

MOVING RIGHT ALONG: USING RFID FOR COLLECTION MANAGEMENT AT THE PARLIAMENTARY LIBRARY

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In December 2003, the Parliamentary Library installed the 3M Digital Materials Flow Management system which is based on Radio Frequency Identification (RFID) technology. The Library uses the technology to manage its collections, current applications being mainly shelf-reading, stocktaking, and exception handling. This paper describes the selection and implementation processes (including interfacing with Sirsi's Unicorn ILS), it provides an evaluation of the 3M system and it explores possible future applications.

What is RFID?

RFID (radio frequency identification) is a wireless technology that incorporates the use of electromagnetic or electrostatic coupling to uniquely identify an object, animal or person. An RFID system comprises three components: a tag, a reader and an antenna. Tags are programmable and they may be read or read/write i.e. the information stored in the tag's memory cannot be changed or can be updated as required. The reader powers the antenna to generate radio frequency waves to transmit a signal that activates the tag and allows data to come into or leave the tag's memory. An excellent overview of RFID technology may be found in Laura Smart's (2004a) article, *Making Sense of RFID*.

Key attributes of RFID are that, unlike barcodes, RFID tags can be read:

- without a line of sight from the reader;
- in any orientation to the reader;
- while moving;
- several at a time; and
- from distances of several inches up to over 90 feet, ranging from low frequency for the former up to high frequency for the latter.

RFID tags are used at two levels, firstly at the container level in supply chain industries such as manufacturing, and secondly at the unit level in applications such as retail, postal services, animal tracking and e-tags on tollways. In recent years unit-level tagging has been introduced in libraries where it is used for four main purposes:

- Circulations, including self-check of library materials by patrons;

- Tagging staff and client identification cards to identify them for borrowing library materials, and also to restrict or enable their access to areas and services;
- Security detection systems to ensure that no materials leave the library without being checked-out; and
- As an aid to the essential tasks of collection management: shelf reading, stock taking and weeding, tasks which, if performed manually, tend to be time-consuming, boring and prone to error.

Mackenzie and Aulich's paper (2002) describes the implementation of RFID in the Brisbane City Council Library Services, one of the first RFID implementations in Australia..

RFID Project Background

The Parliamentary Library maintains a collection of approximately 110,000 monograph items and 10,000 serial titles. The breakdown of the monograph collection at July 2003 (the commencement of the RFID implementation project described below) was:

- 80,300 books
- 15,700 folios
- 11,000 pamphlets

This collection comprises 60% of the Library's net assets and in accrual terms, the collection is valued at \$5.4 million. Because of its significance as an asset, the Library is required to value and stocktake the collection on a regular basis. In 1999-2000, the Library commenced a rolling stocktake of the monograph collection. The 2002-2003 stocktake was the final phase of the first complete monograph stocktake.

Each item in the monograph collection is recorded in the Library's Integrated Library System (ILS), Sirsi's Unicorn, and has a barcode and a tattle-tape security strip attached.

The monograph collection is maintained by staff who undertake the following activities:

- Shelving and re-shelving items removed from the shelves;
- Shelf reading, to ensure that all items are placed in the correct order to enable fast and effective retrieval;
- Shelf checking, to ensure that each item is in good condition and that spine labels are accurate;
- Weeding of items no longer required;
- Periodic updating of items (such as reclassifying); and
- Annual stocktaking.

Collection maintenance staff strive to keep good shelf order by shelf reading the most heavily used sections of the collection more frequently, but the manual process is time-consuming and prone to error.

The rolling stocktake performed each year required the equivalent of two to three staff working full-time for 2 weeks. It entailed carrying out a number of labour intensive operations. First, a series of shelf list reports were generated from the ILS and divided among the staff. Then, loan records were checked for items not on the shelves. Staff checked the information in the shelf list reports against the items on the shelves, and annotated the reports to indicate items found and not found. They pulled items off the shelves which did not match the information listed in the report or were damaged. The stocktake thus identified books with incorrect labels or barcodes, books without records in the ILS or recorded in the ILS but not found, damaged books, and occasionally books from other libraries.

The Parliamentary Library sought a solution which would reduce the staff time needed to perform these essential tasks in collection management so that staff could focus on broader client service delivery.

