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Introducing RFID at Middlesex University Learning Resources

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Abstract

Purpose - To describe the first year of the implementation of RFID in Middlesex University Learning Resources. **Design/methodology/approach** – The technology is explained in detail to set the scene. Information on the implementation is presented in chronological order. **Findings** - Problems which would generally be applicable to other installations in these early days of the use of RFID in libraries are pointed out. **Practical implications** – It is possible to implement RFID without too much lead time, though had longer been available some aspects would have gone more smoothly.

1. Introduction

RFID technology is not new but its commercial application is quite recent because costs have reduced as the technology has matured and become more widespread. RFID stands for Radio Frequency Identification and in essence consists of a miniature transmitter or receiver incorporated into a device known as a tag, in a moveable item which can be located by a receiver or transmitter which may be stationary or also movable depending on the application. RFID in library systems consists of two items, a transponder (the word is derived from TRANSmitter and resPONDER) consisting of an antenna and a chip and a reader attached to a computer to identify the item. The total package is called a tag or a label. The tag or label is attached to the item to be identified and the reader is non-moveable, for example fixed in a security gate or incorporated into a library counter or a self-service machine.

Data can be written to and stored in the tag, data which may include a barcode and much more beside; the tags used at Middlesex have a capacity of 1,024 bits.

As far as library materials are concerned, RFID rivals barcodes as a means of identification and magnetic strips as a means of security so RFID can be regarded as dual purpose in that respect. Barcodes have to be read by an optical scanning device such as a light pen; they have to be in line of sight of the reader. RFID tags on the other hand can be placed inside an object for their greater security. For example, IBM have used RFID technology to locate small to medium-sized items of boxed equipment which may be placed inside a carton with a tag attached to the item inside the box but 'visible' to the RFID reader.

They are also used in the retail trade for security: a tag on an item inside a shopping bag can activate an alarm and indicate the item that is being stolen so that it can be identified against goods that have been legitimately paid for. The same methodology can be used with library materials to control their accidental or deliberate unauthorised removal from the library.

The book trade has been interested for a few years in the application of RFID technology. If every book had incorporated into it during production a tag, this could contain data such as the ISBN plus copy number which together would make a unique identifier. This could be a write-once tag, its data would never change. This might be used by library systems and equated to the library's item identification number by means of a table held in the database of the automated library system. By identification number is meant the identifier in the system often referred to as the barcode or accession number. This tag could therefore be used by the publisher, wholesale distribution, retail distribution and the library successively. Because of the cost of RFID tags (currently 25p to 55p) it is best to use them repeatedly. A library will have a great deal of re-use so an RFID tag may be particularly cost effective for libraries, certainly more so than for the retail trade. Read-only tags are cheaper than those which can be constantly changed in their contents. Another scenario could involve a writeable tag being incorporated into publications which could be re-used by different systems. In this case a succession of owners of a book could write to the tag the data each needed to control the items within their particular environment. It can therefore be seen that a library would benefit more from RFID being incorporated into a book than the book trade. RFID as envisaged in this scenario would be most effective if it were incorporated into the majority of books.

Tagging publications universally at the point of production was rejected some years ago by the book-trade. Profit margins would have been seriously depleted if tags had been added to books. The main beneficiary would have been libraries who can re-use tags repeatedly as books are circulated and indeed need to be prevented from leaving the library illegally over time. Libraries did not show sufficient enthusiasm or the will to pay for published materials to include this technology at the time of production.

There are different standards for tags. Tags can vary according to the radio frequency they transmit. Most library systems currently are using 13.56 MHz. They also vary according to their air interface: there are four different protocols for that. They can also vary according to the conventions used for storing the data.

