This item was submitted to Loughborough's Institutional Repository (https://dspace.lboro.ac.uk/) by the author and is made available under the following Creative Commons Licence conditions.

For the full text of this licence, please go to:
http://creativecommons.org/licenses/by-nc-nd/2.5/

A case study into the implementation of RFID at the Pilkington Library, Loughborough University.

by

Matthew S. Cunningham, LLB

A Master's Dissertation, submitted in partial fulfilment of the requirements for the award of Master of Arts degree of Loughborough University.

September 2010

Supervisor: Ian Murray

Department of Information Science

Abstract

The aim of the study was to examine the implementation of RFID at the Pilkington Library. This was the first time the entire process had been examined, pulling together both qualitative and quantitative data.

The study examined internal Library statistics on issue figures, sick leave, staffing costs and enquiries. It also used pre-existing Library user survey data and an internal training survey. These were combined with interviews with Library staff to gain their impressions of the implementation process. All these data streams combined to create a longitudinal case study over a period of two years, so that an impression was gathered of RFID both in its infancy and as it matured.

The study concluded that implementation was an undoubted success: issue targets were exceeded within three months, staffing costs were reduced ahead of schedule and enquiries increased. The user survey proved popularity amongst users and staff interviews provided proof of positivity towards RFID.

It is important that major initiatives are assessed to evaluate success. Having done so, other libraries could use the success of Loughborough to support their own arguments for investment. It also makes it more likely that the Pilkington Library will gain further investment from the University as they can be seen to provide excellent value for money.

The study's main limitation is that it is based at one library. It would be worth examining the processes involved at other libraries to establish common themes or to assess whether the Pilkington Library's experience with RFID is an anomaly.

Acknowledgements

I would like to thank my family (especially my wife, who became a dissertation widow in the evenings & weekends) and work colleagues for their support and encouragement whilst writing this dissertation and my supervisor, Ian Murray, for his advice on submission and methodology.

Table of contents

List of figures and tables

List of abbreviations and acronyms

ATM   Automated teller machine

AV   Audio visual

CILIP   Chartered Institute of Library and Information Professionals (formerly the Library Association)

EM tag   Electromagnetic tag – a thin strip of metal which acts as a form of security in library books as it needs to be de-sensitised before issue to prevent activation of the alarm at the exit gate

ESPO   Eastern Shires Purchasing Organisation

FTE   Full Time Equivalent

JISC   Joint Information Systems Committee. JISC is an independent advisory body that works with further and higher education by providing strategic guidance, advice and opportunities to use ICT to support learning, teaching, research and administration

RSI   Repetitive strain injury a.k.a. WRULD

RFID   Radio frequency identification

LMS   Library Management System

OED   Oxford English Dictionary

PC   Personal computer

PDR   Performance and Development Review

SDR   Staff Development Review

SIP2   The second version of 3M's session initiation protocol, which allows communication between a LMS and self-service software

UK   United Kingdom

USA   United States of America

WRULD Work related upper limb disorder

Chapter 1

Introduction

1.1 About the Pilkington Library

This study explores the introduction of RFID self-service in the Pilkington Library at Loughborough University in 2008. The Pilkington Library is currently the only library on campus and opened in 1980. The building, which measures 7,777 m^2 (Loughborough University 2010a), is situated in the West Park side of the University campus and consists of three floors – the entrance level (confusingly titled Level 3), which contains the main group study area entitled Open^3 in which users are able to talk, use their mobile phones and eat/drink. Also situated on this level are the Library's café, the main enquiry desk in the Library and all the Library staff offices. There are two further floors going down from the entrance level entitled Levels 2 and 1, respectively, which are for the more traditional forms of library use – silent study spaces where no food or drink (apart from bottled water) are allowed.

Loughborough is a large campus-based university in the East Midlands area of the UK. The total student population in the year RFID went live was 16,834 (Loughborough University 2010b). Loughborough University is a member of the 1994 Group which emphasise that high quality research should be supported with high quality teaching and so the Library is expected to play its part in this aim. As a result of this, the Library has to balance expenditure on Library resources with the provision of study spaces: the Library currently has 900 study spaces, including 140 open access PCs, whilst still providing access to over 500,000 books; 90,000 bound serials and access to approximately 19,000 e- journals (Loughborough University 2010a).

A note on "self-service": for the purposes of this dissertation, the term "self-service" is used to describe the automated process of circulation transactions, previously carried out at the counter by a member of staff i.e. issuing/returning books, renewals and payment of fines.

1.1.1 Self-service pre-RFID

In 2002, the Library had invested in three 3M 6210 machines - a style of machine that read barcodes in the books to issue them to a user. The machines were only used to issue books, not to return them and did not have any method of accepting payments for fines.

Figure 1 6210 self-service machines

The machines were not the most user friendly piece of equipment, however, and as a result both Library staff and users had become increasingly resistant to using them due to bad experiences: items either being unable to be issued or having been incorrectly issued and setting the alarm barrier off, leading to embarrassment after being called back to the counter.

The initial problem came with activating the machine – the University encodes student/staff identification onto a magnetic strip on the back of their student/staff cards. The 6210 machines had to be specially adapted by 3M to accept this form of activation with the introduction of a slot for the card to be inserted into, in the same way an ATM machine is activated. However, the University also registered students at the start of each academic year by placing a different coloured sticker on the rear

of the card. Whilst students were normally able to use the machines in their first year, once they started their second or third year, the sticker for that new academic year was invariably placed onto the previous year's sticker, meaning cards either would not fit into the slot on the self-service machines to start off with or would jam inside the machine, causing the slot to become unusable unless thoroughly cleaned – causing a lot of potential downtime for the machines.

As can be seen from Figure 1 above, the machines also relied on stock being placed in a certain way on the issuing platform to ensure it was issued correctly. The book needed to have the barcode placed at the bottom middle of the first page of the book, so that the laser reader of the machine scanned the barcode at the same place on every transaction. The spine of the book containing the EM tag also had to be flush to the rear of the machine so that the magnetic pulse correctly desensitised the tag, so that the tag did not set off the barrier alarm.

In practice, however, the barcode was often not in the correct position in the book – no effort had been made to re-barcode older stock when the self-service machines were purchased - so a user would need to know how the system worked to ensure all the books were issued correctly and, even then, could be frustrated in their desire to use the self-service option if the books they wanted to borrow were incorrectly bar-coded.

The final problem was that AV materials could not be issued on the self-service machines due to the magnetic pulse to deactivate the EM tag leading to content being wiped from the material. At a time when a lot of short loan stock was in the form of video, this limitation hindered any successful self-service solution.

As a result of the lack of success with self-service in the Library, a group of Library staff was established to look at the possibility of tendering for an RFID solution to the self-service problem. This group looked at three possible options:

- **Improve self-service facilities using RFID**

Implementing RFID would require a significant capital outlay to migrate the existing Library stock from barcodes/EM tattles across to RFID tags and for equipment. This cost would be offset by annual staff savings due to both increased use of self-service facilities and efficiency gains in circulation.

This option outlined how RFID would benefit the Library by providing simple and rapid self-service loan, renewal and return of Library stock, together with self-service payment of fines. It also outlined how beneficial it could be in improving the range of self-service facilities available to users throughout the Library's opening hours.

It also outlined the reduction in RSI problems at the counters and how all the other East Midland universities had implemented RFID self-service solutions.

- **Maintaining existing barcode/EM self-service facilities**

The second option was to simply replace the existing units with newer models. This would allow the Library to maintain a status quo with regard to self-service (issue and renewal only) although this still required capital investment in equipment.

- **Discontinuing self-service**

The third option was providing no capital funding for upgrading to RFID or replacing the existing units resulting in additional recurrent staffing costs to cater for the additional transactions that would need to be carried out by Library staff.

The report concluded that over the course of five years, the most financially viable option would be to pursue RFID implementation.
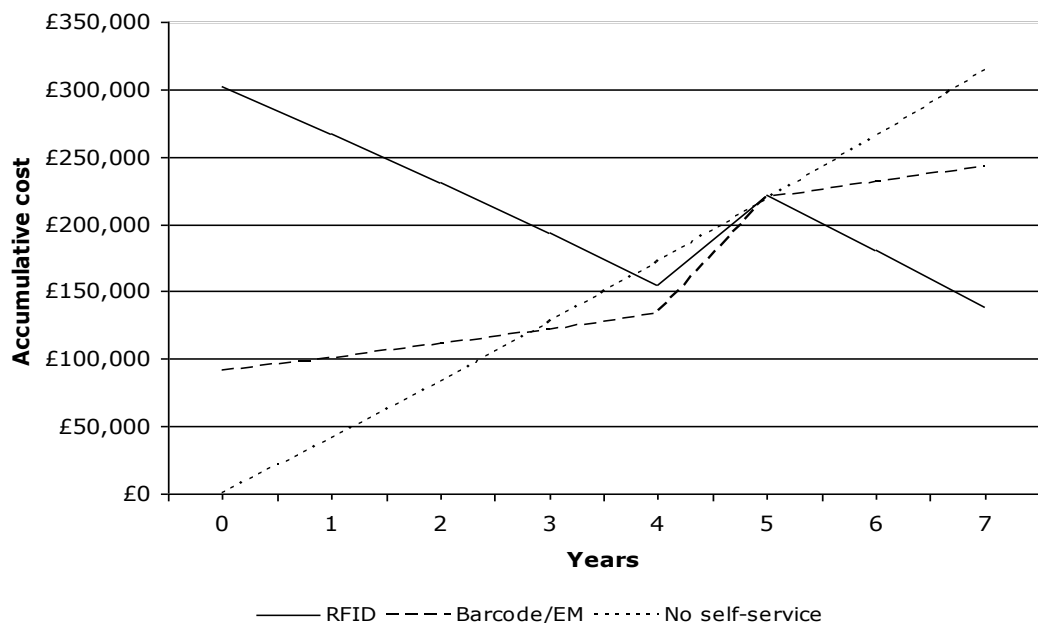
Figure 2: Cost analysis of three options (Brewerton 2007)

4

The University's Operations Committee agreed with the recommendations of the report and funding was granted to implement RFID on 1st October 2007.

1.1.2 Self-service post-RFID

After a period of consultation and tendering, the Library finally went live with its RFID self-service provision in September 2008.The company chosen to provide the solution was Intellident Ltd, one of the leading companies in Europe in dealing with RFID installations who supply over 500 UK, French and Dutch university and public libraries (Intellident 2010 (a)).

The Library purchased five smartServe™ self-service units. It was decided to spread these units out across all three floors of the Library: one was situated on each of the lower floors, two on the entrance level and the fifth one in the short loan collection. All the machines had exactly the same functionality: being able to issue, return and renew books, allow the user access to their account to see the status of hold requests/outstanding loans/fines on the user's account and to pay fines using coins.

Figure 3: Self-service machine on Level 3

The previous problems self-service had faced in the Library were addressed by the new self-service options: books no longer had to be placed in a certain way on the machine to issue/return them – they only needed to be placed within the issuing aperture (the blue lit box on the self-service machine in the picture above). There was also a swipe mechanism for the self-service machines to activate rather than the need for a slot – thereby negating the problem of the registration stickers which had been a problem for the old machines.

AV materials could also be issued under the new system as the security on the RFID tags was applied/removed with radio frequency rather than a magnetic burst, leading to an opening up of self-service throughout the Library's stock, not just the book stock.

1.2 Structure of the dissertation

This dissertation is split into six chapters. Chapter One introduces the reader to the site of the case study – the Pilkington Library – and outlines the aim of the dissertation.

Chapter Two gives a potted history of the development of RFID from its very early applications in World War II, to more recent Library applications in self-service and security of book stock. Chapter Two also outlines how RFID actually works and concludes by discussing some of the problems opponents of RFID suggest such as problems with privacy and lack of universal standards.