The Tender Process

The Business Case

A business case recommending the acquisition of RFID technology to improve management and control of the collection was put to Library senior management. The business case described RFID and its applications in libraries and detailed the manual processes carried out in the library including the direct staff costs of these processes. Estimates of the installation and ongoing costs were included in the business case along with relevant information from sites such as the Lied Library at the University of Nevada, Las Vegas and the Glasgow University Library (DPL 2003a). A description of the implementation of RFID at the University of Nevada, Las Vegas may be found in Fabbi, Watson and Marks (2002).

It should be said that initially there was some staff resistance to the project. Questions were raised about the cost of the technology and whether it would be cost effective. Some staff keep library materials in their offices and were concerned about privacy issues.

Request for Solution

A Request for Solution for the Management of the Parliamentary Library's Collection was issued in May 2003 (DPL 2003b) which included statistical information on the Library's collection, a description of the existing situation and the technical environment. The project deliverables were:

- Integration with Sirsi's Unicorn;
- Reduction of ongoing costs while ensuring that client services continued to be given priority; and

- All stocktake, valuation and audit processes to be met efficiently and effectively.

The selection criteria focussed on value for money with factors under consideration being:

- Ability to produce project deliverables;
- Claims against the requirements;
- Ability to meet the timeframe specified;
- Favourable referee responses; and
- Cost.

Three companies tendered and after an evaluation process, 3M was selected as the successful tenderer. Smart (2004b) provides a useful guide to the leading providers of RFID solutions.

A decision not to include patron self check was made on the basis of cost efficiency, with circulation statistics indicating that the number of loans per month did not warrant the purchase of such a system.

Using RFID technology at the circulation desk makes it possible to perform the traditional circulation tasks in a more ergonomic fashion. It also means a one-tag solution for identifying items, without the need for a separate barcode. These are desirable features, but integrating circulations with RFID technology at the Parliamentary Library would have required changing all the item IDs in the collection, installing new workstations and RFID readers at the two circulation desks (one in the Ground Floor Reading Room and the other in the Main Library) and re-configuring the circulation desks. Weighing up the costs and benefits, it was felt that the relatively low number of items processed at the circulation desks did not justify the move to RFID for circulation functions.

The Library also decided not to convert the existing Library security system, a 3M detection system based on tattle-tape security strips and electronic detection gates, to RFID technology. The gates would be expensive to replace but quite apart from the cost, the tattle-tape strips are more effective as they are virtually impossible to find and remove whereas the RFID security tags are difficult to conceal.

The 3M Solution

The 3M quote included hardware, software, installation and training. The Library purchased 120,000 RFID tags – sufficient to tag the whole collection (excluding serials) plus provide a supply for the subsequent two to three years - three Digital Library Assistants, two Tracking Pads or SmartPads and the 3M Digital Data Manager software (one copy for the whole site). A description of each of these elements follows.

The 3M RFID tag is a 1.88" x 2.25" (48mm x 57mm) rewritable tag with a memory chip used for storing item information which identifies and tracks the item. 3M guarantees it for the life of the item to which it is affixed.

The 3M Digital Library Assistant or DLA is a cordless hand-held unit with an antenna, powered by a re-chargeable battery, used to read or scan RFID tags affixed to library materials. Its weight is 25 oz (708.7 g) including battery, and the battery life is typically 6 to 8 hours between charges. Dimensions are 9.5" x 7"x 4" (24cm x 10cm x 1.25cm) for the handheld unit and 9.5"x 4"x 0.5" (24cm x 10cm x 1.25cm) for the antenna.

The DLA requires the 3M Digital Data Manager software and a Compact Flash Card reader/writer. The PC to run this needs to have Windows 2000 or higher and a USB port for connection of the flash card. Data Manager provides an interface between the DLA and the ILS. It utilises text files generated from the ILS to create data files which are exported into the flash card inserted into the DLA. The Data Manager is also used to import data captured by the DLA through the scanning process which can later be uploaded into the ILS for inventory and statistical use. It does not talk to the ILS server at all but can use the reports generated by the ILS.

The SmartPad is used to program/reprogram RFID tags and converts item IDs from barcodes to RFID tags. If using RFID for circulation, it also checks-in and checks-out RFID-tagged items. It is thin and flat with the dimensions 8.5"x 8.5"x 0.4" (21.6cm x 21.6cm x 1.0cm). It has a maximum read range of about 200mm directly above it and extends to about 200mm around its perimeter. The read range can be adjusted down if there is any difficulty with unintentional tag reads. It can be mounted under the desk and if the desk is of suitable construction, one of the advantages of RFID is that it can read the item through the desktop. The SmartPad is connected to a PC and requires the installation of the 3M Digital Conversion Station software to allow programming of the tags. This is a standalone application which runs on Windows 2000 or higher. Only one SmartPad can be supported per PC.

