

# Use of RFID technology in Libraries: A perspective from the Catholic University of Eastern Africa (CUEA), Nairobi

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## **Abstract**

This paper explores the potential of Radio Frequency Identification (RFID) technology in facilitating efficient library operations with a focus on the experience gained at The Catholic University of Eastern Africa (CUEA). It also examines key challenges experienced in the deployment of the technology as well as main issues that need to be addressed in order to achieve successful implementation of RFID in Libraries.

Literature review was used as the key methodology. Further information is based on experience collected in implementation of the project.

The paper demonstrates that RFID can be used in libraries to ensure security and facilitate innovative services and highlights key issues that need to be addressed in order to achieve successful implementation of RFID in Libraries.

This paper presents an initial review of the experiences in the implementation of RFID technology in one library. There is need for an empirical study to uncover in a deeper way the perception and experiences of library patrons in the use of RFID technology

The paper also examines main issues that need to be addressed in order to achieve successful implementation of RFID in Libraries including RFID standards, appropriate software and hardware, training of staff, privacy concerns of patrons and proper process planning.

It exposes the initial efforts to apply RFID technology in management of library services in the East African region. This forms the basis for further research in how this technology can contribute to efficiency in the provision of automated library and information services in the region

## **1. Introduction**

Radio Frequency Identification (RFID) technology is a wireless technology mainly used for automatic identification using radio-waves to detect, track, identify, and thus manage various objects and people that e.g. merchandise (Ayre,2010; Juels, 2005). It works by transmitting data from a portable device called a tag, to an RFID reader to execute a particular application based on the tag provided identification or location information (Narayanan & Somasekharan, n.d). Therefore RFID has been referred to as “a non-contact method of using radio frequency electromagnetic waves (with a frequency of up to 2.5GHz) for communication between two remote entities”.

RFID (Radio Frequency Identification) is the latest technology to be used in libraries to ensure security and facilitate innovative services (Kern, 2004). It is an automatic radio

communications (ADC) technology which functions through wireless radio communication to identify people or items. Its basic components include a reader or interrogator, and radio frequency (RF) transponder that transfers data by radiating electro-magnetic carriers (Nayaranan, Singh & Somasekharan, n.d). RFID system can also be used to store data suitable by use of tags (transponders) on which information can be written and updated. This means information stored in RFID chips can be read and updated from remote distances. This data can be retrieved, transferred by use of machine-readable equipment for various application systems.

RFID has been around for over 70 years and was originally developed for improving warfare technologies. It was first used by Britain as an Identify Friend or Foe (IFF) system to distinguish friendly aircraft from enemy aircraft during World War II (Landt, 2001). In the 1960s it was used in commercial activities as part of Electronic Article Surveillance (EAS) equipment to counter theft in retail stores. Later RFID was to be regarded as the “first important technology of the twenty-first century” (Qinling, & Chen, 2014) and has been implemented in various, including the following significant applications:

- RFID electronic toll collection systems which identify vehicles mounted with RFID transponders and automatically deduct toll fees electronically without impeding traffic flow.
- Animal RFID implant tags to identify and track animals and combined with GPS makes it possible to perform round-the-clock surveillance of animals in the world.
- Library systems to control access, manage extensive collections of books, as well as offering self-check and protecting them against theft.
- e-Passports a next generation passport equipped with an embedded RFID chip to store digital information and biometric data of passport holder.
- Supply chains for inventory management, increase asset visibility, track shipments, trace recalled products and prevent theft.
- Equipment tracking systems e.g. generators, communication masts, transforms to prevent tampering (Wyld, 2008; Chachra, n.d).

RFID technology is recognized as an ideal technology for managing ICT-driven academic library of the 21st century. In order to achieve the overall objective of providing seamless library information services, 3 years ago CUEA identified and made a decision to install RFID technology in the new library housed in the newly established ultra-modern Learning Resource Centre (LRC). It was felt that RFID would facilitate innovative library and information services and in overall it would lead to better control of the library processes.

Drawing from experience at the Catholic University of Eastern Africa (CUEA) situated in Nairobi, Kenya, this paper explores first, the potential of RFID technology in facilitating cost-effective and efficient library operations and secondly, the key challenges and risks that we have experienced in our drive towards successful deployment of the technology in libraries. The overarching argument is that RFID technology can be used to facilitate innovative cost-effective and efficient library and information services. The paper starts by examining the basic operating principles of RFID technology in libraries. This is followed by an examination of the benefits of using RFID technology in provision of library and information services and review of the main challenges that have been experienced in the deployment of this technology. It also proposes areas of concern that need attention in order to achieve successful RFID implementation.

