In Search of the Radio Frequency Identification (RFID) Implementation Framework: Lessons from the United Kingdom's Public Sector

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ABSTRACT

This study presents a normative framework of the RFID implementation process in the UK public sector. It was motivated by the lack of socio-technical studies on the RFID implementation process in the UK public sector and the need for existing and potential RFID project managers to have an implementation model which could guide their effort in implementing any RFID initiatives in the sector.

The study has been conducted through a combination of case study research and grounded theory research approach. Primary data have been collected from the in-depth interviews conducted with the RFID project managers from seven public sector organisations, i.e., five libraries and two hospitals. The analyses of the data were in two main stages. The first stage involved the analysis of the RFID implementation process in each of the organisations and the second stage involved a cross analysis of the RFID implementation process across the entire organisations.

Potential contribution towards the existing body of knowledge on RFID implementation was in the form of a normative framework of RFID implementation process in the public sector. This framework describes the main and sub activities in the implementation process, and illustrates the dissimilarities and similarities between the implementation processes. Consequently, the implications of the study to the existing and potential RFID project managers in the public sector and also to the study of information system and RFID implementation are discussed.

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CHAPTER 1
INTRODUCTION

1.1 Introduction to RFID

RFID was first used over sixty years ago in Britain to identify friendly aircraft in the Second World War. However, it took almost twenty years after the war for the technology to be considered as a business solution by the industry and almost forty years for the industry to take the technology seriously. The move started in late 1990s when the researchers at the Massachusetts Institute of Technology (MIT) Auto-ID Center were investigating how RFID can be used as a new way to track and identify objects as they move between physical locations. The centre focussed on reducing the cost of manufacturing RFID tags, optimizing data networks for storing and delivering larger amounts of data and developing open standards. When the Auto-ID Centre officially closed on 26th October 2003, the centre's task was taken over by EPC Global (RFID: An introduction, 2009; RFID: A short introduction, 2009).

A RFID system usually consists of three major components: (1) a tag/transponder, (2) a reader/interrogator, and (3) a host computer. A tag comprises a simple silicon microchip attached to a small flat aerial, embedded in different materials depending upon its intended usage. The finished tag will be attached to an object or read remotely to ascertain its identity. On the other hand, the reader/interrogator sends and receives radio frequency (RF) data to and from the tag via antennas. Meanwhile, the host computer contains specialist RFID software or middleware. When it receives the data from the readers, the software and middleware will be used to filter the data and route it to the correct application. Figure 1.1 demonstrates the basic operations of RFID.
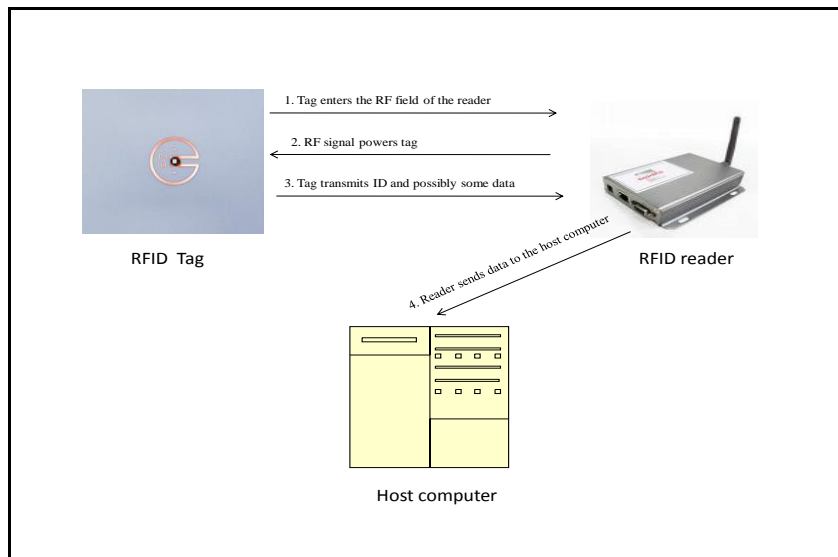
Figure 1.1: The basic operations of RFID (Source: RFID: An introduction)

The RFID technology can be divided into: (a) the types of RFID tags (passive or active) and (b) the primary frequency bands. Passive RFID tags are powered by radio wave from a reader while active tags are powered by batteries. As a result, active tags cost significantly higher than passive tags. However, active tags have bigger memory

capacity and can transmit signal over greater distances than the passive tags. On the other hand, the inexpensive passive tags make them ideal for tracking lower cost items. In terms of frequency bands, a RFID system can operate in any of these frequencies: low, high or ultra-high. Low frequency operates at 125 or 134 KHz and is commonly used for access control, animal tracking and asset tracking. High frequency that operates at 13.56 MHz is used when the application requires a medium data rate and read ranges up to about 1.5 metres. Ultra-high frequency operates between 850 MHz and 950 MHz and offers the longest read ranges of up to approximately 3 metres (An introduction to RFID, 2009).