Chapter Three is a literature review of self-service and RFID developments within the library community. It outlines the first cases of self-service in the UK in both public and academic libraries and goes on to describe the adoption of RFID technology in both the USA and the UK. It also discusses a study on self-service provision: the SELF Project before focussing in on the impact RFID has on both staff and users. It concludes by discussing the state of the UK market today as a result of a survey commissioned by the JISC LIB-RFID – the JISC list set up primarily for UK libraries to share experiences and ask questions about the technology - to try and gain a better picture of the current status of RFID in the UK library market.

Chapter Four discusses the methodology used in this dissertation – a longitudinal case study of RFID adoption at the Pilkington Library at Loughborough University, the time frame used and the methods used to gain evidence both quantitative and qualitative.

Chapter Five discusses the detailed findings of the case study and the proof they provide as to the success of the overall implementation. These results have both quantitative results from data gathered over the two year period of the case study and also discuss the qualitative results of interviews with customer service staff to gather their opinions on the process.

Chapter Six discusses the aims and limitations of the dissertation itself and also makes recommendations on how the process of RFID implementation could be improved.

1.3 Aim of dissertation

The aim of this dissertation is:

- To analyse the results of RFID implementation in the Pilkington Library to enable an assessment of its overall successes and how this could be improved upon for anyone undertaking similar processes.

To help achieve this, the dissertation contains chapters on:

- the concept of RFID and why it is beneficial to library services

- a literature review on self-service in libraries and how this has been expanded by the recent introduction of RFID

- A discussion on longitudinal case study methodology and how it can be applied to the RFID process at Loughborough

1.4 The approach

The case study approach was considered to be the best one available to the author due to his position within the organisation – initially as Circulation Manager and subsequently as Customer Services Manager of the Pilkington Library. He was able to gain insight into the reasoning for and processes of implementation and had a readymade pool of staff to interview to gain their opinions on the process and result

of implementation over the two years of the case study. The methodology will be discussed further in Chapter Four.

Chapter 2

What is RFID?

2.1 What is RFID?

The OED defines RFID as:

> *"radio-frequency identification, a method for tracking objects, animals, etc., by means of an attached or embedded device which transmits a radio signal."*

2.2 The history of RFID

The origins of RFID can be traced back as early as World War II where a crude version was developed by the British armed forces entitled "Identification of Friend or Foe system". In this system, radar pulses from the ground drove the transponder in the plane to reply to coded messages and identify themselves as a friendly aircraft (Ollivier 1995).

It was not until 1973, however, that Mario W. Carullo received a patent (US Patent 3,713,148) for his passive read and write tag (Palmer 2009). It is the development of this format, which combined existing technology such as the detector systems and chips with a memory into a small, portable tag that enabled later tags to be used in a variety of roles:

- Electronic toll payment systems such as Exxon Mobile's Speedpass (Speckman and Sweeney2006). The benefit of RFID in this situation is that it comes without the risk of human interaction such as scanning individual barcodes. There is also less chance of an RFID tag becoming lost or damaged as they are an integral part of the system/package. This also means that there is no need for line of sight scanning, so that individual packages do not have to be moved to a certain viewpoint to be scanned and it also allows for several items to be read simultaneously.

- Supply chain management: Ford uses RFID to manage its parts replenishment system in its factories and dealerships and to track the location of its vehicles in the distribution network (Katz 2006)

- Retail supply chain: one of the earliest big adopters for RFID tagging in its retail supply chain was Wal-Mart (this is also one of the reasons for the drop in prices for RFID tags as the wholesale price of tags drop when massive orders are placed by multi-national companies). Working in conjunction with firms such as Procter and Gamble, Wal-Mart established that by having replenishment systems in place could lead to massive growth in profits due to a reduction of out of stock products. Sliwa (2003) states that the benefit to Proctor and gamble alone could be in the region of $400 million if they could reduce their out of stock products by 2%.

- Leisure activities: Palmer (2009) describes a list of activities that currently use RFID technology without the user being conscious of it intruding in the experience. E.g. Alton Towers use an RFID wristband which is linked to cameras around the park to enable a personal movie to be created for each customer; football clubs in the UK such as Manchester City and Fulham have introduced RFID tickets to reduce queues (McCue 2006).

- Travel cards: Palmer (2009) outlines how the successful implementation of the Oyster card in London has meant that the routine and tedious task in purchasing tickets has been replaced by a smart card, thereby making the element of the commuting process more convenient and easier to use.

- Tagging animals/humans: Palmer (2009) suggests that it is increasingly common for animals to be tagged either for simply distribution reasons or for identification whilst lost. However, Kravets (2008) describes how a group of Amish farmers are challenging US rules regarding tagging of livestock as the devices used are a "mark of the beast" and quote a passage from the Book of Revelation in support of this:

  "He causes all, both small and great, rich and poor, free and slave, to receive a mark on their right hand or on their foreheads, and that no one may buy or sell except one who has the mark or

the name of the beast, or the number of his name." Revelation 13: 16-17."

Whilst the tagging of a human being is currently not a common occurrence (other than in the case the tagging of a criminal as part of a non-custodial sentence using a secure band round their ankle), extreme forms of RFID use can be found in cases such as Amal Graafstra (http://www.amal.net/rfid.html), who has embedded RFID chips into both his hands, allowing him to unlock doors without keys and log onto his computer

2.3 How does RFID work?

Yu (2007) describes the three components of an RFID system as developed by Kern (2004):

1. The RFID tag (or transponder): this is normally found in the format of a paper thin, flexible smart label (although this form can be adapted for use inside animals in the shape of a pellet). This tag contains an etched antenna and a tiny chip that can be both readable and writable. On this tag, information is embedded that can be read and transmitted. In a library for example, the tag will normally contain the individual barcode of the book. It could also, although this is now becoming less common, contain bibliographic information, call numbers and circulation loan status. The reason the barcode "licence plate" method is becoming the norm is because a barcode does not normally need to be reprogrammed, whereas if you add call numbers etc and they subsequently change, you would have to reprogram each tag, which is a time consuming, labour intensive activity.

   There are two types of tags: active and passive. Passive tags have no internal power source and so have a longer life, but rely on an external power source to supply data and so can transmit only over short distances. Active tags contain their own battery and, therefore, have a shorter lifespan, albeit with a greater capacity to transmit over larger distances.

2. The RFID reader (or interrogator): this is the link between RFID tags and the application system. The reader finds the information contained on the individual tag and sends this information to the application system. It is composed of a radio frequency module and antenna to interrogate the tag. It is the reader which usually provides the power source for the tags and which creates the radio frequency via which information is transferred. This radio frequency can be of various strengths:

- Low (up to 148 kHz): mainly used for access control and animal identification. It can be accessed up to 10cm away and is suitable for hostile environments, which can make it an expensive option. It offers a high penetration level around liquids and metals.

- High frequency (13.5 MHz): the most common form of tag used in libraries utilises this frequency due to its relative low cost. It can be read up to 1m away and has a medium penetration of liquids, but does not work well with metal.

- Ultra high frequency (433MHz and beyond): originally solely used in the supply chain management aspect of RFID, this frequency works well around metals but is not compatible with liquids (hence leading to problems of tags being shielded when simply being held by humans). It has a range of up to 100m if using an active tag or up to 10m if not.

- Microwave (2.45 GHz): mainly used in wi-fi and Bluetooth applications.

3. Application system (which is used for the reader to transport or receive data from a tag). Each RFID unit is normally some form of PC which communicates to other software. In the case of libraries, the RFID application is the link between the RFID system and the LMS. The RFID system does not actually know anything about the user who wants to borrow books or the status/loan period of the book(s) they want to borrow. It is up to the application system to feed back to the LMS the details on the tag and the user and then it is informed by the LMS how long the user can borrow the book

for or if their account is blocked. It communicates to the LMS via the SIP2 protocol (session initiation protocol) (3M Library Systems 2006), which was developed by 3M:

> *"to enable its own barcode-based self-service products to work with any LMS, but has subsequently become the means by which many other third-party products – manufactured by a great variety of companies – interoperate with an LMS"* (Palmer 2009).

2.4 How RFID has developed in Libraries

This will be developed further in Chapter Three's literature review. However, in brief, there are three main reasons for adopting RFID technology:

2.41 Self-service

The single largest application developed for library use has been in the area of self-service. Pre-existing barcode system suppliers such as 3M have adapted their self-service solutions to adopt RFID technology. It has also allowed new entrants into the market, such as Intellident, who have no previous library experience to become major players by developing systems from scratch that make use of RFID technology.

2.42 Security

Depending on which system is utilised, it is possible for the RFID tag to act as security on a book as well as the method of issue/return. This has the cost advantage of negating the need for a second electromagnetic (EM) tag, but will mean that there is a potential for breaches in security as the tag is much more visible than the EM tags usually placed inside the spine of the book. Tags can be peeled out of the book or be blocked by the use of tin-foil. Efforts can be made to disguise the tag by printing book plates to cover the tag. This, however, increases the largest cost in implementation of an already expensive element of the system.

2.43 Stock taking

Due to the large number of items contained in libraries, stock taking at most institutions is a rare occurrence. The development of RFID means that stock taking is much more likely as the use of hand held readers enables the scanning of RFID tags

within books whilst they remain on the shelves. These readings are then cross-referenced with what stock should be on the shelves according to the LMS to allow for swifter reordering/locating of missing stock.

2.5 Concerns about RFID

RFID is not without its detractors. Two common problems identified are the possibility of invasion of privacy and the lack of universal standards leading to a fear of interoperability.

2.51 Privacy

Muir (2007) outlines a number of fears (seemingly from the USA – attempts at gaining a European perspective did not bring up similar concerns – European Commission 2005; Commission of the European Communities 2007) with regards to RFID implementation in libraries. He outlines a scenario where agents (of governments or other organisations) could create a scanner which reads the contents of the RFID tag in a book. This would mean that it could be possible to ascertain what material a user has selected for their own use without them being aware of this fact. He cites previous attempts by the FBI to gain access to library accounts in the USA and the development of the Patriot Act to allow more government access to personal information.

This is echoed in Palmer (2009) who uses the CASPIAN (Consumers against supermarket privacy invasion and numbering) group and the Electronic Frontier Foundation (EFF) as organisations that are mobilising against the use of RFID tagging in both the retail and library sectors not just for the possible misuse of information at the moment, but for what could possibly be developed in the future.

Palmer also describes two further developments in the debate on privacy: "hotlisting" and "tracking". Hotlisting involves the development of a list of books and their tag numbers which are then used to determine who has borrowed them via hacking into the LMS. Tracking uses multiple sensors to track the movement of an item to show who may have come into contact with material.

It should be noted, however, that both these activities rely on hacking into the LMS, which could have been done without the presence of RFID tagged items. However,

the presence of RFID tags would certainly make the process easier for individuals to gain access to personal information if they were determined to do so.

As a response to the concerns about privacy, the American Library Association endorsed the guidelines for dealing with RFID tags in books created by Book Industry Study Group (2004):

> *"All businesses, organizations, libraries, educational institutions and non-profits that buy, sell, loan, or otherwise make available books and other content to the public utilizing RFID technologies shall:*
>
> *Implement and enforce an up-to-date organizational privacy policy that gives notice and full disclosure as to the use, terms of use, and any change in the terms of use for data collected via new technologies and processes, including RFID.*
>
> *Ensure that no personal information is recorded on RFID tags which, however, may contain a variety of transactional data.*
>
> *Protect data by reasonable security safeguards against interpretation by any unauthorized third party.*
>
> *Comply with relevant federal, state, and local laws as well as industry best practices and policies.*
>
> *Ensure that the four principles outlined above must be verifiable by an independent audit."*

As can be seen from these discussions, privacy is an issue that is clearly important to at least some of the potential users of RFID technology. Whilst in the UK public opinion does not seem to be as motivated, it is still necessary to carefully consider whether the usefulness of a technology such as RFID outweighs the drawbacks. At the very least, library managers should ensure that the amount of information placed on tags should be kept to the minimum to reduce the risk of invasion of privacy.