## 2. RFID technology in libraries: Principles of operation

The basic RFID technology in a library consists of the following components: RFID tags (tags / Security Tags), RFID Tagging machine, inventory scanner and analyzer, access control gates (flap gates), exit RFID Security Gates 3, RFID Application server, RFID self-check stations, Self-payment stations and staff work-stations, RFID Smart cards, and Library Book drop and RFID Software (Butters, 2007). According to Boss, (2009) for example a RFID tag is a small microchip supplemented with antenna that transmits a unique identifier in response to a query to a reading device. It has readable internal memory which can be encoded with an identifier of an object (e.g. barcode of a library material and other required data including its bibliographic details and the status).

In a RFID enabled-library, RFID Tag replaces the barcode with a micro-chip which is attached a piece of paper. In is attached to an object and is used to identify the object when it is brought close to RFID reader/antennae (Howard & Anderson, 2007; Weis, n.d). They key advantages of RFID tags include:

- a) Each RFID tag can have a unique code that ultimately allows every tagged item to be individually accounted for.
- b) RFID allows for information to be read by radio waves from a tag, without requiring line of sight scanning or human intervention.
- c) RFID allows for virtually simultaneous and instantaneous reading of multiple tags.
- d) RFID tags can hold far greater amounts of information, which can be updated.
- e) RFID tags are far more durable (Wyld, 2005; Wyld, 2008; Bansode & Deale, 2009)

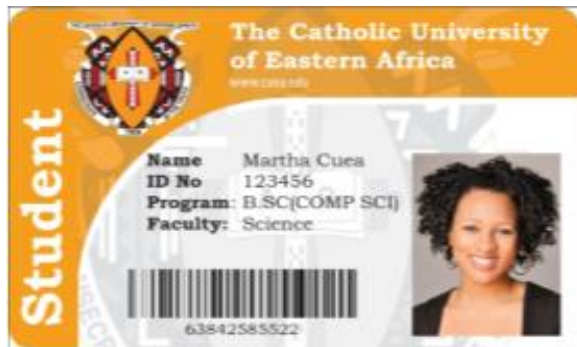
A RFID tagging system/station is a conversion unit used to print on the RFID tag information about the library material (e.g. barcode) during the conversion stage while RFID Staff Station (Reader with an antennae) are used to facilitate modes of operation, to issue, return and renew items. The antenna is used to scan information from the RFID tag and send to the LMS for processing. In self-operated borrowing system, RFID Antenna also transmits data from RFID tag to the library management software for processing. In a self-operated borrowing set up, the antenna connects to a reader (in the self-check station) that communicates with the self-check software to read and write information from to the RFID tag (Kapoor, 2014; Vashsista, n.d)



The RFID software is the main component as it provides an interaction between the data stored in the Library Management System (LMS), and specific RFID components which in turn perform the specific transactions using the data and register the changes or results in the database (Bahri, 2013; Yu, 2007). The RFID software work using the data of patrons and reading materials which is stored in the LMS database and instruct the RFID components to perform the above tasks. Through radio frequency transmissions RFID technology interacts

with the library management system (LMS) to enhance the efficiency of library processes and facilitate extended related services in the context of the key functions of the library.

Self-check in/out stations are used by patrons to issue library materials to themselves as well as return. Using these stations patrons can also check their library accounts for borrowing trends as well connect to e-payment systems to clear their overdue fines (Chachra, 2003; Yu, 2008). Self-check stations works with a with RFID-based patron cards, each of which has a unique RFID number tagged with personal details in the patron database. They also combine a magnetic-strip a barcode to multiple uses such as online banking.



**RFID-Patron Card**



**Self-Check Stations**

The exits of RFID-enabled library is equipped with a RFID security gates look like standard securities in libraries but in this case have the capacity to emit sound alarms if the material has not been checked out (Palmer, 2006; Mehrjerdi, 2011).



**RFID Access Gates**



**RFID Exit gates**

Another component is the inventory wand which is a hand-operated used to scan library material on the shelves for the purposes inventory management, weeding, and finding misplaced materials. The inventory wand consists of scanners for use with RFID tags placed on materials and a PDA for processing. Most inventory wands can be connected to the library management system (LMS) via wireless or wired connection to process reconciliation lists in the case of missing or misplaced materials (Howard & Anderson, 2007; Seadle & Yu, 2008).