The Implementation Project

As a first step, an email went out to all clients and staff alerting them to the commencement of the project and requesting that they return items on loan to the Library so that they could be tagged. This received quite a good response and, in part, overcame the privacy issue mentioned earlier in that staff were more willing to return items than have people come to their offices to tag books.

3M used two of their own Conversion Stations for the high volume tagging of the entire collection, employing contractors for the task. They advised that during the tagging process, it would be possible to set up the Conversion Stations to identify items which should be pulled off the shelves, for example, items to be weeded or marked as missing. The Library did not wish to undertake weeding during the conversion process but certainly felt that identifying items marked as checked out or missing would be useful.

In order to do this, it was necessary to export a file of these items from Unicorn into Data Manager. The report that was closest to the format required by Data Manager was a custom report that Sirsi had written for the Library's manual stocktake which output the following fields:

- Item Type (identifies whether the item is a book, folio or pamphlet)
- Call number
- Copy number
- Barcode
- Title
- Location
- Notes

This report was massaged into the format required and used to retrieve and export items that were checked out or missing into Data Manager.

The 3M team commenced applying the RFID tags to the collection on 28 July and completed tagging of the items on the shelves on 17 September. They used two Conversion Stations. Each Conversion Station included a touch screen, optical barcode scanner, RFID reader and portable cart. The tagging process involved taking a trolley-load of books, placing an RFID tag inside each one, reading the barcode into the Digital Conversion Station program using the barcode scanner, and linking the barcode to the RFID tag using the RFID reader.

Since the completion of the tagging by 3M, Acquisitions staff have been applying RFID tags to new monographs received while Collection Maintenance staff have been applying the tags to monograph items returned for shelving and found without a tag. In-house tagging is done using the SmartPads, which work in a similar way to the Conversion Stations except that the Digital Conversion Station program is loaded into the staff workstation to which the SmartPad is connected.

The RFID tags are affixed to the inside back cover near the spine and away from the base of the item. Having the tag near the spine puts it in a position where the DLA can be held right up against it, and having it away from the base minimises possible interference from metal shelves. The Digital Conversion Station program alternates three possible placement positions on the item to reduce the likelihood of tags cancelling each other out if their fields overlapped. This is particularly likely with thin pamphlet-like material.

One question that initially concerned the Library was how would the items which had been overlooked in the RFID tagging process be detected. The answer was that these would be picked up in a stocktaking/inventory process which can be an on-going by-product of shelf-reading, as will be described later.

The Initial RFID Stocktake

To do a stocktake based on the RFID conversion, it was necessary to mark each tagged item as 'inventoried' in Unicorn. The Unicorn report which does this – the Load Scanner Transaction report - requires the following input file format:

SCANNER|<date in YYMMDDhhmm format>|<barcode>

3M provided us with the log files from the Conversion Stations while the Library was able to extract the log files from the Smart Pads. The log files contained the required data but were not in the correct format. Attempts to correct the format by manual manipulation failed to make the Load Scanner Transaction report work. This was eventually discovered to be due to the presence of hidden characters. The problem was only resolved when the Library's IT staff wrote a Visual Basic program to convert the log files. The Load Scanner Transaction report was then successfully run to mark the items in the log files as inventoried. Finally an Inventory List report was run to identify items with no inventory date.

Out of a total 107,000 collection items tagged, 2863 items were identified as not inventoried. This comprised 2042 items in the lending collections and 821 in the reference collection. A shelf check was done against the listings of these items. 1174 items in the lending collections and 531 items in the reference collection were found on the shelves to be untagged or incorrectly tagged. These were subsequently tagged or re-tagged, and individually put through the Inventory Item transaction in Unicorn. The remaining 868 items in the lending collections and 290 items in the reference collection were deemed to be missing. Another Unicorn report was run which assigned items without an inventory date to a location of NOTONSHELF.

A total of 1,705 items or 1.5% of the collection were missed in tagging or tagged incorrectly during the conversion process. This was communicated to 3M who responded with an undertaking to review procedures to determine ways of avoiding a similar error rate occurring on other sites.