1.2 The Global RFID Industry

The RFID industry is growing very rapidly. IDTechEx forecasts the RFID market to grow from USD$2.77 billion in 2006 to USD$12.35 billion in 2010. More than half of that growth will be contributed by active RFID such as the one used for Real Time Location Systems (RTLS). The system enables users to track and trace the movement of items in their premises in real-time. On the other hand, growth in passive RFID will be driven by the tagging of high volume items such as consumer goods, drugs, and postal packages (IDTechEx, 2009).

The market's high growth in terms of value is caused by the technology's high cost of implementation. The implementation cost includes the costs of tags, tag readers, tag printers, RFID middleware, the infrastructure to support and manage RFID related data, strategy and technology consulting, changes to internal business systems, training & change management, third party service provider fees and engineering work related to the placement of readers and tagging equipment. As a result, most companies will be spending from USD$9 million to USD$25 million on RFID mandate compliance (Schutzberg, 2004).

The high growth of the global RFID market and the technology's expensive implementation cost has attracted many firms to the RFID industry. They can be divided into manufacturers, resellers and system integrators. Manufacturers are companies such as Hitachi, which produce RFID equipments such as RFID readers, tags, and tag printers. Resellers are companies that sell RFID equipments while

system integrators are companies that provide consulting services to organizations that intend to implement the technology (RFID Gazette, 2007).

1.3 The Research Problem

The studies conducted on RFID, especially in the context of the private sector such as retailing and manufacturing have been increasing (Ngai, Moon, Riggins, Yi, 2008; Angeles, 2005, Young, 2006). This phenomenon is in line with the significantly larger investment by the private sector over the public sector (ID TechEx, 2008). However, a direct consequence of this phenomenon is the number of studies on the public sector's RFID implementations has been insignificant.

The lack of study on the UK public sector organisations may affect the sector's success in implementing RFID. The sector's RFID project managers who require appropriate guidance have to model their implementations upon the private sector experience. This strategy may be counterproductive as the issues faced by the public sector's information system (IS) are not fundamentally similar (Caudle, Gorr, and Newcomer, 1991). In other words, the managers should not assume that the private sector's implementation model will work equally well in the public sector.

This study is thus aimed at developing a normative RFID implementation framework in the public sector. The framework will be developed from the investigation on the RFID implementation in library and healthcare organisations in the UK which were found to be the most active RFID implementers in the public sector (Kable, 2006).

This study poses this central research question: **How do organisations in the UK public sector go about implementing the RFID technology?**

From the central research question, three research sub-questions are posed. They are:

1.   What is the normative RFID implementation process framework in the UK public sector?

2.   What are the key activities in the RFID implementation process framework?

3.   How do organisational and social factors combine with the technical factors to form the RFID implementation process framework?

4.   How do contextual differences affect the implementation process?

To answer this fundamental research question, three main research objectives have been developed (in order of significance):

1.   To develop a normative framework for the RFID implementation process in the UK public sector.

2.   To encapsulate the key technical and organisational activities leading to the process of RFID implementation in the public sector.

3.   To identify where the key activities in the implementation process have been employed differently by different public sector organisations.

To achieve the above objectives, the research design combined the case study research and the grounded theory strategies of inquiry. In-depth interviews with the person leading the RFID projects in two hospitals, one public library, and four university libraries were the main source of data. The data went through two stages of analysis: within and between the organisations. The analysis resulted in key activities that were

combined to form the normative framework of the RFID implementation process. The framework was then subjected to several measures (i.e., interpretive, phenomenological and theoretical validity) to enhance its overall quality (i.e., credibility).