2.52 Lack of universal standards and interoperability

Until January 2010 there was no single UK data model. For years, observers had expressed concerns that as each RFID supplier was potentially using their own model for transferring data, there was no possibility for libraries to pick and choose which parts of the systems these companies developed they could purchase, instead

being tied to a single supplier for all aspects of the solution: tags, self-service machines, security barriers and digital library assistants.

However, the adoption of ISO 28560-2 means that this will all change. All major UK RFID suppliers have agreed to meet this data model and to enable their existing clients to migrate over to it, if not already compatible. Will this really be a big change?

Yes – as stated above, purchases of RFID solutions will no longer be tied to a single provider, so that purchasers can choose which parts of different suppliers' products give the best results. It also means that purchasing frameworks such as Catalist and ESPO will have to be changed as they are based on the old model of dealing with a single supplier. New purchasing strategies give greater scope for pooling resources and getting local consortiums together to drive down prices through economies of scale and bulk orders.

There is also the potential for a national inter library loan scheme for public libraries where individual items can be identified throughout the process.

Chapter 3

Literature review on self-service and RFID in libraries

For a profession that is traditionally seen as old fashioned and traditional to the general public and in popular culture (the image of an elderly lady with glasses on a chain in a cardigan telling people to be quiet), libraries are actually one of the more dynamic organisations in the way they are constantly evolving the way they deliver their stock and services. If you look back in time, the biggest culture change in library life came with the concept of self-service. Up until the turn of the 20th century, most libraries' collections could only be accessed by request and stock would be brought to the user from the stacks by library staff. Since then, however, the opening up of library stock to users has meant that the way staff interact with users has changed and much of their role has developed into user education about how to locate and use library stock, even more so with the recent development of e-journals and databases in the academic world.

3.1 The beginnings of self-service in the UK

It is no surprise, therefore, that libraries saw the benefits of self-service to both staff and users. The first documented case of self-service in the UK was by Shropshire Public Libraries (Williams 1990). This was a small pilot scheme due to the lack of funding and suppliers available at the time. One of the smaller public libraries was fitted with a self-service system where users were able to issue their own books at terminals using a scanner. This project allowed Williams to identify the major obstacles faced by self-service:

- payment of fines/fees

- self-service of AV materials

- users with special needs e.g. users with some form of disability

- damaged stock

The first pioneer in academic libraries in the UK was Bradford University in 1992 (Ketley 1993). They were joined the following year by the University of Sunderland (Stafford 1997). Janet Stafford (the systems manager at the time of the changeover to self-service) outlined four key factors for the success of self-service implementation:

- **Preparation:** thought to be given before implementation to the position and quality of the barcode used, user and staff training and support given to Library staff – Sunderland had to re-barcode their entire book stock to enable self-service to succeed

- **Position:** there are two schools of thought about the position of self-service machines. One believes that they should be located near to the book stock to allow easy access to users who want to borrow library materials. The other school believes that the machines should be sited near the staffed counters so that they are visible to staff on the counters (Gollin 2003 states that 94% of libraries surveyed locate their self-service machines close to their counter). Whichever position is chosen, "visibility and convenience of the units is very important in order to maintain maximum usage" (Morris, Thornley and Snudden 2001).

- **Publicity:** the use of the equipment must be encouraged and promoted from the implementation date onwards

- **Persuasion:** users should be persuaded that using self check is a good idea.

Shipp (1997) added an additional five key success factors to this list:

- Ensure the equipment is reliable before full scale implementation – this may lead to the long term survival of fewer companies dealing with self-service systems as libraries would be less likely to experiment on new ventures without a significant track record in success

- Ensure users have the necessary operating skills or knowledge

- Ensure help is readily available either from staff members or is provided intuitively by the system – if a system is not intuitive, staff must be available

from the launch of the self-service system to show users how to use it. Once this initial launch effort is made, it becomes self perpetuating and users will often educate each other on the procedures involved.

- Ensure self-service replaces rather than augments staff mediated service - having invested significant funds to enhance self-service provision, libraries will want to ensure the technology is used rather than rely on traditional counter service (although they will not want to completely remove the human element in case of queries on accounts that cannot be dealt with without referring to the LMS e.g. fines/blocks).

- Ensure the capability of the users to adopt is not underestimated – the last thing a library would want, having persuaded their users to use the system is for it to not have the capacity to perform successfully by having to few machines/tags to cope with demand, leading them to rely on the counter service instead.

3.2 The SELF Project

The biggest study on self-service in libraries in the late 1990s was a yearlong study funded by the European Commission starting in February 1995: SELF. The provision of self-service facilities for library users (Brophy 1997). This study was undertaken by the Centre for Research in Library and Information Management whose aim was to "examine the scope of self-service in libraries and to investigate the technical aspect of these systems" using the University of Central Lancashire and the National Library for Psychology and Education at Stockholm as their case studies. User and staff surveys were completed to establish the impacts of the new systems and further investigation was made of the functional specifications required to achieve successful self-service implementation.

The report concluded:

- The supplier market is too small. More companies need to become involved to increase competition amongst suppliers of self-service solutions in order to drive down costs, thereby making it a viable option for smaller libraries to consider implementation of self-service.

- The security aspects of self-service needs to be enhanced by suppliers e.g. by the use of smart cards

- International standards should be developed for self-service systems to ensure integration with existing LMS is improved

- There should be an improvement in privacy so that borrower details cannot be seen by other queuing clients

- There is a need to improve the design of systems (possibly mirroring ATMs in banking) to encourage use by exploiting public awareness of these self-service technologies – e.g. users commented that they were used to inserting their bank cards into ATM machines using their magnetic swipes in the slots and were now being asked to use a barcode on a card facing a particular way to activate their machines

- Staff issues need to be taken into account when implementing systems by emphasising the new opportunities that can arise as a result of a successful self-service implementation

3.3 Reasons for implementation

Librarians looking for reasons to implement self-service have lots of evidence to back up their case:

- Morris (2001) described how queues created by the increase of student numbers at university libraries are reduced with the successful implementation of self-service systems. This is backed up by Smart (2004) p 14 who states that productivity is increased by 85%

- It allows for redeployment of staff from routine circulation roles to customer facing enquiry roles - 22% of library staff had changed their role after self-service implementation according to Gollin (2003).

- Gollin (2003) added that 47% of libraries surveyed have used self-service to extend their opening hours without additional labour costs.

- Costs to the library will be reduced in the long term (once the initial capital investment is paid for). One supplier even provides a self calculation tool for prospective clients to calculate this (Intellident 2010(b)).

- It is a means of maintaining competitiveness in the library sector: Daniels and Wright state that libraries that have self-service consider themselves to be forward thinking, Morris, Thornley and Snudden (2001) discusses the concept of "flagship" installations and Gollin (2003) backs these theories by finding that 54% of libraries say that the reason they install such systems is to improve their image.

- Morris and Dyer (1998) outlined the reduction of repetitive strain injury as a benefit to self-service implementation. Whilst individual books may not be too heavy to handle, staff who are solely employed for counter work in libraries were increasingly suffering from RSI (also known as "work related upper limb disorder" – WRULD).

3.4 Impact on staff

Ketley (1993) suggested that the long term impact of self-service is a reduction in library staff. Whilst it is true that one of the benefits of self-service is that staff costs can be reduced, that is not always necessarily the case. Self-service still needs staff support e.g. assisting users, changing receipt rolls and dealing with blocks/queries (Becker 1997)

McDonald (1997) suggested libraries should look at the responsibilities given to library assistants who were just there to perform circulation roles, although recognises that fear of change in relation to job description can lead to anxiety amongst both staff whose jobs were being changed and amongst professional librarians, who could see their position being under threat as well. McDonald also recognised that many library staff work in circulation because of the way they get to deal with customers – if staff interaction is depersonalised due to self-service, would this mean an increased level of unhappiness?

Sykes (1991) stated that staff can deal with more interesting work, but that managers should be careful not to replace dull work with equally dull work. Morris, Thornley

and Snudden (2001) agreed and said managers should ensure full training is given to staff to enable them to complete their work fully.

Ketley (1993) also warned that libraries that implement self-service, should be wary of technophobia amongst its staff and users, although recognises that this is much less likely when dealing with academic environments.

3.5 Impact on users

Both Stafford (1997) and Morris, Thornley and Snudden (2001) warn about the possibility of dehumanisation. User feedback from Shipp (1997), on the other hand, stated that users in Australia have not found it a problem to have counter services removed completely and be replaced with self-service units.

All authors agree on one thing – there needs to be an element of user education. Stafford (1997) stated that the first time an individual uses a self-service terminal decides whether they will use it again in future. Cookman (1997) described how problems at Maidenhead Library after the introduction of self-service lead to a decline in overall use which was only rectified after the production of posters, flyers, leaflets and a video selling the benefits of the system to its users and showing them how easy it was to use.

3.6 The beginnings of RFID

If self-service was progressing well, why did anyone decide to implement RFID?

Snelling (2005) found that most libraries using barcode based systems achieved self-service levels below 10% of total issues, with self-return not utilised at all. As stated previously by Morris, Thornley and Snudden (2001) for barcode self-service to work effectively, the barcodes need to be in a standard position in the each book – hence Sunderland having to re-barcode all their stock.

The other major problem faced by self-service pre-RFID was what to do with videos and DVDs. As the self-service equipment in use at the time was based around a magnetic pulse to sensitise/desensitise the EM tag, it was not possible to issue AV material on self-service units as it wiped their content when being processed.

These problems were overcome by the use of RFID technology because it was not a line of sight technology (Bansode and Desale 2009) – the tag could be situated

anywhere in the book and could be picked up by the readers – which used radio waves instead of magnetic pulses, thereby making the process available for all stock and the systems involved much more user friendly.

Palmer (2009, p.15-17) outlined the early stages of RFID adoption. Despite discussion of RFID being a viable solution as early as the 1980s, the first documented case of library books being tagged with RFID technology was in 1991 at the University of Guelph in Canada.

However, it is not clear that these tags were used for self-service at the time, so it is claimed that two projects in the late 1990s changed the library world's view of this new technology.

In September 1998, Bukit Batok in Singapore went live with their RFID service. This was a public library based in a shopping mall with a stock of approximately 200,000 items and 28,000 members. The success of the newly installed RFID system meant a reduction in the queuing time from 90 minutes to 15 minutes and an ability to cope with a continual increase in transactions without having to increase staffing levels. It was so successful that RFID was rolled out to all 212 libraries in the authority by April 2002.

At roughly the same time as Bukit Batok was installing RFID, Rockefeller University Library in Manhattan (a library serving mainly PhD students with approximately 500,000 items of stock) was experimenting with their own version of RFID for self-service, security and stock control. This went live in February 1999 and led their supplier Checkpoint (2000) to claim:

"The Intelligent Library System ™ has delivered on all its promises, according to University Librarian Pat Mackey who attests that the system's technology has been exceedingly reliable".

One of the earliest major adopters was the University of Nevada, Las Vegas, who were the beta testers for 3M's Library Systems Digital Identification System (Fabbi 2002). The process took a total of three years from testing to full implementation, but laid the groundwork for full roll out of the new system in the university's state of the art Lied Library which had over one million tagged items.

Despite these successes, Richard W. Boss (2001) contrasted the small number of library installations (50 worldwide) with an approximate 500,000 warehouse and retail installations. Reasons for this were the high costs of tags and the lack of any standard approach to the use of the technology in libraries. Even libraries that had used RFID were relatively small, due to the costs involved.

