RFID IN AUSTRALIAN ACADEMIC LIBRARIES: EXPLORING THE BARRIERS TO IMPLEMENTATION

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Since 2002, radio frequency identification (RFID) systems have been installed in a growing number of Australian libraries. The institutions embracing the technology are to be found in the public, school and special library sectors. As of February 2008, no Australian academic library has installed a RFID system. This article briefly introduces RFID and outlines the benefits offered to libraries and suggests a range of factors that might contribute to the lack of the technology's penetration into the Australian academic library sector.

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Radio frequency identification (RFID) represents a range of identification technologies that are rapidly evolving and being adopted increasingly by businesses and other organisations worldwide, particularly in the Asia Pacific region.[1] These technologies are used in the identification and tracking of people, animals and things as varied as medical equipment, casino poker chips and oak wine barrels.[2] RFID offers identification beyond line of sight and the possibility of identifying dozens, if not hundreds, of individual items at high speed.[3] RFID is also increasingly converging with other technologies such as sensors, GPS, and cellular telecommunications to provide accurate real-time location and environmental information.[4]

Within libraries, RFID may be used in a way that replaces traditional barcodes for the storage of item identification and other data.[5] Staff and library users are able to interact with library materials in ways that enhance efficiency and reduce repetitive handling of materials. The library application of RFID employs what are essentially smart labels[6] with adhesive backing and memory capacities sufficient to store the item identifier, usually equivalent to the barcode number, together with other information required such as institutional identifier,

media code or call number. During circulation-based activities, radio frequency readers are used to collect this data for transmission to the library management system in a process analogous to, although considerably faster than, scanning and transmitting a barcode.

RFID SYSTEM COMPONENTS

The heart of a library RFID system is the transponder or RFID tag. A tag has an antenna for communications and for scavenging power from the reader's radio frequency field, and a silicon chip with processing capacity and read-write memory.[7] An RFID tag is applied to all or most items in the library's collection and is used for identification and, optionally, item security. Understanding the benefits of standardisation, libraries generally choose to employ tags and readers conforming to ISO/IEC 15693 or ISO/IEC 18000-3 standards. These commonly used standards secure a range of supply options and establish a common foundation upon which data model initiatives are currently building library-specific standards which will permit interoperability with other institutions.

Most of the other system components making up the library RFID system are RFID readers purpose-built into a range of devices and designed to read the RFID tags within library materials. These devices include self-service loans and returns units, smart returns chutes and sorting machines, security gates, staff circulation workstations and hand-held collection management tools. In the self-service context, for example, library users are able to issue RFID-tagged material quickly and easily. Multiple items may be issued simultaneously without the requirement for the user to locate and present each barcode to the machine, as required by older technology. This leads to faster transactions for the borrower and higher use of self-service equipment.

Staff performing collection management activities such as inventory, shelf ordering and weeding, may use a hand-held device which essentially removes the requirement to take items from the shelf for identification. As an example, to collect data for inventory purposes an RFID-equipped hand-held unit is used to scan the items on shelf, quickly collecting their electronic identifiers for upload later to the library management system. Using this method some suppliers claim that the identifiers in up to 10 000 items can be read by a single staff member in one hour.[8]

In addition to its identification role, the RFID tag can also be used in place of the traditional electromagnetic security strip. As data stored in the tag may be deleted or changed, a circulating library item containing an RFID tag may have its internal security status reset at the point of issue. RFID equipped security gates can detect this security status and trigger an alarm if the item has not been authorised to leave the library. Additionally, some systems may also interrogate the tag responsible for the alarm and present specific information to the staff to enable them to quickly isolate the item from others so that it may be processed efficiently.

BENEFITS OF RFID WITHIN THE LIBRARY APPLICATION

While it is true that libraries do prioritise the benefits resulting from an RFID implementation based on their local requirements, experience suggests that there is a common set of positive outcomes desired by most libraries.[9] These include:

- *Productivity* – the expectation that staff circulation tasks will be more efficient and that RFID will provide the basis for a move to a complete or predominantly user-facilitated circulation model, thus freeing staff time for other borrower-focussed activities. Other productivity contexts may include maintaining existing services in the face of reducing staff numbers due to budget cuts or increasing service demands resulting from service growth.

- *Occupational health and safety* – the expectation that the above scenario will lead to a reduction in manual handling by staff and, therefore, to a commensurate reduction in repetitive motion injuries in the workplace.