The study offers three possible contributions to the field of RFID implementation. The first and the most significant contribution of the study is the normative model for the process of RFID implementation in public sector organisations. The model describes the main activities at different stages of the RFID implementation and shows how these activities are linked to form the general RFID implementation process. Moreover, it explains how RFID project managers in the public sector may use the model for their own implementation. The explanation highlights the key activities where the technology's implementation process may differ, these representing areas where more emphasis should be given by the project managers. In addition, the study offers suggestions on potential research in the field of RFID implementation, especially in the public sector.

The study's second contribution is the identification of the research problem in the area of RFID implementation. This study highlights the lack of studies on the implementation of RFID in the public sector and on the socio-organisational aspects of the technology's deployment. For its third contribution, this study reconfirms the usefulness of Lewin's model of change to develop an IS implementation framework. This study disputes the claim that the model is outdated and has very little use in the study of IS implementation.

The dissertation is structured as follows. The first chapter introduces the background and the motivation for the study. In this chapter, the study's central research question is discussed and the objectives of the research are set. The chapter also gives a digest of the research methods and provides a justification for the research through its main contributions.

The second chapter explains the present state of the literature and proposes a theoretical framework that will be used in setting the parameters of the study. It identifies the lack of studies on the implementation of RFID in the public sector and the lack of studies on its implementation process. It also identifies libraries and hospitals as the two public sector organisations that have received most of the attention on RFID implementation, these representing the most appropriate organisations for understanding the RFID implementation process in the public sector. The chapter proceeds by offering a definition of implementation and the reasons behind the selection of the process approach for the study. Next, the chapter links the implementation process with change management and describes the change model selected for the study.

The third chapter presents the research methods employed by this study to achieve its aims and objectives. It starts by explaining the philosophical basis of this study, which leads to the selection of the qualitative research approach. The chapter proceeds by describing the reasons for the combination of the case study research and the grounded theory strategies of inquiry as the study's research design. Following that, the study's research process is explained.

The fourth chapter describes the pilot studies. It starts by describing the process of generating an initial framework of the RFID implementation process and how the framework was refined for the primary data collection. When the initial framework has been developed, the lessons learned from the study are discussed. The main purpose of this chapter is to demonstrate the readiness of this study to proceed with the primary data collection.

The fifth chapter presents five illustrative case studies of RFID implementation in public sector organisations. These illustrative case studies consist of RFID implementations in the De Montfort University, Said Business School, Leicester University, Nottingham Trent University libraries and Arrowe Park Hospital. These case studies describe the main activities at different stages of the RFID implementation and how they link to form the organisations implementation process. The case studies also describe the issues arising from the organisations' implementation process.

The sixth chapter explains the process of developing the normative framework of RFID implementation process in the UK public sector. The chapter starts by comparing the five organisations' RFID implementation process. Their key activities at different stages of the implementation process were tabulated side-by-side to ascertain their similarities and differences. Those similarities and differences were noted and the reasons for them were investigated. The chapter then proceeds with the development of the normative framework of RFID implementation process in the libraries. The normative framework will be compared with the RFID implementation

process in the hospital to from the normative framework of RFID implementation process in the UK public sector.

Finally, the seventh chapter concludes the study by discussing the major and minor contributions of the study. Following that, the measures taken to enhance the quality of the study's findings are explained. The chapter ends by providing some implications as well as suggestions for future research in the implementation of RFID.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

In this chapter, the literature on RFID implementation in the public sector is reviewed. The main purpose of the review is to find out the gap within the existing RFID implementation in the public sector body of knowledge and to propose the research theoretical framework. The chapter is divided into two major sections. In the first section, the literature on RFID is reviewed. The review included the literature on RFID in the public sector, in libraries and in healthcare. In the second section, the study's proposed theoretical framework will be discussed. The discussion includes the implementation definition chosen for this study, the approach taken to investigate the RFID implementation, the various IS theories and implementation models considered and the framework chosen for this study.

2.1 A Review of the Literature on RFID

A significant number of RFID studies was devoted to the technical improvement of RFID technologies (e.g., Arumugam, Gautham, Narayanaswami, Ayer & Engels, 2009; Carbunar, Ramanathan, Koyutürk, Jagannathan & Grama, 2009; Chen, Chen, Chang and Lu; 2009; Chen, Fu, Gong, Chen & Li, 2009; Eom, Yim & Lee, 2009; Hsu, Chen, Yu & Park, 2009; Wang, Liu & Liu, 2009; Bennet, Liu & Lazar, 2009; Braaten, Reich & Glower, 2009; Florkemeier & Sarma, 2009; Jo, Youn & Chen, 2009; Maguire & Mappu, 2009). These studies employed some experiments and simulations to show how their proposals could improve the technology. The findings came in the form of proposed improvements to RFID tags, antennae, readers and general infrastructure. For example, Eom et al (2009), Hsu et al. (2009) and Chen et al. (2009) presented mechanisms to reduce collision among RFID readers in dense and dynamic RFID environments; Maguire and Mappu (2009) described a procedure to achieve optimal read-rates through the ISO/IEC 18000-6C RFID air interface protocol while Jo et al. (2009) and Carbunar et al. (2009) presented methods to increase the accuracy of mobile RFID tag detectability.