RFID Shelf Reading

The handheld DLA is used to scan the library shelves primarily to check shelf order. In order to do this, it needs to compare shelf lists from Unicorn against the information that it reads from the RFID tags. However the sort order of the shelf lists produced by the custom stocktake report did not correspond exactly to the physical shelf order. Items with identical call numbers in the report were sorted by item ID (barcode number) while items on the shelves with identical call numbers are sorted by title. The sorting order in the custom report for multiple copies of multiple volume works also did not reflect the shelf order. The custom report listed volumes one together, then volumes two, volumes three, etc, while of course on the shelves the arrangement is volume one followed by volume two then by volume three etc. for each copy. Sirsi was approached to make the necessary modifications to the custom stocktake report which they duly did.

The shelf lists (generated by the modified custom report) are downloaded from Unicorn into Data Manager from where they are exported into the flash card which is supplied with the DLA. Items that are checked out or marked as missing, on hold or 'It's New' (on the new-books trolley), are downloaded separately so that they can be identified if found on the shelves during shelf reading. Because catalogue and circulations data are continuously updated in Unicorn, the downloading and exporting processes need to be done just before commencing the daily shelf reading. It takes collection maintenance staff about 10 minutes to run through the processes which have been incorporated into the shelf reading procedure.

The flash card is inserted into the DLA and provides it with the data it requires to perform the shelf reading. The DLA beeps when it encounters an item which is out of shelf order and the small screen display on it indicates in which direction the item should be moved. As well as wrong shelf order, the DLA also alerts staff to items on the shelves that are not in the catalogue, incorrectly labelled, in the wrong location or marked as checked out, missing, on hold or 'It's New'. This means that a number of collection management problems are now resolved on an ongoing basis.

The DLA can be configured to scan thin items, defined as anything below 0.5" (1.5 cm.). But using the DLA to scan very skinny items or an uneven mix of thick and thin items is a challenge. One way is to touch or tap the DLA antenna to each item to be sure that it is scanned. With the pamphlet collection, which is housed rather tightly together in boxes, items need to be taken out of the boxes and "fanned" out on a table. Each staff member who uses the DLA regularly develops their own techniques for scanning. If doing an inventory, the shelf only needs to be "swept" twice to ensure that everything has been scanned, but if shelf reading, it is a slower process.

Before installing the 3M RFID system, we wrote to Sidney Watson of the University of Nevada library to ask how effective the DLA was with thin materials. Being a curriculum materials library, we expected it to have a lot of atypical materials. Sidney Watson's response was that at first they were obsessed with counting items by hand to be sure that the DLA did not miss anything. But over time library staff had become much more relaxed because they had discovered that the DLA did not miss much. We have not been scanning the pamphlet collection long enough to be quite so confident.

At the Parliamentary Library, what used to take six months to shelf read manually is now completed in about six weeks with RFID scanning. The staff prefer using the DLA to the more tedious manual shelf reading process, especially for thinner materials where the call number is not displayed on the spine and each item has to be pulled out to be examined.

Ongoing RFID Stocktaking

Data captured by the DLA through the scanning process can be imported into Data Manager and then uploaded into Unicorn for the items scanned to be marked as inventoried. Thus ongoing stocktaking of the collection can be

done using the scanned data. As each DLA shelf reading session uses updated data, it is necessary to import the file of scanned data after each session or it gets overwritten. With shelf reading being done daily, this has of course resulted in a large number of imported files quickly accumulating. In order to avoid having to upload and run a multitude of files separately through the Unicorn inventory reports, library IT staff provided another Visual Basic program to enable the separate files to be periodically consolidated into a single file. It also validates the format of the data in the files so that errors, usually scanning errors, can be corrected or removed before the file is uploaded. At the time of the writing of this report (November 2004), the results of the ongoing stocktaking process have not yet been compiled but we hope to present this data at the Conference.

Advantages of RFID

In summary, some benefits that the Parliamentary Library has experienced from RFID technology are:

- A significant reduction in the time taken to shelf read the collection;
- Staff satisfaction in using the technology rather than carrying out the more tedious manual processes of collection management;
- Improvements in occupational health and safety as many repetitive actions in shelf reading and stocktaking have been replaced by the simple action of moving the DLA across the shelves;
- Ease of identification of items which are mis-shelved, incorrectly labelled, in the wrong location, not in the catalogue or which should not be on the shelves, for example, marked as being checked out, missing, on hold etc.;
- Resolution of collection management problems on an ongoing basis rather than the experience of 'bottlenecks' which developed when these problems were uncovered only during the annual stocktakes;
- Inventorying of items as a by-product of shelf-reading, enabling ongoing stocktaking of the collection to be done; and
- High reliability of RFID readers. Vendors of systems claim a detection rate of close to 100% using RFID tags. However the evidence is anecdotal rather than backed up by statistical data.