- *Collection management* – the expectation that RFID will enable new ways to manage library collections. This may include making it possible to undertake tasks previously considered impractical, such as regular stock-takes, or entirely new activities, such as identifying reservations or other exception items that have been inadvertently returned to open shelving. Also, existing tasks such as shelf ordering, weeding and item searching may be accomplished in new ways.

- *Security* – the expectation that the overall security of the collection will be increased, as every RFID tagged item can essentially be secured by the same tag. In this context, RFID may compare favourably in many barcode and electromagnetic security contexts where all items are identified (the barcode) but not all items are secured (the electromagnetic (EM) security tag). This is a common scenario within public libraries where often only part of the collection is secured.

- *Customer service* – the expectation that RFID will free staff to spend more time with borrowers, but also the expectation that self-service facilities for borrowers will be significantly improved through RFID, providing faster and easier transactions for library users.

- *Image* – the expectation that the image or profile of the library service will be enhanced through the implementation of RFID. The use of cutting-edge technology in this way is considered by some to be a demonstration of innovation and leadership within the library community.

FACTORS AFFECTING RFID IN ACADEMIC LIBRARIES

Clearly there are differences among library sectors. These differences can be seen in the user populations, the purpose and type of library usage, the mix of services expected and the types of material required. The following paragraph attempts to identify some significant differences that have an impact on the potential acceptance and use of RFID in academic libraries when compared to public libraries, which have the majority of RFID installations in Australia at present.

The Productivity Cost/Benefit Equation

While libraries have many motivators for implementing RFID, improving staff productivity is probably the most common among public libraries.[10] What an individual library wishes to do with productivity gains may range from redeployment of staff time toward value-added services, through to downsizing and budget reduction. Actual productivity gains associated with RFID tend to be realised principally from automating the loans process and possibly also the returns process to some extent, a task made significantly easier with RFID than with barcodes. In these contexts libraries are presented with an equation consisting of an initial and then recurrent cost for RFID tags and equipment, which may be set against the cost of staff time no longer required to perform specific circulation-related activities. While it will be unlikely that the productivity benefit is the only advantage included in the business case, it is often at the core of the cost/benefit calculation. Unfortunately this productivity case is not always as easy to make within an academic library.

To illustrate the productivity case in two institutions, consider the table below which presents some key data provided by the two institutions. One is a large and innovative public library service in the northeastern suburbs of Melbourne and the other is an academic library situated on a beautiful treed campus northwest of Sydney.

Table: Comparison of Public Library and Academic Library

Institution	Staff numbers (Full-time equivalent)	Number of Items Held	Number of Loans for 2007
Yarra Plenty Regional Library	88	510 000	3 660 000
Macquarie University Library	124	1 800 000	323 613

A glance at the figures reveals some obvious differences between the two libraries. The public library has fewer staff and a much smaller collection, with a relatively high circulation. The data could be analysed from several perspectives, but when contemplating a productivity case based on RFID, the public library has much more to gain. Removing the circulation burden from the public library staff, even if only for loans, is likely to be more transformative than in the academic library

context because not only are there more loans, but the manual transaction of these loans will constitute a larger work component for the smaller number of staff.

Also, within the business case, the costs of implementing RFID are likely to be lower for the public library because of its smaller collection size, requiring fewer of the relatively expensive RFID tags. Even though the academic library will need to spend less on self-service equipment to automate their reduced number of loans, any savings here will be minimal when compared with the requirement to purchase so many more RFID tags. In fact, it is entirely possible with current prices that the public library may obtain their entire RFID system for a price equivalent to the RFID tag cost alone for items in the academic library's collection.

Considering the figures above, it is not surprising that most RFID systems in Australia are installed in public libraries. The highly transactional nature of a core public library activity often delivers a robust business case where RFID self-service is concerned.

Trends with Printed Materials

In many libraries the requirement to hold printed materials is declining with time, as more efficient delivery methods for information evolve. While this is true within the public library sector, it is especially being felt within academic libraries.[11] The application of RFID within libraries is tied very closely to physical assets and their management. Whether it is collection management, security or circulation, the physical library assets are what are being considered in any discussion of RFID. If online delivery of information is progressively displacing the need for physical assets, academic libraries might question the benefit of investing in technologies designed to manage items for which they have a reducing need. This is not to suggest that libraries will cease to carry books, but rather to acknowledge that the benefits delivered by physical asset management systems such as RFID may gradually be eroded if current academic library trends continue.