In 2005, Birgit Lindl of Bibliotheca (Palmer 2009) estimated that the number of libraries using RFID had increased to over 300 worldwide with approximately 120 million tagged items. This increase in demand was one reason why Laura Smart (Smart 2004) was able to identify 10 suppliers of integrated systems in the US alone.

Smart then estimated the cost of installing a RFID system containing one self-issue unit, one self-return unit, one entrance gate and 200,000 tags. The estimates ranged from the lowest of $100,000-130,000 to the most expensive at $175,000-275,000 (the average figure being $150,000). When you consider that when Bukit Batok and Rockefeller went live, the average cost of RFID tags was $1, it is clear there had been a considerable drop in the cost of the most expensive cost of conversion to RFID – the tag.

This is also seen in the UK where one early adopter, the University of Central Lancashire found:

"We first began our exploration in the late 1990s, during the design stages for our Penrith campus...tags were £1 each...by the end of 2006   the cost of tags had dropped from £1 to about 25p" (Mossop 2008).

3.7 RFID Survey 2010

In December 2009, Mick Fortune, a UK RFID expert, was asked to complete his second annual survey of UK RFID use by JISC (Fortune 2010). The survey ran for four weeks, ending on January 15th 2010. This survey was longer than his survey of the previous years and so this needs to be taken into account when looking at the results.

3.7.1 Institutions planning/already using RFID

"The 259 responses received represented 193 different organisations, 116 of which have already deployed RFID to some extent. By comparison the 2009 survey attracted responses from only 51 libraries, of which 28 were using RFID, mostly for self-service"

This is a massive increase in both responses and, accordingly, with the number of institutions that have opted for RFID up to the end of 2009 (up 414% year on year), with the majority of both existing installations and those planning to develop RFID based in England (Figure 4).

It is interesting to note, however, that the number of public libraries using RFID is greater than that of academic libraries (Fig 5) albeit that the number of fully completed installations (seven out of a total of $63 - 11\%$) is far less than the number of completed installations in academic libraries (21 out of a total of $47 - 45\%$).

There is an expectation amongst both academic and public libraries that they will expand their use of RFID over the next two years (Figs 7and 8), which if successful, will mean that public libraries will soon catch up with their academic counterparts. This figure is subject to the financial pressures facing both public and academic libraries over the next two years. With the Government seeking to make cuts of up to 40% of departmental budgets at the time of writing, it remains to be seen if these major capital investments will be a victim of cost-cutting and it will be interesting to see whether these figures remain stable in the survey at the end of 2010 when councils and universities will have a better idea of the savings they will have to make.

	Using	Planning	Total
England	102	44	146
Scotland	9	7	16
Wales	5	3	8
All	**116**	**54**	**170**

Figure 4: Total institutions using/planning RFID (Fortune 2010)

	Using	Planning	Total
Public	63	25	88
University	47	21	68
College	5	6	11
Other	1	2	3
All	**116**	**54**	**170**

Figure 5: Different types of RFID user (Fortune 2010)

	Fully	<10%	10-25%	25-50%	50-75%	>75%	DNA	Total
Public	7	2	14	8	7	4	0	63
University	21	5	4	7	4	4	2	47
College	3	0	0	0	2	0	0	5
Other	0	0	0	0	0	0	1	1
All	**31**	**28**	**18**	**15**	**13**	**8**	**3**	**116**

Figure 6: Percentage of completed installations in 2009 (Fortune 2010)

	<10%	10-25%	25-50%	50-75%	>75%	DNA	Total
Public	7	12	14	10	12	1	56
University	6	3	5	3	5	4	26
College	0	0	0	1	1	0	2
Other	0	0	0	0	0	1	1
All	**13**	**15**	**19**	**14**	**18**	**6**	**85**

Figure 7: Percentage of installations to be completed in 2010 (Fortune 2010)

	2010	2011	after 2011	Total
Public	12	4	9	25
University	9	5	7	21
College	1	1	4	6
Other	0	2	0	2
All	**22**	**12**	**20**	**54**

Figure 8: Planned future date of deployment of RFID (Fortune 2010)

3.7.2 Use of RFID systems

Rank order 2008	Rank order 2009		2CQR	3M	Axiell	Bibliotheca	D Tech	Intellident	Intrepid	Plescon	Telepen	Unknown	All
1	1	S/S loans	5	35	2	1	7	50	1		3	8	112
1	2	S/S Returns (no sorter)	5	27	2	1	6	47	1		2	7	98
3	3	S/S Renewals	2	25	2	1	7	46	0		2	7	92
8	4	Cash Payment	0	16	1	1	3	39	0	0	0	3	63
4	5	Borrower a/c management	1	10	1	0	4	37	0	0	0	6	59
6	6	Finding Lost Items	1	24	0	0	2	14	1	1	0	2	45
4	7	Taking Inventory	0	12	0	0	3	13	1	1	1	2	33
7	8	Automated Returns Sorting	3	6	0	0	1	9	0	0	2	1	22
11	9	Automated Book Drop	1	2	0	0	1	7	0	0	1	2	14
9	10	Smart Card	1	3	1	0	1	3	0	0	1	1	11
9	11	Credit/Debit Card Payment	1	2	0	0	0	3	0	0	0	3	9
12	12	Smart Shelves	0	2	0	0	0	0	0	1	0	0	3
		Total Users	7	36	2	1	7	50	1	1	5	10	120

Figure 9: Patterns of use (Fortune 2010)

Figure 9 (above) outlines the reasons for using RFID amongst the respondents in 2008 and 2009. Self-service (loans, returns and renewals) remains the top three reasons for implementation of RFID in both years. This is followed by cash payments, which has risen four places from 8th to 4th on the list and then stock management (finding lost items 6th, taking inventory 7th and automated returns sorting/automated book drop in 8th and 9th respectively. The more experimental aspects of RFID use such as smart cards and smart shelves remain towards the bottom of the list- in 10th and 12th place in 2009.

At the time of writing, there are two clear frontrunners in the UK market: Intellident and 3M. The survey doesn't provide reasons for choosing either of these two systems, but it is clear that they offer the widest number of applications to the largest numbers of respondents. One possible reason for this is the lack of a UK data standard at the time of purchase – libraries buying RFID were forced to purchase the whole range of applications from one supplier in order to guarantee the applications would work together. It will be interesting to see if the adoption of a single standard has an effect on the UK market over the next few years as it seems to have done in Europe, so that a much wider range of companies can sell competing products that

are interchangeable with a single operating standard instead of having proprietary controls.

3.7.3 Attitudes towards RFID

Users					
	SA	A	D	SD	DNA
Only for Self-service	0%	5%	57%	23%	15%
Book security is poor	2%	19%	50%	2%	27%
CD/DVD security is poor	11%	35%	33%	4%	17%
Privacy is an issue	0%	5%	64%	14%	17%
Standards are unimportant	0%	5%	45%	33%	17%
No plans to use the UK data model	0%	5%	52%	18%	26%
Planners					
	SA	A	D	SD	DNA
Only for Self-service	0%	2%	62%	22%	15%
Book security is poor	2%	11%	68%	5%	15%
CD/DVD security is poor	5%	37%	40%	3%	15%
Privacy is an issue	0%	11%	69%	3%	17%
Standards are unimportant	5%	3%	42%	34%	17%
No plans to use the UK data model	2%	0%	46%	32%	20%

Key:

SA Strongly agree, **A** Agree, **D** Disagree, **SD** Strongly disagree, **DNA** Did not answer

Figure 10: Attitudes towards RFID (Fortune 2010)

Figure 10 (above) shows that UK adopters of RFID strongly feel that RFID should not just be for self-service (only 5%). This is even more strongly felt in those who are planning to purchase RFID, where only 2% say RFID will only be used for self-service.

There are some concerns over the security of book stock (21% agree/strongly agree) and significant numbers (46%) agree/strongly agree that the security of CDs/DVDs is poor. Interestingly, in the UK at least, privacy does not seem to be an issue, with only 5% agreeing that privacy is an issue with RFID.

It also seems as if the development of a standard and UK data model are important to users, with 78% disagreeing with the statement that standards are unimportant and 70% disagreeing/strongly disagreeing with the statement they have no intention of using the UK data model.

3.7.4 Reasons for adopting of RFID

Users	1	2	3	4	5	DNA
Reduce staff costs	17%	19%	17%	14%	16%	18%
Introduce Self-service	5%	4%	7%	19%	50%	14%
Improve stock control	6%	15%	16%	26%	20%	18%
Improve security	20%	23%	22%	11%	5%	19%
Other libraries using it	21%	23%	24%	8%	1%	22%
Non Users	**1**	**2**	**3**	**4**	**5**	**DNA**
Reduce staff costs	14%	20%	20%	12%	17%	17%
Introduce Self-service	5%	3%	11%	20%	46%	15%
Improve stock control	2%	5%	12%	37%	31%	14%
Improve security	15%	18%	25%	15%	11%	15%
Other libraries using it	6%	20%	29%	22%	9%	14%

Key: **1** = not very important, **5** = very important, **DNA** = Did not answer

Figure 11: Reasons for adopting RFID (Fortune 2010)

Figure 11 (above) outlines the reasons libraries have given for adopting RFID. Interestingly, it seems as if there is a largely neutral response to the reduction of staff costs, with only 30% stating it was important or very important to them. Whether this will change over the next few years in the light of potential budgetary cuts will be interesting to monitor.

It seems as if the value of self-service is still the main reason for adoption of RFID technology, with 69% of users stating it is important or very important to them. This is followed by improving stock control (46%).

Two reasons that do not seem to play a large factor in adopting RFID are improving security (16%) and other libraries using it (9%).

For those who do not have RFID, but are planning to obtain it, it seems as if stock control is becoming more important than simply self-service – 68% v 66%. It is more important to these potential users with regards to improving security (26%) and that other libraries have RFID (31%).

3.7.5 Interoperability of RFID/LMS

	2CQR	3M	Axiell	Biblio- theca	DTech	Intellident	Intrepid	Plescon	Telepen / Codeco
Axiell (DS)	2	3	5	3	2	8			
Bibliomondo						1			
Civica		3	1			1			
Endeavor		1							
Ex Libris	1	5				4			
Infor						2	1		
Innovative	1	11		1	1				
IS (Oxford)								1	
OLIB	1								
SirsiDynix		5		1	2	9			
TALIS	2	9			2	19			3

Figure 12: Variety of RFID systems working with different LMS (Fortune 2010)

RFID	No. of different LMS		LMS	No. of different RFID systems
3M/Intellident	7		Axiell (DS)	6
2CQR	5		TALIS	5
Dtech	4		Innovative	4
Bibliotheca	3		SirsiDynix	4
Axiell	2		Civica	3
Intrepid / Plescon / Telepen/Codeco	1		Ex Libris	3
			Infor	2
			Bibliomondo	1
			Endeavor	1
			IS (Oxford)	1
			OLIB	1

Figure 13: Flexibility of RFID/LMS suppliers (Fortune 2010)

Figures 12 and 13 (above) outline which LMS and RFID suppliers currently work well together. As all the suppliers claim to use the SIP2 protocol, all systems should, in theory, be interoperable. However, it seems as if there are clear winners in the UK

31

with both 3M and Intellident working with the largest number of LMS providers (seven) and with Axiell leading the LMS field, currently working with 6 RFID systems.

3.8 Conclusion

Palmer 2009 (ix) states:

> *"The simple fact is that - for any library management that is only slightly risk averse – RFID is still not the path to take. There are so many imponderables – choice of system, choice of frequency, choice of tag, tag deployment method, and much more – that anybody looking for a future-proofed investment is going to be disappointed and should postpone their decision for a while."*

This view is excessively negative and does not seem to represent the views of current RFID users nor those of libraries that intend to implement over the next two years. The market is mature enough in the UK ensuring there is a choice of suppliers, with a range of products to suit all available budgets. The introduction of a universal standard further opens up the market and provides new possibilities for co-operation between both suppliers and purchasing consortia, which could lead to even more developments in the field.