Whilst the technically-oriented literature showed the enthusiasm of the scientific community in improving and enhancing the RFID technologies, a smaller number of literature provided caution to the technology through the issues of security and privacy (e.g., Chen & Deng, 2009; Chien & Laih, 2009; Choi, Lee, Lim, 2009; Han & Kwon, 2009; Kaya, Savaş, Levi, & Erçetin, 2009; Liu & Bailey, 2009; Mirowski, Hartnett & Williams, 2009; Peris-Lopez, Hernandez-Castro, Estevez-Tapiador, &

Ribagorda, 2009; Langheinrich, 2009; Ryu & Takagi, 2009; Spiekermann, 2009; Van Deursen & Radomirović, 2009). These studies discussed the security and privacy weaknesses of RFID technologies and presented methods to alleviate those weaknesses. For example, Han & Kwon argued the vulnerabilities of an RFID authentication protocol while Liu and Bailey (2009) proposed a privacy and authentication protocol called PAP for passive tags while Spiekermann (2009) compared three privacy approaches in addressing consumer concerns.

Although the literature on security and privacy has highlighted the weaknesses of the existing RFID technologies, many organisations still decided to implement the technology. This observation was especially true for organizations in the private sector, lead by those in logistics and supply chain management, manufacturing and retailing. This group of literature can be further divided into three categories.

The first category presents the benefits of applying RFID (Baars, Gille & Struker, 2009; Kenneth, Whitten & Inman, 2009; Lee, Cheng, Ying, 2009; Lin & Ho, 2009; Miragliotta, Perego, & Tumino, 2009; Roh, Kunnathur & Tarafdar, 2009; Véronneau & Roy, 2009). For example, Lin and Ho (2009) suggested that there is a positive relationship between the willingness to adopt RFID technology and supply chain performance for logistics service providers while Miragliotta et al. (2009) suggested that there are more benefits in applying RFID in case-level than pallet-level tagging.

On the other hand, the second category suggested the most appropriate method of adopting RFID (Cheung, Chu & Du Timon, 2009; Lee, Cheung, Kwok, Chan, Chan

& Leung, 2009; Lee & Chan, 2009). For example, Lee et al. (2009) developed a framework for automating the processes in a manufacturing environment using RFID while Lee and Chan (2009) suggested the use of RFID to support reverse logistic system by counting the quantities of collected items in collection points and sending the signal to the central return centre.

Meanwhile, the third category discussed the issues involved in the technology's implementation (Kapoor, Zhu & Piramuthu, 2009). For example, Kapoor et al. (2009) identified and discussed critical issues in the implementation of RFID in supply chain management such as ownership transfer, privacy/security, computing bottleneck, and read error. They also discussed cost-benefit issues such as opportunity cost, risk of obsolescence, information sharing, and interoperability standards.

The implementation of RFID in the private sector outnumbers the technology's implementation in the private sector such as healthcare, education and libraries. This disparity is caused by the difference in nature between the private and public sectors. Being profit-oriented entities, private sector organizations are consistently finding ways to enhance their efficiency. When RFID emerged as a technology that would enable that aim to be achieved (Angeles, 2005), it was inevitable that the private sector organizations would implement the technology first. Consequently, not so much is known about the technology's implementation in the public sector. Although the public sector may learn from the private sector's deployment of RFID, understanding how they apply in the context of public sector is vital for the

technology's successful implementation. Therefore, the next section will discuss the present state of RFID in the public sector.