Collection Management Solutions

This is possibly an under-investigated benefit of RFID implementation within academic libraries. One might expect that, considering the nature and size of their collections, academic libraries should have a greater need for systems and tools aimed at improving collection management when compared with their public library counterparts. Perhaps this is the most significant benefit delivered by RFID within academic libraries. Even if this is the case, some of the previous comments regarding physical assets may still apply. The reducing need for access to printed materials and the large collection sizes within academic libraries essentially mean that RFID is a very expensive collection management solution if it is the only benefit sought, and potentially one with a slowly diminishing value. Whether this means that RFID cannot be justified for its collection management contribution today will obviously be a decision for each institution individually.

Internationally, some academic libraries have embraced RFID in this context. The dean of one library system, Kenneth Marks of University of Nevada-Las Vegas Libraries, an early adopter of RFID in the United States, believes that, following a move to RFID 'we have the most accurate library in the world'.[12]

Security – The Single-Tag Solution

As stated previously, many public libraries do not secure their entire collection, but choose only to apply electromagnetic security strips to items of high value or perceived as highly desirable. By using a single RFID tag not only as the identification technology but also to secure each item, public libraries can mount an argument that the collection as a whole is more secure following a migration to RFID.

The reality is, however, that RFID-based security is not as effective as that provided by electromagnetic technology, particularly in systems utilising strips inserted into the spines of printed materials or in the gutter between the pages. In comparison with these systems, the individual RFID tags are larger, less covert, easier to remove and more easily shielded than purpose-built EM security strips. Despite this, the public library position that an 80% effective security system covering all materials is still better than a 100% solution covering 40% of the collection may still be sound. In academic libraries, however, it is more usual to find all materials secured by the superior EM technology. Because of this the argument for improved item security under RFID may not apply. In fact, academic libraries may need to continue applying EM strips as well as RFID tags to maintain their current level of protection. Of course there is nothing to prevent an individual academic library deciding to use RFID-based security and foregoing their EM tags based on a cost/loss assessment. The point remains, however, that the positive argument used by public libraries in justifying an improvement in security with RFID may not exist for many academic libraries.

First Adopter – Leadership

There is some evidence that public libraries are early adopters of new technology.[13] Within Australian academic libraries there has been no 'leader' as yet to implement RFID and to prove its value within the academic context. Perhaps the sector is waiting for this to occur before the technology is considered seriously by many institutions.

Other Competing Technology

One of the reasons that RFID is sometimes deployed relates to the profile of the library service in terms of being an innovator and a leader within its community. Particularly in the context of a new library building designed to be a showcase, cutting-edge technology such as RFID can be a desirable asset. As a line item in such a major project, an RFID system may also be a relatively modest additional cost.

Unfortunately for RFID, it is not the only technology that might take centre stage in such a building or renovation project. In Australia there is growing interest in another technology finding potential application within academic libraries – the Automated Storage and Retrieval System (ASRS).[14] These systems essentially comprise a compact, unmanned warehouse of library material which is serviced exclusively by an industrial robot or robots. The general idea, following the 80/20 rule, is to place low circulation material into the ASRS while keeping high circulation material in open shelving. As a result the footprint of the library building might be significantly reduced or more space devoted to providing electronic access to relevant materials. In a typical scenario the ASRS interfaces with the library's OPAC and users may request material stored within the ASRS, which can be retrieved by the industrial robot and delivered to a staff member with a delay of only five or ten minutes.

Such technology might impact on RFID in obvious ways, such as displacing it in the technology budget or simply by serving as an alternative showcase technology within a new building project. More interestingly, considering that ASRS systems and RFID are in no way mutually exclusive, the ASRS system may actually dilute some of the benefit that RFID offers to academic libraries. Consider the following examples:

- *Productivity* – notwithstanding earlier comments about the difficulties involved in developing a business case built on RFID-enabled productivity in academic libraries, the ASRS may actually reduce RFID's contribution toward productivity even further. In typical ASRS installations, the retrieved material is delivered, not to the requesting borrower, but to a staff member. To a large extent this occurs because the ASRS is not storing single items but, for reasons of cost and efficiency, is storing steel bins packed with perhaps 50 items. Prompted by the ASRS software, the staff member selects the requested item from the bin and passes it to the borrower, either issuing it at the same time or indicating that the borrower should use the self-service facilities for the loan transaction. Such a system mandates staff interaction in a number (hopefully small) of transactions. While the promise of the RFID system might be to allow 100% of loan transactions to be accomplished without staff handling, the ASRS mandates staff handling of every item requested from its storage locations. Regardless of the percentage of items retrieved from the ASRS, the ability to perform staff-free circulation under RFID will be to some extent eroded. This is by no means a criticism of ASRS systems which are often not installed as a productivity tool; it is merely a comment regarding their potential impact on RFID self-service models.