Chapter 4

Methodology

4.1 Choice of approach

When planning this dissertation, it was decided that the best methodology to use would be a case study. Case studies allow the researcher to use a range of data gathering techniques and permit the use of both quantitative and qualitative data in providing information to draw conclusions from. Harrison (1987) specifically recommends that case studies be used for investigating organizational structure and functions or organizational performance.

Yin (1989) defines a case study as:

> *"an empirical inquiry that: 1) investigates a contemporary*
> *phenomenon within its real life context; when 2) the boundaries*
> *between the phenomenon and context are not clearly evident; and*
> *in which 3) multiple sources of evidence are used."*

In contrast to many research methods, case studies lend themselves to "intensive analyses of a small number of subjects rather than gathering data from a large sample or population" (Powell and Connaway 2004).

This view is supported by Paris (1988), who states:

> *"The detailed observations that case studies provide are*
> *especially useful in documenting phenomena occurring over a*
> *period of time or whose implications are complex."*

The methodology used was a sub-section of case study called longitudinal case study. This emphasises that the study takes place over a length of time rather than being simply a snap shot of an event/process.

So how long does a case study have to be to be classed as a "longitudinal" one? The simple answer is that there is no set time limit. Saldana (2003), however, suggests

that "a minimum of nine months of fieldwork is suggested for an educational study to be considered longitudinal, whether the project is ethnographic or a field experiment".

The study within this dissertation took place over the course of two academic years at Loughborough University – September 2008- July 2010. The reason two years were chosen rather than just a single year was that the main aim of the dissertation was to discover whether the implementation of RFID at the Pilkington Library was a success. If just the first years data was drawn upon, this would be biased as the change would have only just happened. As RFID was undoubtedly the biggest single change in the Library since the beginnings of automated LMS some 15 years previously, it was inevitable that there would be an extreme reaction to its introduction in the first year under the well documented change management formula developed by Lewin (1951): unfreezing, moving and refreezing.

4.2 Data used

The case study drew on a range of data, both qualitative and quantitative to help build its conclusions. This mixed methodology was specifically chosen as it provided the widest range of data available to the author to decide whether the implementation of RFID had been a success. This is because success can be measured in a number of different ways: percentage of books issued, monetary impact, and staff/user perspectives on the new system. The range of data collections methods included:

- Quantitative statistical data on percentage of loans issued on RFID, hits on webpages, number of days taken as sick leave, staffing costs, number of enquiries and number of books issued in 24/7 periods. All these data sources provide factual evidence of clearly measurable targets that had been reached.

- Qualitative data from the Library's online user survey, online staff training survey and a number of unstructured interviews of Customer Services Staff as part of their annual appraisals at the end of each of the two years of the case study. These sources provided information on how staff and users viewed the new service and the training that had been provided and also how

the Customer Services Team (who had been affected the most by the implementation of RFID) felt about the changes.

If one or the other forms of data was ignored, the case study would not have given a true reflection of the overall success of the entire RFID implementation. E.g. if the survey found that RFID was a success simply because it had exceeded its 80% target figure for issues, but ignored the possibility that staff feedback was negative, this would lead to an inaccurate impression.

4.3 Research Limitations

This research only examined self-service and RFID in one university library, which may not be persuasive enough to portray the general phenomenon in all libraries and organisations. Staff in other university libraries would need to be interviewed to obtain more data if more time had been available for this study.

Another possible limitation would be that the author of this dissertation was asking his own staff about their impressions of how the changes had affected them. Whilst they were told that they should give their honest opinions and that if they expressed any negative ones it would not be held against them, there is still the possibility they felt unable to give their true feelings.

Denscombe (2007) stated:

> *"Our sex, our age..... ,even our occupational status, are aspects*
> *of our 'self' which, for practical purposes, cannot be changed.*
> *We can make efforts to be polite and punctual, receptive and*
> *neutral, in order to encourage the right climate for an*
> *interviewee to feel comfortable and provide honest answers.*
> *What we cannot do is change these personal attributes"*

Despite this, it may have been more advantageous to employ a researcher to interview staff to gain a truly unbiased set of opinions.

Chapter 5

Findings

5.1 Introduction

The findings below come from a range of sources: statistics gathered from internal Library sources, interviews with Library staff and information gained from working with the marketing and Publication and Training Groups within the Library.

5.2 Self-service statistics

One of the major reasons the Pilkington Library wanted to implement RFID was to increase the self-service option for users to issue and return their own books, rather than having to rely on counter staff doing this for them. The tender document prepared by the Library (University Library 2007) stated:

"the self-service units should ideally be located to allow the Library to achieve its target of 80% of all circulation transactions to be carried out via self-service"

As can be seen from Figure 14, below, this 80% target was quite a challenge for the self-service machines as the average percentage managed in the year before implementation was 34%.

Self-service issues	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total %
2007/08	34	34	35	32	34
2008/09	72	92	93	93	90
2009/10	91	94	94	93	93

Figure 14: Self-service statistics 2007-2010

How was the library going to achieve this challenging figure? It was decided at an early stage that using the self-service machines was not going to be an option, as had

previously been the case. Users that were to come to any of the enquiry points asking for books to be loaned to them would be shown how to use the new self-service machines.

As can be seen from Figure 14, the first quarter after RFID went live was challenging for all Library staff. Every user had to be shown how to use the new self-service terminals, not just the first year students/new staff and researchers, as had previously been the case. It was also a period when some of the teething problems encountered whenever a major change in processes occurs, came to the fore:

- a number of the 500,000 tagged books had not been programmed correctly and so had to be reprogrammed at the counter if they did not work on the self-service machines

- the loan period for staff and researchers expired the same week the Library went live and many books had not been tagged at the time of issue, up to six months before. Again, staff had to tag books on the spot before they could be returned on the machines, which was not a good first experience for the category of user it was most difficult to persuade to use new technology. It did, however, lead to one of the most positive experience of this period where a group of engineering students, fascinated by the new system borrowed one of the departmental trolleys to take all 200 of their books to the Library to examine the whole tagging and conversion process – this enthusiasm was mirrored on many occasions by the users. Within weeks of the system going live it was not uncommon for staff to observe users showing their friends/colleagues how easy it was to use the new system.

- many items/users had blocks on the LMS to prevent them using the new machines – these had not previously been a problem as they were in a field that had not been used under the old self-service system. A list was swiftly generated of all blocks so that these could be amended/deleted to allow the items/users to be active on the new RFID system

Despite these teething problems, a very respectable 72% of all issues/returns were achieved on the new system during the first quarter of 2008/09. This figure increased

to 92% in the second quarter and the end of year figure gave an annual self-service rate of 90% - 10% above the Library's target rate.

Despite a problem with new cards issued with incorrect coding on the magnetic strip at the start of 2009/10, this 80% target has been consistently exceeded, with the end of year average going to 93% for 2009/10. Further analysis of the 3rd quarter's figures in 2009/10 shows that of the 94% total usage, the highest proportion of self-service use is 96% amongst taught postgrads and the first 2 years of undergraduates, the lowest - 81% - from staff. Whilst this is not unexpected (staff traditionally preferring a more hands on, personal level of service), it does show how successful the Library has been at getting its message across to the student population.

The level of self-service use is never going to be 100% - there will always be issues with individual cards/items that prevent this. However, achieving an average self-service rate of 93% within 2 years of going live is certainly more than the library had hoped for and is a sure sign of success.

5.3 User survey 2009 (Walton 2010)

As part of the annual user surveys carried out by the Library, in 2009 the Library wanted to gain an impression of how the users viewed the new self-service facilities. Almost 91% (503) of users said they had found borrowing materials on the new self-service facilities either very or fairly successful, with only 21 out of the 553 responses (3.8%) stating they were fairly or very unsuccessful.

Very successful	351	63.47%
Fairly successful	152	27.49%
Fairly unsuccessful	19	3.44%
Very unsuccessful	2	0.36%
Don't know or Not applicable	29	5.24%
Total Answers	**553**	

Figure 15: Responses from 2009 user survey on borrowing Library material using the self-service facilities

This figure was the joint highest success rate of users using Library services and is an indication that the overall RFID project was a success. This was echoed in the

free text comments outlined in the user survey, below, where users praised the new machines and actually asks for more of them to be provided.

Free text comments:

- "More of the new self-service machines - they're great!"

- " and the self-service machines are very straightforward to use"

- " the new self-service facility is great"

- "More checking out machines required"

5.4 Costs – reduction in staffing

One of the reasons given in the submission for a new RFID system was the reduction in staffing costs. The Library had been tasked with reducing its FTE by four posts over the first three years of implementation by the University as part of the conditions attached to the funding for the RFID project. It was made clear to all Library staff, who were understandable worried about possible job losses, that no one would be made redundant as a result of the introduction of RFID, but that all vacancies would be reviewed before being replaced to consider whether natural wastage could account for some/all of the required reduction in cost.

In the year leading up to RFID implementation, the Circulation Team (as it was known at the time, before being re-named the Customer Services Team after implementation) had a total weekly number of staff hours of 273.25.

During the Summer leading up to RFID implementation a number of staff handed in their resignations (not for any negative reasons like not wanting to work under the new system, but because their studies had ended and so they had found full time employment or, in one case, because of emigration to New Zealand). This lead to a reduction of staff hours worked in the new Customer Services Team to 187.75 per week – a reduction of 31.29% (85.5 hours).

There were also two resignations in the evening/weekend team and one staff member retired from each of the Support Services and Social Science and Humanities Faculty Team. None of these staff posts were replaced, leading to the required reduction of

staffing costs being met within the first year of RFID implementation – two years ahead of schedule.

How was this reduction possible? The major gain was in Customer Services. Staff were no longer tied to service points or to back up where books were discharged from a drop box for processing. As up to 94% of all routine issuing/returning of Library stock happened on the self-service machines, staff who had been tied to these duties in the past were now free to join the wider Customer Services Team in staffing enquiry points that had previously been staffed solely by Faculty Team members. This had a knock on effect into those teams so that they were freed up to concentrate on their other tasks and so had an inbuilt natural wastage facility when staff left as their work could be picked up by existing faculty team staff due to their reduction in staffing the enquiry points. None of this would have been possible without the introduction of RFID.

5.5 Increase in enquiries

Before RFID had been introduced to the Library, staff working in the evenings/weekends had been concentrated on Level 3, only going downstairs to shelve books returned during those periods onto the dumping area or when a user came to the main enquiry desk to ask for assistance.

Once RFID had been introduced, there was no longer a need to have all staff on the one level as the majority of routine transactions occurred on the machines. As a result, it was decided that staff from the evening/weekend team would keep the enquiry desks on Levels 1 and 2 open throughout the periods they staffed the Library i.e. 17.30 – 22.00 weekdays, 9.00-17.30 on a Saturday and 10.00-21.00 on a Sunday.

Statistics have always been kept to monitor the level of use at the enquiry points in the Library (see table 16, below).

Month	2007/8	2008/9	2009/10
August			
September	300	308	567
October	975	2655	2252
November	1248	3271	2257
December	804	1350	1121
January	741	2224	1626
February	626	1406	1205
March	409	2207	1719
April	689	389	300
May	1237	3112	2474
June	739	1327	1181
July			
Total	7768	18250	14702

Month	2007/8	2008/9	2009/10
August	130	68	267
September	82	554	799
October	1542	3312	3353
November	1580	3355	3755
December	718	1791	1764
January	987	2933	2344
February	712	2044	2075
March	497	3114	2844
April	722	777	639
May	2069	4077	3154
June	1125	2075	1861
July	42	87	147
Total	10206	24187	23002

Figure 16 Enquiry stats for weekends and evenings 2007/8 to 2009/10

These figures show a massive increase in the number of enquiries made at the desks between 2007 and 2010 – up 89% at the weekends and 125% in the evenings. Clearly having staff on the lower levels, means that users are much more likely to ask for assistance, than when they had to come to the main enquiry point on Level 3. As one of the aims of RFID implementation was to be in a position to free staff up to answer more enquiries, it seems as if this was a success.