**RFID Inventory wand**

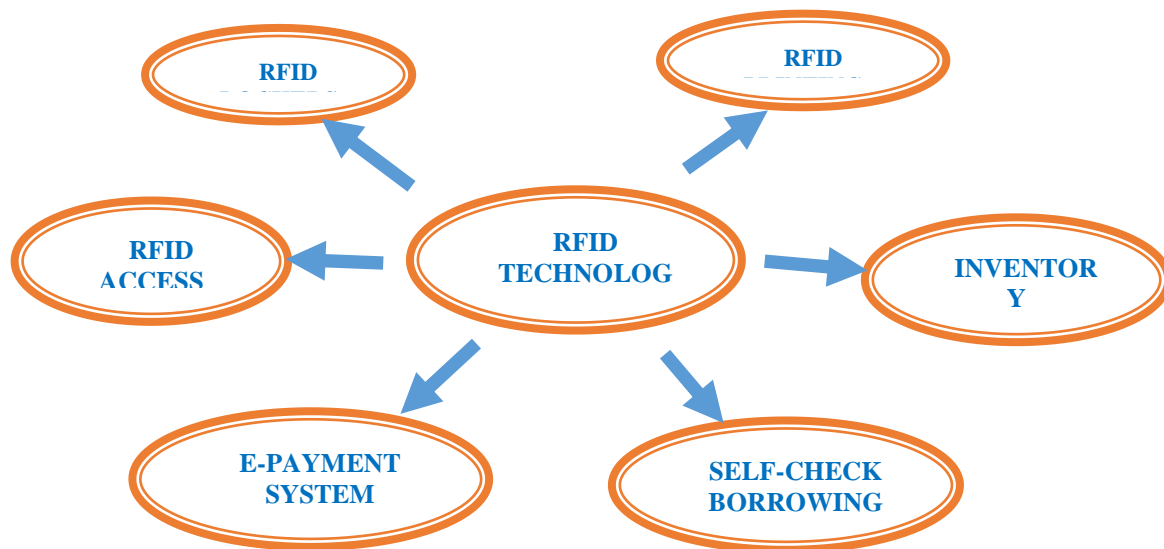
One key enhancement to RFID Technology at CUEA library is the implementation of an e-payment system which is an online payment with virtual accounts that can be topped up through mobile money services (M-Pesa, Airtel Money) Accounts (Visa, MasterCard, etc.). This e-payment system integrates with RFID-based operational components such as multifunctional printers, point of sale (POS) systems to facilitate cashless payment of library fines, and seamless academic support services such as self-service self-printing, photocopying, payments in cafeteria, bookshop, infirmary and college fees payments.

**RFID E-payment system**

### 3. Benefits in using RFID technology at CUEA.

Over the last three years of RFID use, a number of benefits have been experienced including improved quality of services and higher satisfaction among library patrons and the public. RFID technology has facilitated more reliable security of information resources areas, and patrons through use of RFID access cards, RFID exit gates which are electronically linked to circulation services, and centralized monitoring base for all transactions. The RFID-enabled

patron cards, which are used as secure entry card to the library as well as access to other to campus facilities. The entry gates are connected to patron database and screens which broadcast patron images and details. RFID exit gates which are linked to the self-borrowing (circulation services) detects materials that have not been properly issued and a centralized monitoring base for all transactions e.g. books leaving the library.



Unlike the previous situation, where barcodes were in use, the library has been able to mount efficient circulation services (borrowing and returning of library resources) to library patron by reducing queues at the front desk and issue are processed faster using self-check borrowing stations, efficient patron access of library materials through efficient shelving and re-shelving of books and journals and well as accurate records of borrowing, retrieval of sources location missing/mis-shelved materials, journals and books.

A major of the use of RFID technology is the innovative use of management library system to provide efficient library services e.g. payment of library dues such as membership and overdue fines which have been an inconvenience to users who have to wait for accounts office to open, or join the cues to small amounts of money which are collected through a RFID-enabled e-payment system. The library has embarked on providing extended library services such as RFID locker-room, RFID-based printing, photocopying through virtual user accounts and RFID-enabled equipment.