2.1.1 The present State of RFID in the public sector

The literature on RFID in government or the public sector has addressed three main organisational issues. The first issue is the role of the government in formulating policies to promote the use of RFID. For example, the Food and Drug Agency of the United States of America has promoted the use of RFID in the pharmaceutical industry to prevent the sale of counterfeit medicines (Ferguson, 2006; Young, 2006). The second issue is the role of the government in passing legislation to protect users' privacy affected by RFID systems. For example, in 2005, the California Senate passed a bill prohibiting the state and local governments from issuing identification documents, drivers' licences, and identity cards containing RFID chips to avoid identity theft and crimes. The third issue is the large-scale deployment of RFID by governments such as China and the United States of America (USA). China is planning to issue identity cards containing RFID chips to its 1 billion citizens (ID TechEx, 2008) while the United States' Army has issued a Request for Proposal (RFP) to provide passive RFID equipment worth millions of dollars (Burnell, 2008).

Similar issues have also been found on the UK public sector. First, some literature has addressed the role of the UK government in formulating policies on RFID. For example, one literature presents an analysis made for the UK government on the employment of RFID (Parliamentary Office of Science and Technology, 2004). However, instead of passing legislations or regulating the RFID industry such as in

the USA, the analysis proposed self regulation of the industry. As a result, a UK code of practice for the use of RFID was drawn by the UK RFID Council for the industry (CILT [UK], 2006). Second, some literature has been found on the large scale deployment of RFID by the UK government. For example, the UK government has installed RFID tags into its new biometric passports to conform to the International Civil Aviation Organisation's standards (Kirk, 2007). It is also considering implanting prisoners with RFID tags containing data on identity, address and criminal record to enable the prisoners to be traced (Thomson, 2008).

Although the literature on RFID implementation in the UK public sector does exist, its quantity is limited. Furthermore, the scope of the literature is limited to news of the technology implementation by public sector organisations. Studies on how public sector organisations actually implement RFID have been found to be scarce. This scarcity is surprising because a number of literature on the technology implementation by hospitals and libraries, two UK public sector organisations, have been found. Investigating the RFID implementation in these two organisations would reveal how the technology is implemented in the UK public sector.

Therefore, the following two sections are devoted to the review of the existing literature on RFID in healthcare and libraries. The review will reveal the type of studies that have been conducted on RFID implementation in UK hospitals and libraries. This review will allow this study to identify the type of study it should be pursuing. To review the literature, the framework proposed by Ngai et al. (2008) has been employed.

Ngai et al.'s framework has organised the literature on RFID into four categories: (1) technological, (2) application, (3) policy and security, and (4) other issues. However, this framework is limited because it does not include case studies of real-life RFID implementation in healthcare and libraries. These case studies have employed a more rigorous research method and their findings have been based on empirical data. To provide a more inclusive framework that encapsulates the whole literature on RFID implementation, another category entitled implementation studies has been added to the framework.

Hence, the review can be divided into five categories: (1) technological issues, (2) application issues, (3) policy and security issues, (4) other issues, and (5) implementation studies (Figure 2.1). The technological issues category includes studies conducted on RFID equipment such as RFID readers, communications infrastructure, tags and antennae. The application issues category includes studies conducted on the implementation of RFID in various industries such as manufacturing, healthcare, and libraries. The policy and security issues category incorporates studies on privacy, security, and standardization of RFID technology. The other issues category incorporates studies that do not fit the three earlier categories. They mostly occur in the form of literature introducing the main concepts of RFID technology. Lastly, the implementation studies category incorporates case studies of RFID implementation in healthcare and libraries.
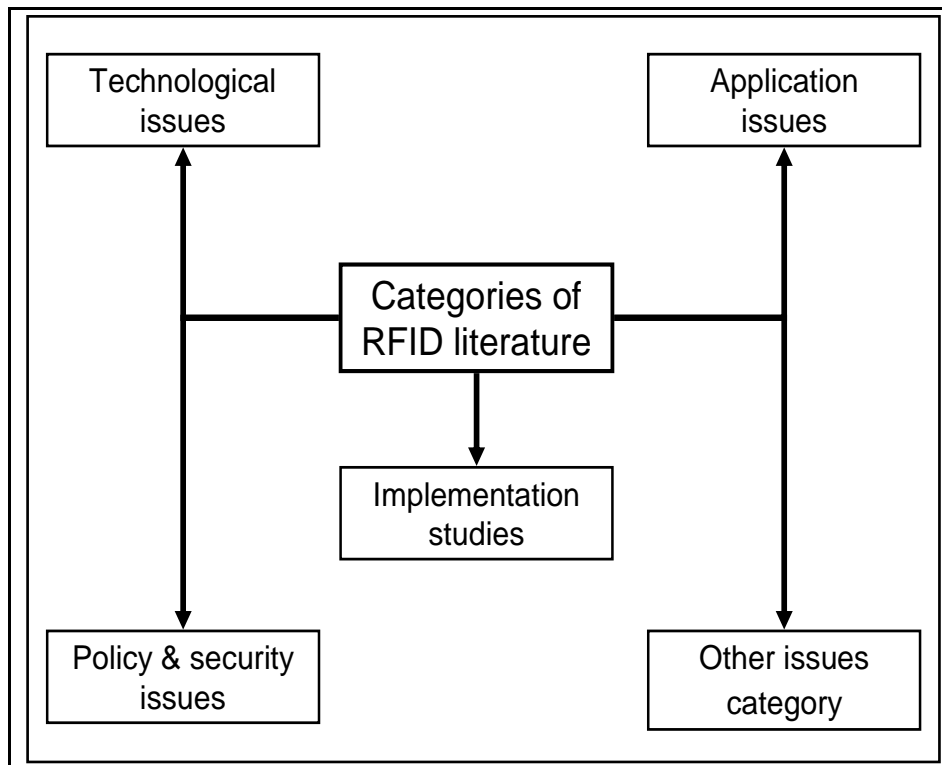
Figure 2.1 Categories of RFID literature (adapted from Ngai et al., 2008)