RFID has been around in libraries for a number of years. In the UK, the first installation for library circulation and security control was at the Norfolk and Norwich Millennium Library where the TagSys system was installed in 2001. In 2002 Intellident's system was installed in the Oxford University Business School's Sainsbury Library in its new building near Oxford Railway Station (Digicult, 2003). Intellident have since set up installations at Colchester Public Library and Nottingham Trent University Library. However, as far as the project at Middlesex University was concerned, the first encounter that any Middlesex University Learning Resources staff had with RFID was at an ISO meeting in Rome in May 2003 where it was reported that Danish Standards (the opposite number of the British Standards Institution in Denmark) had attempted to develop standards for the selection and layout of data on an RFID chip: a representative of Danish Standards gave a paper describing the technology and explaining the standards that were needed to make it function, those that were in place and those that were required. Next, at the IFLA General Conference in Berlin in 2003 (Lindquist, 2003), a session was presented on RFID: speakers included the research director of the library automation system vendor VTLS (Chachra, 2003). After this session, visits were made to one or two stands in the exhibition which were demonstrating RFID, one of which was the Swiss company

Bibliotheca. About the same time, the University Librarian came across RFID in use in libraries in Singapore.

2. RFID at Middlesex University

Middlesex University is a multi-site university with eight learning resource centres on geographically separate campuses which offer mostly a library service, academic computing support, audio-visual service and language centre. Since a new learning resource centre was under construction at the Hendon campus where Middlesex University Business School and other schools are situated, it seemed appropriate to consider RFID for library circulation there. The stock is around 500,000 items including 2,000 CDs and DVDs and upward of 8,000 students use this campus.

An approach was made to DYNIX who supply Horizon, the university's library management system, for assistance with implementing RFID in the new library. The answer came back that they had appointed Bibliotheca as the company to provide an RFID solution for Horizon. In turn Bibliotheca had appointed an agent in the UK, namely D-Tech Direct.

A demonstration of RFID was organised in January 2004 (during the university's inter-semester break when libraries are quiet, in order to get maximum attendance from library staff); as a result of the demonstration, RFID was greeted enthusiastically. The main problem foreseen was that students would tear out the tags. On the other hand, the University Librarian after having seen RFID in operation in Singapore was very supportive of staff enthusiasm and prepared to take the risks which are always present when pioneering. There were only around five installations in the UK at the time and none using Bibliotheca's product at all, let alone using it with Horizon. After a brief visit to Nottingham Trent it was decided that a visit should be made to the headquarters of Bibliotheca to Switzerland and at the same time to a nearby customer, Winterthur Public Library. This took place in mid-February, about seven months before the library was due to reopen on its new site. The visit enabled Middlesex staff to meet the company, to see the wand in action albeit in a shelf of books at the company office and to see the book returns unit and self-issue/return in a live situation at Winterthur. Interestingly, the party was impressed by seeing a member of staff helping a very senior citizen to use the self-issue equipment for the first time and find that he found it very easy to use. Staff at Bibliotheca were also able to explain that the BiblioChip system which they used was based entirely on ISO standards ISO 15693 and ISO 18000-3 part 1. This means that libraries adopting this system are able to source their tags from any supplier of ISO-compliant tags, rather than being confined to a proprietary tag architecture.

Because RFID was intended for introduction into a new library building, it was possible to absorb the costs into those of the new building and its equipment. Nevertheless it was important to undertake a cost benefit analysis and a risk analysis. Documents from these exercises were presented to senior management and it was approved. The main points were:

1. The security system using metallic strips was not reliable and was set off in error by objects such as mobile phones causing staff and library users to lose confidence in it. RFID was claimed to be more reliable

2. The current self-issue machines were not easy to use and given an increase in student numbers in this campus library it was vital to offer better self-service options for library users.

Material at the Hendon campus needed to be barcoded for circulation transactions when material was picked up and returned by readers at other campuses. In the workflow which has been in use for tagging new books, the barcode is swiped to read the identification number in the process that writes the identification to the tag. Figure 1 shows the screen of data seen by the member of staff when activating a tag, having retrieved a record by swiping the barcode. Displayed are the data which will be written to the tag.