It is no surprise that the number of enquiries is slightly down between 2008/9 and 2009/10. This can be explained by more users being aware of the RFID system, so needing less assistance than they needed the previous year.

5.6 Lack of RSI problems

In the two years leading up to RFID implementation, a number of the Circulation Team staff had been suffering from RSI problems, leading to referrals to Occupational Health at the University and lengthy periods off work with RSI symptoms such as pinched nerves in the back and shoulders, gripping problems between thumb and finger and bad backs due to bending over a drop box to pick up returned books.

Occupational Health had recommended that these staff be placed on "light duties" away from handling books. However, as this was the main reason for the team's

existence, this was far from easy in practice and had started to lead to further complications due to the pressure placed on other team members to compensate for their less able team mates.

In the two years since implementing RFID, the members of staff who were on long term sick have returned to work and there has been a huge reduction in time off for RSI related matters, due to the machines handling the majority of transactions. RFID has, undoubtedly made the workplace a much healthier environment.

5.7 Staff feedback

In each of the years following the implementation of RFID, part of the annual appraisal in the Library (known as the Staff Development Review in 2008/9 and Performance and Development Review in 2009/10) focussed specifically on staff's impressions of the new self-service arrangements.

In the Customer Services Team, the overall response to the changes in RFID were positive, with only one out of the 26 staff interviewed raising negative comments relating to the amount of time they spent downstairs in the evenings and weekends. Examples of comments contained in these appraisals are:

- " the best change ever".

- "the changes have been a success, the users really appreciate the new roles/systems and that [she] does enjoy the new roaming nature on the lower levels"

- "[She] has also enjoyed interacting more with other Library staff and is now answering queries [she] has never had to deal with when on the desks, confident that [she] can refer on when necessary"

- "[She] likes the interaction with the users when on the desks and thinks the new systems have worked extremely well"

The general theme throughout the whole of the SDR/PDR process was how successful the new RFID arrangements had been for CS staff. There has been a vast reduction in the physical dimension of their role and daytime staff have really appreciated working on the desks with other Library staff (actually sharing their

circulation knowledge with them was a real confidence boost). They also had the chance to experience working on desks on the lower levels for the first time. This has given new insights on how users make use of the Library.

Evening staff (with one exception) have also enjoyed the new ways of working: the added interest of working on the lower levels gives more job satisfaction as they enjoy taking ownership of the lower levels and the chance to spend more time with the users. One downside of the changes is that, in peak times, there is pressure placed on the staff on L3 - especially during 24/7. This can be compounded if staff are sick and have not been covered by volunteers due to the minimal staffing levels in the evenings/weekends.

5.8 Marketing

One of the main reasons for the success of RFID implementation was due to the marketing work done both prior to and after implementation.

5.8.1 Self-service video

In order to ensure the maximum number of returning students were aware of the changes resulting from RFID, every returning student was sent a link to the self-service video guide on how to issue/return books on the new system, created by the Customer Services Manager and Facilities Manager (Figure 17). This video had 1801 hits in 2008, 2185 in 2009 and 1562 in the year to date. It has also been posted onto You-Tube, where it has amassed 1,359 hits to date.
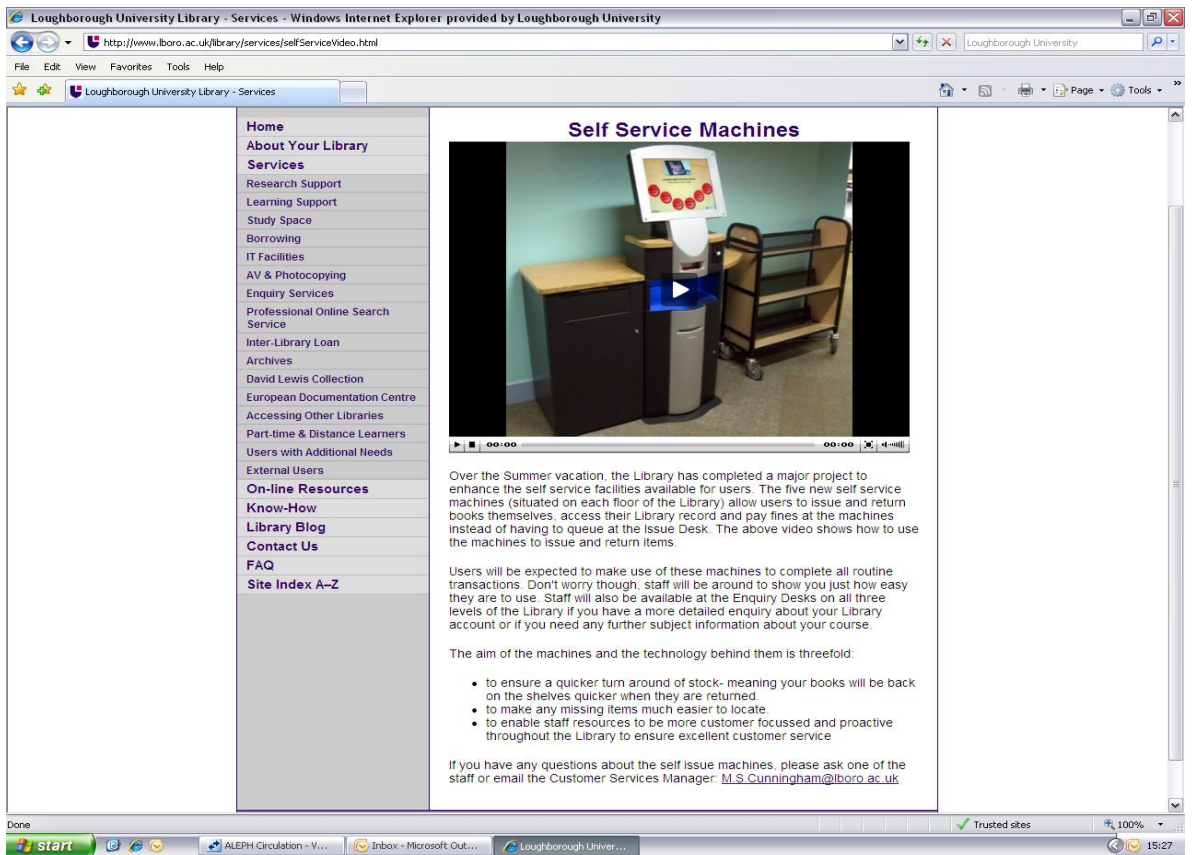
Figure 17 Self-service video

The video was considered to be such a success, that the supplier of the Library's RFID system asked if they could use it as a best practice case study on their own website (Figure 18).
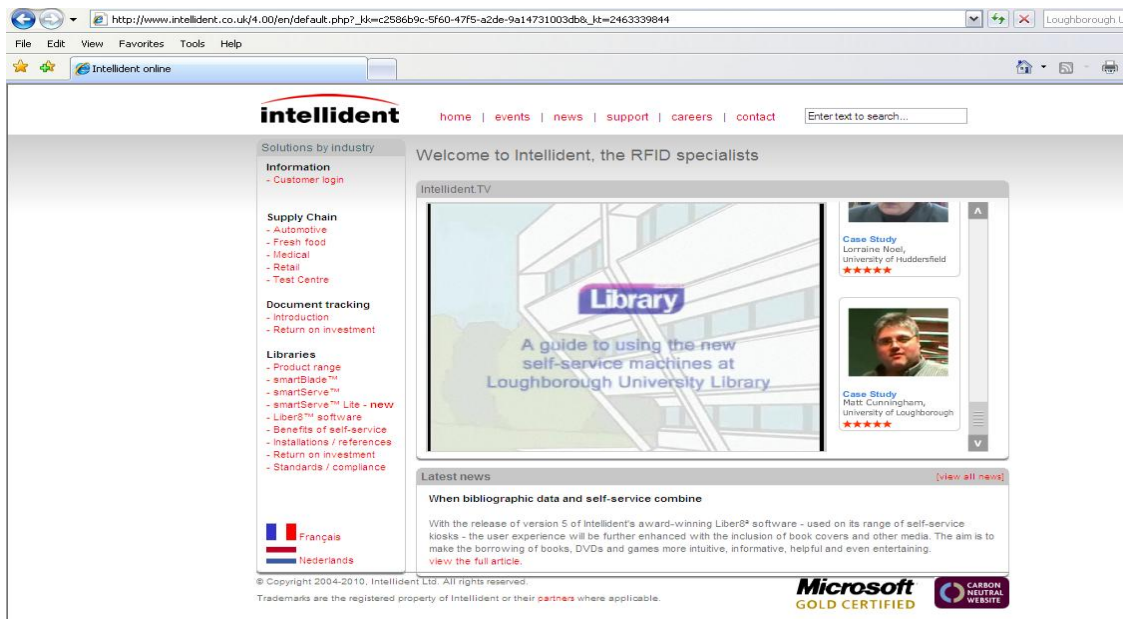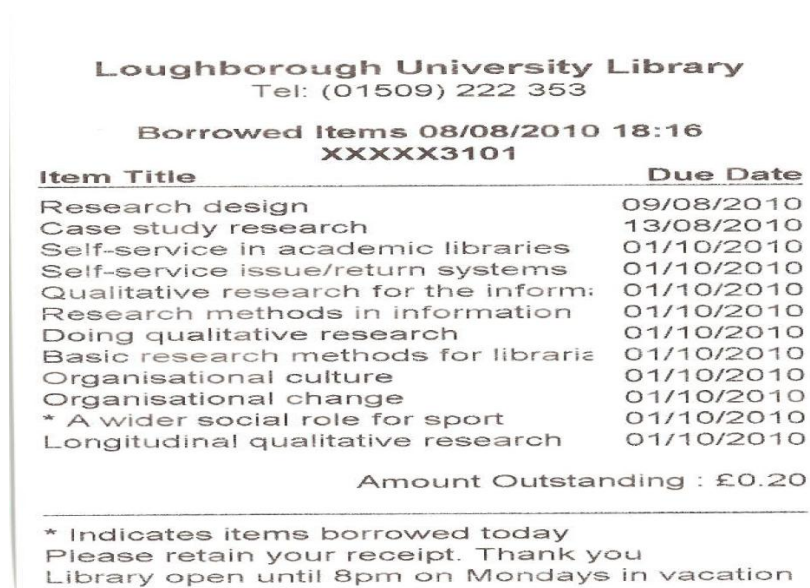

Figure 18: Case study on Intellident website

5.8.2 Receipt rolls

The bottom on the receipts issued when transactions are carried out allows the Library to add a footer. This footer has proved to be an additional way of marketing information about the Library and University such as: what's in the archive displays, extended opening hours in vacations or 24/7, a reminder to finalists to clear their account and asking finalists to complete the National Student Survey. The current footer informs users the Library is open until 8pm on a Monday in vacations.

Figure 19: Footer advertising extended summer opening

3.8.2.1 Sponsorship of receipt rolls

The cost of printing receipts for all transactions is expensive – it cost £1,400 for the receipts in the first two years of implementation. To counter this negative impact, Intellident have arranged for advertising to be placed on the back of their receipts, so that this pays for the cost of the rolls. The first batches went live in June 2010 and were advertising dry-cleaning services in Loughborough.

