://www.vtls.com/products/virtua
(accessed 7 April 2015).