The literature on RFID in healthcare will be reviewed first, followed by the literature on RFID in libraries.

2.1.2. RFID in Healthcare

The application issues category has the highest number of literature on RFID in healthcare (Marks, 2009; Gibson, 2009; Ho, Moh, Walker, Hamada and Su, 2005; Wu, Kuo and Liu, 2005; Meyer, Chensue and Monticelli, 2006; Mertens, 2005; Panagiotis and Ria, 2006). They represented efforts to enhance specific areas of healthcare through the application of RFID. Marks (2009) represented efforts to enhance IVF procedures; Gibson (2009) represented efforts to enhance endoscope management; Ho et al. (2005) represented efforts to enhance healthcare system for the elderly; Wu et al. (2005) represented efforts to enhance inpatient nursing; Panagiotis

and Ria (2006) represented efforts to enhance the Hospital Information System (HIS); Meyer et al. (2006) represented efforts to enhance disaster victim identification, while Mertens (2005) represented efforts to prevent babies' abduction.

The findings from these studies came in the form of design for future RFID systems in healthcare. The findings from Ho et al. (2005) described a blueprint for an in-home healthcare system for the elderly healthcare system that monitors patients' intake of medicine using RFID. The findings from Wu et al. (2005) produced a blueprint for a pharmaceutical operation in inpatient nursing using RFID.

The findings from Panagiotis and Ria discussed how RFID can be integrated into a Hospital Information System. The findings from Meyer et al. (2006) illustrated how RFID can be employed to identify disaster victims while Mertens (2005) described the use of the technology to prevent babies' abduction. Based on these findings, a conclusion can be made that the healthcare community is very enthusiastic about applying the technology to enhance healthcare delivery.

On the other hand, a lesser number of literature on RFID in healthcare was found on the other issues category. This category consists of literature that discusses RFID issues such as consumer sentiments towards RFID healthcare technology (Katz & Rice, 2009), identifying RFID-embedded objects (Tu, Zhou & Piramuthu, 2009), tag readability for pharmaceutical products at item level (Erdem, Zeng, Zhou, Shi, David, 2009), healthcare supply chain management (Kumar, Swanson, Tran, 2009), RFID in pervasive healthcare (Thuemmler, Buchanan, Fekri & Lawson, 2009), system analysis and design (Perrin and Simpson, 2004), implementation barriers (Young,

2006) and data usage (Flower, 2006). Katz and Rice (2009) showed that the US consumers have mixed feelings about the use RFID in healthcare. Tu et al. (2009) studies the dynamics of locating and identifying tags in pervasive healthcare systems. Kumar et al (2009) identifies the types of RFID application that will be cost effective in the healthcare sector. Perrin and Simpson (2004) stressed the importance of understanding pharmaceutical usage patterns as well as the efficacy of different treatment regimes for different diseases in designing a RFID system. In other literature, Young (2006) opined that the issues hampering the progress of widespread implementation of RFID in the drug-supply chain were mostly non-technical ones such as ownership of data, access to data, and data transparency. A conclusion that can be made from this category is that healthcare organisations have to be aware of the issues raised in the literature for their RFID implementations to be successful. However, the literature in this category has not shown how these issues are addressed in the actual technology's implementation.