Going beyond the Parliamentary Library's experience, Richard Boss (2004) mentions some other advantages of RFID technology for libraries:

- Rapid check-in and check out in circulations. RFID tags can be read much more quickly than barcodes and a stack of several items can also be read at the same time;
- Quicker and easier self-check systems. Patrons do not have to place the items carefully within a template and can check-out several items at once. RFID readers can also be installed in book drops.
- A 50% increase in throughput at the circulation desk in a system where a single RFID tag replaces both the barcode and security strip, because the check-in/sensitizing and check-out/desensitizing operations are combined.

Disadvantages

On the other hand there are some drawbacks which should be mentioned:

- Tags are visible and can be easily removed by simply tearing out a page which the tag is on or by peeling off. This is a serious disadvantage if the tag is used for security.
- The cost of RFID equipment and tags is high. While the equipment is a once-off cost, the tags are an ongoing expense.
- The system can be relatively easily compromised. The radio signals can be blocked by wrapping an item in two to three layers of aluminium foil. The signals from two tags can also be made to cancel each other out by placing two items against one another so that one tag overlays another (Boss 2004).
- Boss (2004) questions the range of exit sensors when RFID is used for security as the sensors must detect the tags at a distance considerably more than the range of the readers used for circulations and inventorying. He knows of no library which has actually tested the loss rate from RFID exit sensors.
- There is a perception that RFID is a threat to patron privacy (Boss 2004). This is addressed more fully below.

Emerging Trends

Looking into the future, some trends have been identified which are likely to continue:

The economic effects from commercial applications of RFID will benefit libraries. The more the uptake of the technology, the lower the costs will be. On the other hand, with the move to digital materials, RFID may become less relevant.

In time, libraries will move to a single tag incorporating item identification, security and possibly a library code to establish ownership and facilitate interlibrary lending.

Concerns over privacy issues will increase. Concerns about consumer privacy have already been raised in Australia by organisations such as Electronic Frontiers Australia and the Australian Privacy Foundation (Cadoo & Cadoo 2004), and overseas by Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN 2004) and Electronic Frontier Foundation (2003). The latter, a civil liberties organization, has forced the San Francisco Public Library Commission to address its concerns (SFPLC 2004). The perception of a threat to privacy is based on the broad commercial applications of RFID within supply chain industries and has been extrapolated to libraries with concerns being voiced about the ability to track a customer's movements and reading habits, or that information may be used to target the borrower in an unwanted marketing campaign. Authors such as Cadoo & Cadoo (2004), Chachra & MacPherson (2003) and Dorman (2003), counter these concerns by arguing that:

- without a reader or antenna, a tag is inactive and powerless;
- the majority of tags in library materials simply contain the item identification number, usually the barcode, and borrower and item information is not recorded on the tag. A patron's borrowing history is not maintained by the ILS and so the use of RFID is similar to that of the barcode in that the only borrower information available is that which is currently on loan; and
- Information stored in RFID tags can only be read from a very short distance (up to 30 cm.) as the tags must reflect the signal from the reader.

Automated materials handling systems will introduce significant time savings in shelving of library materials. This is a conveyor system that can sort library materials into separate bins according to classification numbers in preparation for shelving. In manufacturing and distribution centres, automated materials handling is used to move material to spaces on shelves and from one area to another. Not many libraries have introduced this application yet because of the high cost of the equipment. In North America there were forty such systems in use as of March 2004 (Boss 2004).

Conclusion

The Parliamentary Library has experienced productivity gains and other benefits since implementing a 3M RFID system for collection management. Purchasing RFID technology is a long-term commitment. It is not cheap to install but the Library expects to recoup the installation costs in approximately 3 years, and estimates that the per annum ongoing costs will be far less than the per annum staff costs of the manual system. What is important is to investigate the options available and ensure that the components of the system meet business requirements in terms of reliability, durability, ease-of-use, security and costs. Close liaison and consultation from your vendors is also essential. We were fortunate that this was possible with 3M and Sirsi.

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