RFID has played a significant role in improving our operational efficiency and strategic planning by enabling the library to generate various types of management reports. It is easy to collect library usage statistics for the books/journals that have been borrowed or used within the library, and by what category of patrons (Shien-Chiang, 2007). Using data on service combined with patron data, and collection use data, process time and service mode has facilitated management of information about people, events, times places, and information resources, the library is able to personalized patron-based services. The library is also able to mount efficient inventory (asset) management of library collection (books, journals, and multimedia items such as CDs DVDS and VHS Cassettes. The library has successfully undertaken accurate stocktaking, and valuation of the collection.

#### 4. Challenges and recommendations on the implementation of RFID technology

Since the implementation of RFID technology, the library has experienced a number of challenges. First, the cost of maintaining the RFID technology is much higher compared to the more traditional barcodes used earlier. At the beginning RFID tags were removed from library artefacts through vandalism since they are easier to find than electro-magnetic strips.

There have been concerns over invasion of personal privacy based on the notion that tags on books contain personal information. The library has also been broadcasting images of visitors to the library and is able to know the kind of materials they read. It is known that RFID tags can be read from a long distance and its contents can be read by anyone with an appropriate scanner because RFID tags cannot tell the difference between one reader and another. While we have no evidence of this, we are vigilant of electronic gadgets that patrons might bring with them to the library. The detection rate of RFID tags by exit gates has been questioned and we are forced to reinforce the RFID exit gates with security personnel to forestall foul play.

Other challenges in the implementation of RFID technology include the following:

- i. **Inadequate expertise and professional advice.** RFID is a relatively new technology which has not yet been implemented in many libraries
- ii. **Lack of standardization for RFID technology.** While the prominent standard is to employ a frequency of 13.56MHz, there is yet no formally accepted standards especially in this region
- iii. **Unreliable power supply.** If the RFID technology is to be used effectively there is need for consistent power supply. Failure to have this will lead to repeated closure of services such as security and circulation services. This may inconvenience library patrons and jeopardize the effectiveness of other library processes

RFID technology is the latest fast growing technology that promises to improve efficiency in library operations. In order to implement RFID technology successfully it is important to consider factors that may affect the success of the project. These issues include the following

- i. **RFID Standards and appropriate software and hardware:** There exist various vendors of RFID technology spread across the globe. Without widely agreed standards, the integrity of various hardware and software for RFID is a thorny issue that needs to be carefully considered. RFID technology implementation is a costly undertaking and every effort needs to be considered to ensure the library achieves its objectives and return on investment (ROI). Particularly there is need to acquire a stable, integrated library system (ILS) which supports all the functionalities of RFID
- ii. **Training of staff:** There is need to train staff on various aspects of RFID technology to encourage embracing of the technology and facilitate proper execution of the various aspects of the project
- iii. **Process planning:** RFID implementation is a complicated project which involves several activities such as procurement of hardware and software, retrospective conversion from existing barcode technology, tagging of books, integration of software, and training of patrons. It is very important that proper planning be made
- iv. **Privacy concerns of patrons:** It is important that patrons fully understand the privacy issues surrounding the use of RFID technology. It is important that they be aware of personal-related data that is being collected by the library through the technology and how it is being addressed. This will minimize mistrust towards the technology.

## 5. Conclusion and Recommendations

RFID is recognized as the ideal technology for managing libraries in the 21st century to facilitate innovative and efficient services and to enhance accountability of the part of LIS professionals.

Since CUEA Library implemented RFID technology, evidence from our customer satisfaction surveys has indicated that library patrons liked the technology and after initial training have used it without coercion; it has provided several benefits such as: eliminating queues at the front desk, decreasing repeatable tasks, increase interaction with patrons, extended internal security, raised the efficiency of inventory management, and reduced the intensity of labour required in processes such as circulation, inventory and staff have been released to perform more intellectually involving tasks such as report generation, and it is hoped that in the long-run lead to better return on investment.

At the same time initially we have experienced negative experiences such as removal of exposed RFID tags from books (vandalism and may be attempted to theft of books from the library) and high cost of maintenance of the RFID technology. However in overall RFID is one of the fastest and most beneficial technologies being adopted by business today and its advantages RFID far outweigh the disadvantages and therefore there are good reasons to implement RFID technology such as management efficiency and customer satisfaction. With careful considerations before investing in RFID technology return on investment can be achieved.

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