The ways some of the above issues have been addressed were found in the implementation studies category (Janz, Pitts, and Otondo, 2005; Wang, Chen, Ong, Liu, and Chuang, 2006; Fisher and Monahan, 2008; Tzeng, Chen and Pai, 2008). They were based on case studies of RFID implementation in North America and Taiwan. The focus of the case studies varies from analyzing the value of RFID implementation to the design and development of the technology. The studies have employed a number of qualitative research tools to investigate the implementation of the technology.

Janz et al (2005) examined how emerging information technology, such as RFID, could assist healthcare organisations improve patient care by measuring and controlling their resources. The researchers conducted a case study of the RFID patient tracking system at the Shelby County Regional Medical Centre in Memphis, Tennessee. The study employed archive analysis, participant observation, and interviews to collect the data. Interviews were conducted with doctors, nurses, training and development personnel, and IT/Systems personnel. Its findings suggested that RFID technology could assist in the measurement and control of workflow processes. The findings also suggested that traditional and non-traditional IS practices are necessary for successful RFID implementation.

In another study of RFID implementation, Wang et al (2006) studied the technology's implementation at the Taiwan Medical University Hospital. The study described the development strategy, design, and implementation of the project. To describe them, the study adopted an exploratory case study approach whereby the participants of the project were asked about their experience. Consequently, several factors have been found to influence the success of RFID implementation in the hospital. These include development strategy, device management, data management, and value generation.

Whilst Wang et al's study focussed on the strategic aspects of the implementation, Fisher and Monahan's (2008) study focused on the social impact of RFID on hospital staff. The study employed qualitative methods for its data collection and analysis. The data was collected mainly through interviews with hospital staff members at three hospitals in the South West of the United States of America, and consultants of the healthcare industry. The study's findings revealed that hospital staff, especially nurses, have reservations about the surveillance potential of the RFID system. The

study also found that the RFID implementation places an extra burden on nurses who have to operate the system. The study concluded that the social and organisational factors that contribute to the success and failure of RFID implementation in hospitals must be further analysed.

Meanwhile, the study of Tzeng et al. (2008) identified the business values of RFID implementation. The values were generated from case studies of five hospitals in Taiwan that have implemented the technology to counter the threat of Severe Acute Respiratory Syndrome (SARS) in 2003. Consequently, the study identified a number of propositions to assess the values of RFID implementation. The propositions included improved effective communications, increased asset utilisation, and enhanced patient care process. The researchers also argued that RFID enables active-patient management, virtual integration of the supply chain, new service strategy, and new business opportunities. They concluded that to successfully implement RFID, the new technology has to be integrated into the existing business systems and included in the overall business framework.

Meanwhile, very few studies were found on the technological issues category and the policy and security issues category. For example, Cavalleri, Morstabilini and Reni (2004) discussed the use of a RFID wearable device to automate the identification of staff and patients. The findings of the literature described the components of the RFID wearable device. The lack of literature in these two categories contrasted sharply with the amount of literature in the other issues, application issues and implementation studies categories. This difference suggests that the healthcare

community is keener on employing RFID than enhancing the technology's capability

and ensuring the security of its patients' data.

In other words, the healthcare community seemed to be more enthusiastic with what

the technology can offer rather than how the technology should be implemented. The

implementation studies do address this imbalance by identifying some

implementation factors e.g. development strategy, device management, value

generation and nurses' resistance, and illustrating how these factors contribute to the

successful implementation of RFID in the healthcare context. However, the factors

have been found to focus more on the technical than the social and organisational

implementation factors. In addition, how these factors combine towards a successful

RFID implementation was not discussed. As a result, RFID managers lack the

guidance on how to employ the factors in their RFID implementation. Uncovering

more organisational factors and identifying how they combine with the technical

factors to produce successful RFID implementation provide two of the strongest

motivations for this study.

The following section reviews the extent of literature on RFID in the library sector.