Figure 20: Advertising on back of receipt rolls

5.8.3 Marketing to the rest of the university

To ensure the maximum exposure to all users, the Vice Chancellor attended the Library just after RFID went live to be shown how to use the new self service system. This was then posted on the Library's blog and in the December 2008 issue of News @ Lboro (2008). The aim of this was to outline the positive impact the self service machines were having to University staff.

Figure 21: Vice Chancellor using self service machines

5.9 Training

A lot of thought was put into the training provided to Library staff both in the lead up to and post-implementation of RFID. It was recognised that staff from both Faculty Teams and Customer Services would be expected to answer questions on areas they had not previously been exposed to.

The biggest success was in the variety of training formats: training in the library had traditionally been hour long lectures on specific topics. The major changes in service

delivery meant the Library needed to find new ways of getting information across to Library staff. As a result of this, the Library created a rich programme of training:

- away days were organised to build awareness of the change in roles

- 30 minute drop in sessions were arranged on a range of topics: laptops, photocopiers, the LMS circulation module, e books and Learn

- Scenarios were placed on the internal Library blog for staff to test their knowledge of new systems

- Online database training by way of Inform tutorials were developed by academic librarians so that staff could do training in their own time at the desks, rather than having to come to formal sessions

- An online guide to the LMS circulation module was produced with a troubleshooting feature to allow staff to pin down reasons why books would not issue on the new RFID machines.

Despite the effort put into developing the training, the staff training survey in 2010 found that 51% of Library staff felt that inadequate time is given to training for major changes in the Library. Clearly, there are still lessons to be learned when implementing future training.

5.10 Unexpected successes

There are two areas of success that had not been anticipated in the lead-up to implementation:

5.10.1 Flexibility of loan periods

Pre-RFID, books were stamped with the return date on a sheet attached to the first page of the book. As there were a number of different statuses for loans, there could be up to six different stamps to use – leading to both the potential for error and confusion if the wrong category of user was stamped inside the book.

The result of this was inflexibility in loan periods at the start and end of terms, with all books issued over the vacation in the last week of term being due for return on the first Friday of the new term. This led to huge bottlenecks at the issue desks as users

queued to have their books issued before the end of term and huge numbers of books being returned in the first week of the new term, leading to problems on a Friday.

Post-RFID, this was no longer an issue. As no stamps were being used on the books due to the self-service machines issuing dated receipts, it was possible to stagger return dates for different categories of user, without any possibility of error at the desk. This meant that books issued to first and second year undergraduates are now due for return on a Wednesday and on a Friday if the user is a finalist, postgraduate or staff/researcher. This has resulted in a much smoother flow of books out and into the Library and less pressure on all Customer Service and Shelving staff.

5.10.2 Finalist clearing

One of the busiest and most stressful times for Customer Service staff is the finalist clearing process where all final year students have to ensure that they have no books or fines outstanding on their Library accounts.

Pre-RFID, students would continually claim at the counter that they had no idea they had any fines on their record to pay (especially as they were still free to borrow providing they had not exceeded their £5 limit). This lead to confrontation and embarrassment when they were told they had to settle this debt.

Post RFID, whenever a user borrowed a book on the self-service machines, it informed them of any outstanding fines (Fig 22 below) and gave them the option to pay it on the machine, without having to deal with a member of staff.

Figure 22: Scanned self-service receipt

This change has lead to much less confrontation at the counter and an increase in the amount of fines collected – from £15,083 in June 2007 to £18,890 in Jun 2009.

5.10.3 Extended opening

Having RFID in place has meant that a full range of services has been available to users during the extended opening hours established in 2009/10, where the Library remained open during term time until midnight each day and during the 24/7 opening periods in January and May/June each year. In 2009/10 alone, almost 6,500 books were issued overnight during the two 24/7 opening periods.

Chapter 6

Conclusions and Recommendations

6.1 Introduction

This chapter considers how successful the dissertation was in completing the aim outlined in chapter one of the dissertation. The aim was:

- To analyse the results of RFID implementation in the Pilkington Library to enable an assessment of its overall successes and areas which could be improved upon for anyone undertaking similar processes.

Three further objectives were also outlined to help achieve this aim:

- To introduce the concept of RFID and why it is beneficial to library services

- To conduct a literature review on self-service in libraries and how this has been expanded by the recent introduction of RFID

- To discuss the longitudinal case study methodology and how it can be applied to the RFID process at Loughborough

6.2 Conclusions

6.2.1 Reflections on introducing RFID and the literature review on self service and RFID

Chapters Two and Three of this dissertation attempted to outline the development of RFID from its beginnings in the middle of the Twentieth Century, through to its Library applications. RFID as a concept is a relatively easy one to convey and Chapter Two tries to describe the technical aspects of RFID in a way that is easy for a lay-person to understand, whilst still covering the required information.

Chapter Three is a wide ranging chapter, covering both the start of self-service in libraries and goes on to develop the themes covered in Chapter Two by introducing RFID into the self service world of libraries. I felt it important that this chapter

contain information on the most up to date and comprehensive survey on RFID in the UK to give a true picture of the impact RFID has had on the library sector as well as how it has developed from its initial beginnings in a few libraries across the world.

6.2.2 Reflections on methodology

As explained in Chapter Four, the research carried out for this dissertation had to be over two years to ensure that data gathered was not distorted by events/opinions too close to implementation. This inevitably led to concerns about establishing what data was relevant to the dissertation, especially what needed to be recorded at the start of the process. This was addressed by establishing lines of enquiry from the start, but also freed the author to add additional topics if they arose during the case study period.

The other concern was that staff might not respond well to enquiries about their working conditions after implementation and would only say what their line manager wanted to hear. Staff were assured at the start of their appraisals that any information they gave would be anonymous

There are disadvantages in using the case study method. 'Critics of the case study method believe that the study of a small number of cases can offer no grounds for establishing reliability or generality of findings' (Soy 1997). It is noted that the 'intense exposure to study of the case biases the findings'. However, despite these disadvantages it is the most appropriate method for the dissertation purposes and the literature states that researchers 'continue to use the case study research method with success'. This was certainly the case for this dissertation, where the author was able to use a combination of qualitative and quantitative data to give an overall picture of the implementation of RFID.

6.2.3 Reflections on the results of the case study

Prior to this study, there had been no attempt to summarise the effect RFID had on the Pilkington Library, its staff and its users. Information had existed in the form of user and staff surveys, statistics on usage and individual items of interest such as web pages, fines and training. However, the information in all these formats was used by different members of Library staff for different reasons, depending on their role within the Library.

One of the faults in the project management style in use at the Pilkington Library is this lack of follow up after a project has been implemented. A lot of work goes into developing proposals for projects and in establishing new ways of working, but little follow up investigation is made to formally acknowledge the success or failure of the project, with individuals responsible for their areas simply reporting how it has affected them, rather than looking at the overall picture. One of the major successes of this dissertation is that it draws upon a number of sources to provide this overall picture.

So, was RFID implementation a success at the Pilkington Library? The overwhelming answer must be yes:

- the self imposed target of 80% of circulation transactions taking place on the self-service machines was exceeded by the second quarter after implementation. The average usage of 93% in the second year of service was 13% higher than the original target.

- the Library users gave positive feedback on the new system and 91% successfully used the new system in the first year

- the required efficiency saving was met with staff reductions within the first 12 months of implementation – two years ahead of schedule - with no negative impact on remaining staff or users

- there has been a complete nullification of RSI related health issues amongst Library staff, saving both sick pay and placing less pressure on remaining staff

- staff feedback has been generally positive amongst Customer Services staff, with a few dissenting voices in the evening/weekend team. Implementation has lead to a more interesting, less physical job, where staff are not simply processing books all day but are able to interact more with the users and answer queries on a range of topics. This had created an increased sense of self-worth amongst a previously demoralised team.

- the introduction of RFID gave a new lease of life to the Library's Marketing Group. Innovative new forms of marketing such as videos, self-service

receipts gained recognition from suppliers, who wanted to use items created by the Library as examples of best practice and to subsidise costs by tying-in external advertising to that offered by the Library.

- in the same way as with the Marketing Group, the Training Group played a large part in the success of the RFID project. Innovative new methods of delivery were created to ensure the maximum support for staff. The only downside to this, was that staff felt that more training should have been provided before implementation.

- areas that had not been planned pre-implementation were also a success, allowing for changes to be made in procedures that would not have been possible without implementation.

If all these areas were a success, was there anything that did not work out as expected?

There are a few things that have not gone as well as had been hoped:

- the parent and child tagging system for CDs inside box sets or within text books has not been without its problems. Some disc tags were placed on top of the parent tag within the book when the tagging process occurred, without thought of how this would work in the self-service machines. Tags have had to be repositioned within the books to prevent interference.

- some discs and books cannot be issued on the self-service machines due to shiny metallic covers or differing metallic content of the discs themselves. Instructions telling users to get these items issued at the enquiry points had to be created.

- when initially installed, a few users took the instructions on screen a little too literally. When a returned item had a reservation on it, the user was told to put it in "the bin" to the left hand side of the machine - meaning the lockable drop box. However, cleaners found a number of books in the dustbin located between the two self service machines on Level 3 of the Library. The wording on this instruction was swiftly changed to prevent further confusion!

- the additional features of RFID other than self-service have not been developed enough to play a part in every day Library tasks. One of the big selling points for RFID is the possibility of searching for missing/queried items with a hand held digital library assistant. This hand held tool can also be used to complete stock takes. Neither of these features has been adequately developed by Library staff, with only minor testing occurring in the second year after implementation. Whilst neither of these features was the major reason for implementing RFID, the Library is missing out on the usefulness

6.3 Recommendations

To ensure the continuing success of the RFID project, there are a few areas of exploration that could be considered:

1. The usage stats for individual self-service machines have not been analysed. It is suspected that the majority of books are issued on the lower levels when a user leaves the floor containing their required books and that the majority of returns are done on the two machines closest to the entrance on Level 3. This could be confirmed by examining the usage stats in order to ensure the machines are situated correctly.

2. The enhanced stocktaking features of RFID be developed by Library staff to enable a wider range of uses

3. Further analysis be made of categories of user, to target information at those who are not making use of its benefits

4. Staff satisfaction should continue to be monitored in annual appraisals

5. User surveys should continue to measure satisfaction levels

6. The findings of this dissertation could be compared with the experiences of other institutions to ensure that the results are not unique to the Pilkington Library

7. To monitor developments in RFID technology such as "smart shelves" to identify where the next generation of viable products could be sourced.

References

Bansode, S. & Desale, S., 2009. Implementation of RFID technology in University of Pune Library. *Program: electronic and library information systems* [online], **43**(2), 202-214.

<http://www.emeraldinsight.com/journals.htm?issn=00330337&volume=43&issue=2&articleid=1789421&show=pdf >, [accessed 11.02.2010].

Becker, U., 1997. Self-service in Cologne Public Library. *Vine* [online]*,* **27**(1), 24-29.

<http://www.emeraldinsight.com/journals.htm?issn=03055728&volume=27&issue=1&articleid=1668779&show=pdf >, [accessed 11.02.2010].

Bhuptani, M. & Makadpour, S., 2005. *RFID Field Guide: Deploying Radio Frequency Identification Systems*. Upper Saddle River, NJ: Sun Microsystems/Prentice Hall PTR.

Book Industry Study Group, 2004. *BISG POLICY STATEMENT POL-002.Radio Frequency Identification.*<http://www.bisg.org/docs/BISG_Policy_002.pdf >, [accessed 11.02.2010].

Boss, R., 2004. *RFID technology for libraries*, <www.ala.org/ala/pla/plapubs/technotes/rfidtechnology.htm>, [accessed 11.02.2010].