Figure 1: Screen display when tagging

This could of course be achieved at the pre-processing stage undertaken by the book supplier but access to the library system catalogue database is needed to write to the tag additional information such as the item location and to display the title for visual verification purposes, to ensure that the correct data has been applied to the tag in the book.

It was necessary to ensure that the system was compatible with the rest of Middlesex University Learning Resources sites which were not going to be supplied with RFID equipment for the foreseeable future, so retention of the barcode on the library materials is not redundant since inter-campus loan is a core part of stock circulation.

The fact that the material had a different security system should not have mattered because material on inter-campus loan is handed over to the borrower and does not need its own security. However, material from Hendon retained its magnetised metallic strip. All these should have been de-magnetised but were not, due to lack of time and effort available. So books from Hendon set off alarms at other campus library security gates which means that security staff at other campuses have to be aware that students may legally hold material issued at the Hendon campus which will set off their alarms. The demagnetising equipment which had been used previously at Hendon was scrapped in the move.

3. Selection, Implementation and Installation

Because there was only one system which had been developed to work with Horizon, there was no choice of system available to operate alongside Horizon which could have been developed within the limited timescale, so lack of choice made selection easier. It was decided to procure four self-issue machines, and to have three RFID staff circulation machines on the counter and two machines behind the counter. Included in the package were a wand for stock control and an automated sorter for returned books.

The book stock had to be moved from the old library to the new location over a period somewhat longer than the summer vacation. Discussions took place with D-Tech Direct on the possibility of sending the books out to be tagged during this period but in the end it proved to be more economical and easier logistically to recruit a team of students to tag the books between their being taken off the shelves in the earlier location and boxed for removal to the new. It had been stated by more than one source (by Bibliotheca staff and library staff in Winterthur) that we would be able to tag three books a minute. Simple mathematical calculation indicated that the time available for the tagging would be tight even including working into the evening.

Because this implementation was piloting the equipment in the UK as D-Tech's first RFID customer using DYNIX, there were a number of delays in installing the equipment before tagging could begin. The computers to which the pads for activating the tags were attached had to access a SIP2 server. SIP2 is a proprietary interface (the second version of the Standard Interchange Protocol developed for the industry by 3Ms). Systems staff were familiar with the concept of a SIP2 server because self-issue systems had been in place for a number of years which also accessed the same SIP2 server. However, in the case of the RFID pads, it proved impossible to get more than one 'client' to access the server at once so they had to be 'daisy-chained' making each computer the SIP2 server of the next in the line. Since each SIP2 server needed a fixed IP address and it was difficult to get these activated by the University's IT department because they were overwhelmed with a move from Novell network architecture to Active Directory, staff had to keep the computers at the library counter switched on all the time in the hope that the IP addresses would not change. This initial setting up of clients to servers caused much delay but when once the 'daisy chain' was stable tagging proceeded at up to six a minute. It is interesting to note that tagging eventually rose to 10 a minute the following year when preparing a large batch of material for RFID from another campus. Eventually, after investigation by Bibliotheca, a dedicated SIP2 server which worked correctly was put in place.

For technical reasons, DVDs and CDs require a different kind of tag and these were procured at a greater cost.

At six a minute rather than three, the materials which had been in the library during the period of the move were all tagged in good time and the materials themselves were on the shelves when the library opened in September 2004. Staff and returning students had been encouraged to take library materials out during the period of the move so that, in effect, they would be doing the moving for us by returning their loans to the new library. Of course this meant that those books had to be tagged on receipt.

Unfortunately, on the day of the opening of the new library to users, the hardware running the University firewall database failed, with the result that no clients could

log on to the library system until mid-day though the library server was running as normal. This was an inauspicious start. After that the system began to be used and self-issue and self-return quickly became very popular. As stated above, four machines had been purchased but of these one had a faulty screen and could not be used and another was not working correctly. The machines had missed out on Windows security updates and therefore quickly attracted viruses. This problem was solved by loading the latest Windows security updates, all of which took time. It took some time for the faulty screen to be replaced because no spare parts were available in the UK since we were the only customer for this kind of equipment. The RFID self-service equipment was specially designed by Bibliotheca and followed an earlier version which had been installed in Winterthur Library and elsewhere.