- *Collection management* – we have stated previously that improved collection management is a benefit flowing from an RFID implementation. Typical collection management activities with RFID include accurate inventory of materials,

shelf ordering, and weeding. In an ASRS-equipped library, a significant proportion (maybe even a majority) of the collection is managed by the ASRS. As library users have no access to materials under the management of the ASRS except through appropriate systems, collection management within ASRS-controlled collections is extremely robust. The ASRS will not lose items, will not mis-shelve items, and will at all times maintain a highly accurate inventory account, rendering stocktaking in the traditional sense redundant. Neither staff nor borrowers have access to stock without recourse to the ASRS robots. In this sense, RFID provides no real collection management benefits to the proportion of the library's collection under ASRS control, again diluting its benefit to the collection as a whole and limiting it to open shelved material.

Of course there is another side to this argument, one that suggests that ASRS-managed material could perhaps only be tagged with RFID when it is requested – effectively reducing the number of RFID tags required and therefore the cost of the RFID implementation. Such arguments obviously have some merit, but caution is needed in ensuring that the process implications on staff productivity in such a scenario are fully understood.

CONCLUSION

This paper is by no means claiming that current RFID systems are unsuitable for academic libraries. Clearly, as many academic libraries worldwide have demonstrated, this is not the case. In the final analysis, individual institutions will make their own decisions regarding the value of the contribution made by RFID technology. This paper is suggesting, however, that the typical productivity-based business case seen most often within the public library sector is not likely to be as robust within the academic library context and therefore may less effectively constitute the core of the RFID proposal.

Given that printed material is likely to be with us for some time to come, the benefits in the area of collection management may be sufficiently persuasive to entice some Australian academic libraries to embrace the technology, and these benefits should be carefully explored. It may also be the case that the current range of products may have to evolve further before a complete benefits package emerges for academic libraries – perhaps combining material location systems for example, adding value to the borrower's experience and contributing further to staff productivity gains. Perhaps also a leader is required in the Australian academic library sector, one who is prepared to embrace the technology, refine affected processes and then report on the quantified benefits and advantages within the academic context. This may perhaps even be in combination with other technologies such as ASRS systems.

NOTES

1. P Jones 'LogicaCMG Tags Australia for RFID Growth' 2007 at http://www.
    zdnet.com.au/news/software/soa/LogicaCMG-tags-Australia-for-RFID-gro
    wth/0,130061733,339274169,00.htm viewed 18 February 2008.

2. J Banks et al, *RFID Applied* Wiley 2007 pp457-474.

3. W Hedgepeth *RFID Metrics: Decision Making Tools for Today's Supply
    Chains* CRC Press 2007 p9.

4. Venture Development Corporation 'Global RFID Market Overview' 2007
    at http://www.integratedsolutionsmag.com/index.php?option=com_docman
    &task=doc_view&gid=73 viewed 18 February 2008.

5. D Brown *RFID Implementation* McGraw Hill 2007 p163.

6. S Shepard *Radio Frequency Identification* McGraw Hill 2005 p57.

7. K Finkenzeller *RFID Handbook: Fundamentals and Applications in
    Contactless Smart Cards and Identification* Wiley 2004 p6.

8. Forms Express Singular Tag System at http://www.formsexpress.com.au/
    library-rfid.html viewed 9 January 2008.

9. C Haley et al *Radio Frequency Identification Handbook for Librarians*
    Libraries Unlimited 2007 p8.

10. L B Ayre 'Wireless Tracking in the Library: Benefits, Threats, and
    Responsibilities' in S Garfinkel and B Rosenberg (eds) *RFID Applications,
    Security and Privacy* Addison Wesley 2005 pp229-243.

11. D Lewis ' A Model for Academic Libraries 2005 to 2025' at https://idea.
    iupui.edu/dspace/bitstream/1805/665/6/A%20Model%20Academic%20Libr
    aries%202005%20to%202025.pdf viewed 19 February 2008.

12. J Yorkovich 'Lied Library: At the Forefront of Technology with 3M Digital
    ID Collection Management' *New Library World* v 102 no 6 2001 pp216-
    221.

13. I Hildebrand 'Rethinking Public Library Websites' 2003 at http://conferences.
    alia.org.au/online2003/papers/hildebrand.html viewed 18 February 2008.

14. The University of British Colombia's ASRS Project is at http://www.library.
    ubc.ca/home/asrs/whatis.html viewed 18 February 2008.