Brewerton, G., 2007. *The future of Loughborough University Library self-service.*

Brophy, P., 1997. The Self Project: an investigation into provision of self- service facilities for library users. *Vine* [online], **27**(1), 8-13.
<http://www.emeraldinsight.com/journals.htm?issn=03055728&volume=27&issue=1&articleid=1668776&show=pdf>, [accessed 11.02.2010].

Checkpoint 2000. Press release: Checkpoint Systems Beat Competition, 10 July, <www.meto.com/download.aspx?page=librarysuccessstories>, [accessed 11.02.2010].

Commission of the European Communities, 2007. *Results of the Public Consultation on Future RFID Technology Policy* <http://ec.europa.eu/information_society/policy/rfid/doc/rfidswp_en.pdf>, [accessed 11.02.2010].

Cookman, N. & Burgess, H., 1997. 3M self issue terminal at Maidenhead library. *Vine* [online], **27**(1)**,** 20-23.

<http://www.emeraldinsight.com/journals.htm?issn=03055728&volume=27&issue=1&articleid=1668778&show=pdf >, [accessed 11.02.2010].

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

<http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6W50-4H1004H11&_cdi=6556&_user=122878&_pii=S0099133305000856&_orig=browse&_coverDate=09%2F30%2F2005&_sk=999689994&view=c&wchp=dGLzVzb-zSkzS&md5=52bab4f2b9043cd897ae48eb657ed9bc&ie=/sdarticle.pdf >, [accessed 11.02.2010].

Curran, K. & Porter M., 2007. A Primer in Radio Frequency Identification for Libraries. *Library Hi Tech* [online]*,* **25**(4), 595-611.

<http://www.emeraldinsight.com/journals.htm?issn=07378831&volume=25&issue=4&articleid=1640702&show=pdf >, [accessed 11.02.2010].

Davies, L. & Roberts, L., 2009. Set your library staff free with RFID: a case study from Cardiff University. *Sconul Focus* [online]*,* **45,** 117-122.

<http://www.sconul.ac.uk/publications/newsletter/45/32.pdf >, [accessed 11.02.2010].

Denscombe, M., 2007. *The good research guide for small-scale social research projects.* 3rd ed. Maidenhead : Open University Press/McGraw-Hill.

European Commission, 2005. *Working Document on Data Protection Issues Related to RFID Technology.* <http://ec.europa.eu/justice_home/fsj/privacy/docs/wpdocs/2005/wp105_en.pdf>, [accessed 11.02.2010].

Fabbi, J., Watson, S. & Marks, K., 2002. Implementation of the 3M™ Digital Identification System at the UNLV libraries. *Library Hi Tech* [online]*, **20**(1), 104-110.

<http://www.emeraldinsight.com/journals.htm?issn=07378831&volume=20&issue=1&articleid=861310&show=pdf >, [accessed 11.02.2010].

Fortune,M., 2010. *2010 RFID Survey*.

< http://www.mickfortune.com/Wordpress/?page_id=201 >, [accessed 11.02.2010].

Gollin, S. & Pinder, C., 2003. *An investigation into the adoption of self-check technology in U.K. academic libraries*. Napier University.

Harrison M., 1987. *Diagnosing Organizations.* Newbury Park, CA: Sage

Hopkinson, A. & Chandrakar, R., 2005. Introducing RFID at Middlesex University Learning Resources. *Program: electronic and library information systems* [online]*, **40** (1), 89-97.

<http://www.emeraldinsight.com/journals.htm?issn=00330337&volume=40&issue=1&articleid=1545426&show=pdf >, [accessed 11.02.2010].

Intellident, 2010(a). *Library installations and case studies*. <http://www.intellident.co.uk/4.00/en/sm_librariesInstallations.php >, [accessed 11.02.2010].

Intellident, 2010(b). *Return on investment*. <http://www.intellident.co.uk/4.00/en/sm_librariesROI.php >, [accessed 11.02.2010].

Katz, J., 2006. Reaching for ROI on RFID. *Industry Week* [online], **255**(2), 29-30.

<http://web.ebscohost.com/ehost/viewarticle?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bJNtq%2bxTLCk63nn5Kx95uXxjL6urUq0pbBIr6aeTbirtlKypp5Zy5zyit%2fk8Xnh6ueH7N%2fiVauntVGvrLRLtq6wPurX7H%2b72%2bw%2b4ti7evLepIzf3btZzJzfhrunt1Gvpq9Jrpzkh%2fDj34y75uJ%2bxOvqhNLb9owA&hid=13 >, [accessed 11.02.2010].

Ketley, P., 1993. Circulation functions within OPAC: self renewal at Bradford University Library. *Vine* [online], **23**(3), 7-11.

<http://www.emeraldinsight.com/journals.htm?issn=03055728&volume=23&issue=3&articleid=1668664&show=pdf >, [accessed 11.02.2010].

Kern, C., 2004. Radio-frequency identification for security and media circulation in libraries. *The Electronic Library* [online], **22**(4), 317-24.

<http://www.emeraldinsight.com/journals.htm?issn=02640473&volume=22&issue=4&articleid=862066&show=pdf >, [accessed 11.02.2010].

Kravets, D., 2008. Farmers see "Mark of the beast" in RFID Livestock Tags. <http://blog.wired.com/27bstroke6/2008/09/farmers-decryin.html>, [accessed 11.02.2010].

Lewin,K., 1951. *Field Theory in Social Science*. New York: Harper and Row

Loughborough University a, 2010. *About your library: library services. at Loughborough University*. <http://www.lboro.ac.uk/library/about/index.html>, [accessed 11.02.2010].

Loughborough University b, 2010. *Planning Office: Facts and Figures.* <http://www.lboro.ac.uk/admin/ar/planning/stats/factsfigures/index.htm >, [accessed 11.02.2010].

McCue, A., 2006. Football Club Tags fans with RFID Tickets. <www.silicon.com/retailandleisure/0,3800011842,39163900,00.htm>, [accessed 11.02.2010].

McDonald, A., 1997. Developments in the UK. In McDonald, A. & Stafford, J., eds. *Self-service in academic libraries – future or fallacy?* Sunderland: Sunderland Press, p 50.

Morris, A., Thornley, L. & Snudden, K., 2001. Self-issue and return systems: experiences in the UK. *The Electronic Library* [online]*, **19**(1), 7-18. <http://www.emeraldinsight.com/journals.htm?issn=02640473&volume=19&issue=1&articleid=861914&show=pdf> , [accessed 11.02.2010].

Morris, A. & Dyer, H., 1998. *Human aspects of library automation*. Aldershot: Gower.

Mossop, S., 2008. *RFID at the University of Central Lancashire: a case study*. <http://www.bic.org.uk/e4librariesfiles/pdfs/081202%20rfid%20case%20study%20UCLAN%20by%20stephen%20Mossop.pdf >, [accessed 11.02.2010].

Muir, S., 2007. RFID Security Concerns. *Library Hi Tech* [online]*,* **25**(1), 95-107. *<http://www.emeraldinsight.com/journals.htm?issn=07378831&volume=25&issue=1&articleid=1597978&show=pdf >*, [accessed 11.02.2010].

News @ Lboro 2008. *<http://www.lboro.ac.uk/staff/news/archive/pdf/newsletter59.pdf>,* [accessed 11.02.2010].

OED Online. <http://dictionary.oed.com/cgi/entry/50195687/50195687se61?single=1andquery_type=wordandqueryword=RFIDandfirst=1andmax_to_show=10andhilite=50195687se61 >, [accessed 11.02.2010].

Ollivier, M., 1995. RFID enhances materials handling. *Sensor Review* [online]*,* **15**(1), 36-39. <http://www.emeraldinsight.com/journals.htm?issn=02602288&volume=15&issue=1&articleid=876175&show=pdf >, [accessed 11.02.2010].

Palmer, M., 2009. *Making the most of RFID in libraries*. London : Facet.

Paris, M., 1998. Thoughts on the Case Study. *Journal of Education for Library and Information Science,* **29** (Fall 1998), 138.

Powell, R. & Connaway, L., 2004. *Basic Research Methods for Librarians. 4th ed.* Westport, Conn.: London : Libraries Unlimited.

Saldana , J., 2003. *Longitudinal Qualitative Research: Analyzing Change Through Time*. Walnut Creek, Calif.: Oxford : AltaMira Press.

Shipp, J., 1997. Helping yourself down-under: self-service in Australian university libraries. In McDonald, A. & Stafford, J., eds. *Self-service in academic libraries – future or fallacy?* Sunderland: Sunderland Press, pp.55-66.

Sliwa, C., 2003. RFID tunes into supply chains. *Computerworld* [online]*, **37**(33), 23-26.
<http://web.ebscohost.com/ehost/detail?vid=2&hid=13&sid=574ce54d-de4d-4e53-95d88d9b68520d5d%40sessionmgr10&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=bth&AN=10899744 >, [accessed 11.02.2010].

Smart, L., 2004. Making Sense of RFID. *Library Journal Netconnect* [online]*,* **129**(Fall 2004), 4-14.
<http://web.ebscohost.com/ehost/viewarticle?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bJNtq%2bxTLCk63nn5Kx95uXxjL6urUq0pbBIr6aeSa6wr0y4qLc4v8OkjPDX7Ivf2fKB7eTnfLujsEi3prVRtK%2byUKTi34bls%2bOGpNrgVeDq5j7y1%2bVVv8Skeeyzr0y1rLBIsqukfu3o63nys%2b585LzzhOrK45Dy&hid=13 >, [accessed 11.02.2010].

Snelling, C., 2005. Self Issue: not a quick win. *CILIP Update* (April) **4**(4), 32.

Soy, S., 1997. *The case study as a research method*.
<http://www.gslis.utexas.edu/~ssoy/usesusers/l391d1b.htm >, [accessed 11.02.2010].

Speckman, R. & Sweeney, P., 2006. RFID: from concept to implementation. *International Journal of Physical Distribution & Logistics Management,* **36**(10), 736- 754.

Stafford, J., 1997. Self-issue and self-return – system selection and performance at the University of Sunderland. *Vine* [online]*, **27**(1)**, 14-19.
<http://www.emeraldinsight.com/journals.htm?issn=03055728&volume=27&issue=1&articleid=1668777&show=pdf >, [accessed 11.02.2010].

Sykes, P., 1990. Automation and non-professional staff: the neglected majority. *Serials* [online]*, **4**(3), 33-43. <http://uksg.metapress.com/app/home/content.asp?referrer=contribution&format=2&page=1&pagecount=11 >, [accessed 11.02.2010].

University Library 2007. *Mini Tender for the Supply and Implementation of a Library RFID Solution Under ESPO Contract Reference 350*

Walton, G., 2010. *Loughborough University Library User Survey: 2009.* <http://www.lboro.ac.uk/library/about/PDFs/usersurvey2009.pdf>, [accessed 11.02.2010].

Williams, T., 1990. Self-service experiment in Shropshire Libraries. *Library Association Record,* **92**(10), 765.

Yin,R., 1987. *Case Study research: Design and Methods*, rev ed (Newbury Park,CA: Sage

Yu, S., 2007. RFID implementation and benefits in libraries. *The Electronic Library* [online]*, **25**(1), 54-64. <http://www.emeraldinsight.com/journals.htm?issn=02640473&volume=25&issue=1&articleid=1593795&show=pdf >, [accessed 11.02.2010].

Yu, S., 2008. Implementation of an innovative RFID application in libraries. *Library Hi Tech* [online]*, **26**(3), 398-410. <http://www.emeraldinsight.com/journals.htm?issn=07378831&volume=26&issue=3&articleid=1745072&show=pdf >, [accessed 11.02.2010].

3M Library Systems, 2006. *3M Standard Interchange Protocol* <http://multimedia.mmm.com/mws/mediawebserver.dyn?dddddNLXpsdyHedrHedd4LYP0DDDDC- > [accessed 11.02.2010].