Figure 2: Self service units with top of bookdrop in foreground

It came with four languages and Bibliotheca had been eager for Middlesex University to specify more languages. Since it is the university's policy that all students should work in English it did not seem appropriate to put any effort into the translation work and so only the four languages delivered with the hardware are available. The self-issue systems proved to be very fast; unfortunately the staff machines are not so fast. The machines at the counter use the normal Horizon circulation module with an additional piece of software which writes to the security bit on the tag and changes its status when books are issued or returned. In future Horizon will support the NCIP protocol which is a NISO (US) standard superseding SIP2 mentioned above and then the security bit switch will be better integrated with the circulation interface. During and just after the installation period, before the fixed IP addresses were obtained (as mentioned above) there was a certain amount of unreliability with RFID machines ceasing to function without no obvious explanation. This happened again at a quieter time and was solved after two weeks of investigation merely by defragmenting the hard disk of the server.

4. Security and data protection issues

The implementation team investigated printing a logo on the tag to make it look like a book plate but discovered that this would increase considerably the cost of the tags.

After careful thought, it was therefore decided to place the tags inside the back cover of the book. There has been an instance of a student tearing out a barcode from a book in the hope that it could be smuggled out and the student was caught when the tag which had remained unnoticed operated the alarm at the security gate. The tags are not invisible but they are not immediately obvious.

RFID serves both in place of the barcode for circulation control and the metallic strip for security. Material that hitherto did not have barcodes such as reference material or runs of bound or unbound journals which were not normally lent out needed a tag for security though not for circulation control. The RFID tag also needed an identification number and, where there was no barcode, a common identifier which represents 'non-loanable item'. Some institutions have treated their journal issues by continuing the old metallic strip system but in that case they need to have two systems in operation and the security gates detecting the metallic strips can interfere with the efficiency of the RFID detectors which means they have to be kept apart at the exit by a few metres with a 'corridor' between. Some systems on the market retain metallic strip for security and use the RFID only for circulation. The view taken at Middlesex University was that everything should be identified by the one system. When time permits security will be extended to other non-bibliographic items which may or may not be loanable, such as computer equipment.

While on the subject of security, it should be noted that there has been concern in some quarters about privacy issues relating to RFID in libraries. Some pressure groups, notably the United States-based Electronic Frontier Foundation (2005) are concerned that an RFID tag in someone's shopping bag could identify to a malicious observer with the appropriate equipment the contents of that shopping bag. Aware of these views which are far less common in the United Kingdom than in the United States, library staff discussed these issues and spoke to teaching staff in computing and business studies: no one consulted felt that the system being proposed for Middlesex University could realistically present any threat to library users. Although the tag holds the title, the equipment necessary to read the tags is very sensitive and can only be used effectively within a limited range. As far as data protection issues are concerned, the University is covered by its existing registration which covers library circulation systems using barcodes.

5. Economic issues

Currently most reports on RFID stress that the cost of tags is still high. In the case of libraries a tag may well be re-used on many occasions as compared with the retail industry where an item will not for long be in the hands of the company that has installed the system; the tag will only be used in a financial transaction once if it contains the price and as far as security is concerned many items never have any attempt made on them to steal them. In our case we had two reasons for embracing the new technology:

- 1) the cost could be absorbed in the cost of re-fitting a new building
- 2) staffing was so critical that anything that could ease the burden of staff contact was welcome

There had been two generations of self-issue hardware at campus libraries within the university. In the Hendon campus library, they had achieved in month by month statistics a maximum of 12% of loans and returns passing through them. When RFID was introduced at Hendon, staff were hard pressed with the opening of the new library and had little time to devote to a campaign to persuade students to use the new equipment. However, it was so easy to use and effective that students did not need much persuading and the percentage usage quickly reached 64% of issues and returns. This despite the fact that students with fines over £10 cannot use the machine.

6. Operation

A number of points have already been mentioned about the operation of RFID. It certainly enhances operations at the counter and self-issue. It is difficult to comment on security but the earlier system was wanting in this aspect. Along with the basic system we ordered a wand which is used in stockchecking. A file can be downloaded into a hand held device and operations can be performed on this file by searching for the identifiers, ranging from stock-check to searching for individual books required to satisfy reservation requests. The wand can also be used to order the books on the shelves. Sorting can be enabled by storing the shelf number on the tag since the wand can work off line. Alternatively it can work by downloading a selection of the catalogue into the hand-held computer which controls the wand, including in this selection barcode and class number in class number order. The device would read the identifier on the tag and check the order of the items against the ordered list produced by downloading the catalogue. The second option is the only one available currently at Middlesex since the class numbers are not available on the tag as mentioned below.

For any activities with the wand, it is essential that the tags have been placed consistently inside the books. For example, if there is a tag in the back of a book which happens to be placed on the shelf next to one with the tag in the front, the tags may be so close that it is difficult for the wand or the operator to distinguish which book had been detected. Self-issue equipment cannot read tags placed exactly above each other. The display on the self-issue screens encourages users to splay out a pile of books on the pad of the self-service machine to reduce the chances of tags being in line.

7. Technical and standards issues

Middlesex University was the first installation of Bibliotheca's system in the UK, and so staff had the opportunity to request requirements for the system and assist in developing the UK Horizon version. This was not necessarily a bonus as there were a number of difficult decisions to be made. The lack of any national or international standard for determining the data that should be stored on the RFID tag meant that staff had to work hard to think what might be needed. We were recommended to include in the data a field which indicated that the book belonged to a UK institution and a code determining the library itself but there was no readily available standard for this. On the other hand although we wanted room for a large string in the classification number field (to use in shelf sorting), we were told that the field was limited to 10 characters, in no way long enough for a Dewey number followed by a space and 3 digit alphabetical extension.

The distance at which tags should be read by the equipment had to be adjusted slightly. There have been instances where a book placed near to the pad on the counter was issued in error by the system to someone with their own pile of books nearby being issued correctly via the RFID pad.

Recognising that libraries in the UK need technical help and need a channel to feed into the development of any standards, the Book Industry Communication and CILIP have formed the BIC and CILIP RFID in Libraries Group in whose membership Middlesex University representatives are included.

8. Future developments

When the library was opened, gates procured from D-Tech were installed with a view to automating them in the future. Students retained their existing cards which meant that self-issue machines had to be fitted with barcode readers for reading the user's card. Issuing RFID cards to students wishing to use the campus library was postponed. The next stage is for students to have RFID cards which they can use in circulation and will also control entry and exit to the building housing the Learning Resource Centre.

The wand has been used for stockchecking. It will become increasingly used for other activities such as searching for books and shelf ordering. The book drop equipment takes up a large amount of space and the plans for the library were well-developed at the time when the contract was entered into for RFID. It has needed liaison with architects after the event which had caused certain problems, so its installation is still in the future though its site has been determined.

9. Conclusion

RFID has proved popular with library users. Library staff have been enthusiastic about the ease of self service as compared with earlier equipment though some have expressed disappointment at the performance of counter machines. One member of staff wondered why they could not use self issue machines at the counter; the reason for that is that self issue machines are streamlined in their functionality to make them easy to use and cannot give staff the opportunity to see more information about a user's transactions or perform functions that only staff can perform.

The Sheppard Library at Middlesex University's Hendon campus was built to replace the old accommodation for all Learning Resources' services. It has a much larger floor space but the same number of staff running it as before. Additionally, more students have been transferred to the Hendon Campus since the building was planned. RFID has contributed well towards alleviating service problems that have arisen through having to serve a larger space and a larger number of students; it has achieved this by reducing the amount of staff time engaged on circulation and stock management functions.

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