2.1.3 RFID in Libraries

Contrary to the literature on RFID in the healthcare sector, the other issues category

has the largest amount of literature on RFID in libraries. Among the issues that have

been addressed were evaluation of vendor solutions (Butter, 2006; Yu, 2007),

management issues (Coyle, 2005), savings from tags' prices (Ipsen, 2005),

implementation issues (Smart, 2004), overview of RFID technology (Ward, 2003) and

the solutions offered by various UK vendors (Ward, 2004). The findings consisted of propositions on how best to address those issues. For example, Coyle (2005) discussed the functional and justification issues facing libraries that are implementing RFID. Ipsen (2005) has assessed the savings that libraries may be able to gain in the future from decreasing RFID tags' prices. In other literature, Smart (2004) discussed some implementation issues such as vendor selection, system conversion process, system's operation and impact measurement. Although these propositions could assist libraries in implementing RFID, the propositions may lack validity because they were not backed by empirical evidence.

On the other hand, a slightly lesser amount of literature on RFID in libraries was found in the implementation studies category. The literature came mostly in the form of a single library's effort in implementing RFID. The case studies narrated the RFID implementation at the City University of Hong Kong (Ching & Tai, 2009), University of Nevada, Las Vegas (Fabbi, Watson, Marks and Sylvis, 2005), the Fayetteville Public Library, Arkansas, USA (Ford, Schaper and Thomas, 2004), the Norfolk and Haringey public libraries, UK (Garland, Palmer, Holden and Edmonds, 2005), Middlesex University, UK (Hopkinson and Chandrakar, 2006), Sutton Public Library, UK, University of Pune, India (Bansode and Desale, 2009) and the King County Library, Issaquah, Washington, USA (Moffit, 2004). The findings of these case studies reflected the respective libraries' experience in implementing RFID. Although they were not mentioned explicitly, the case studies described a number of factors that influence the technology's implementation in the libraries. For example, Moffit (2004) identified vendor selection while Hopkinson and Chandrakar (2006) identified system integration as important factors in libraries' RFID implementation.

An almost equal number of literature was found in the application issues category. In this category, the literature illustrates the technological applications that represent advanced applications of RFID in libraries. They included a library guiding system (Lin, Lin & Yuan, 2009), a library search system (Choi, Oh and Song, 2006), an isolated robotic system (Kho, Ang, Ang and Goi, 2002), a data mining system (Minami, 2006), and a digital library system (Morales-Salcedo, Ogata and Yano, 2005). The findings from these studies contained the applications' proposed method of implementation. Findings from Choi et al. (2006), Kho et al. (2002), and Morales-Salcedo et al. (2005) described the required infrastructure for their applications. On the other hand, findings from Minami (2006) discussed the manner in which data on materials usage can be analysed to help increase the effectiveness of libraries. On the other hand, findings from Lin et al. (2009) suggested that the suggested guiding system was well received by the consumers. These findings suggest that the libraries community is actively exploiting the RFID capabilities to provide newer and better services to its patrons.

On the other hand, very little literature was found to address the technical issues of RFID in libraries. Erwin and Kern (2005) described the technical features of a modern RFID system while Jose, Chand and Rao (2005) discussed the system components, standards, and protocols. The findings from this literature have provided technical guidelines to libraries that are planning to implement RFID. Findings from Erwin and Kern provided guidelines in evaluating different library's RFID solutions. On the other hand, findings from Jose et al. (2005) provided guidelines on the available components, standards and protocols of a RFID system for libraries.

Perhaps, the stability of the RFID technology for libraries has made the libraries community less concerned with the technical issues.

An even smaller number of articles were found in the policy and security issues category. For example, Molnar and Wagner (2004) identified ways in which the current RFID system fails to protect the privacy of the library users. The findings from the literature have proposed methods of improving the privacy protection of library users. The very small number of articles in this category suggests that the value of patrons' data has been given a lesser priority by the libraries community.

Literature on RFID in libraries has shown similar patterns as the literature on RFID in healthcare. The majority of the literature introduces the technology, its benefits and its advanced application. Very little literature was found to address the technological and security issues. This finding suggests that the library community is more passionate about the technology and how it can be used to offer more benefits to the library's patrons. On the other hand, little attention has been given to how the technology should be enhanced and protected. Meanwhile, the implementation studies do provide some of the implementation factors that contribute to the successful implementation of RFID in libraries. However, the factors were not thoroughly discussed by the literature as they were merged with the narratives of the implementations. Furthermore, they only discussed some parts of the implementation. Narration about the entire implementation process is missing from the existing literature on RFID in libraries. Filling this missing piece provides one of the strongest motivations for this study.

Investigating the entire RFID implementation process in the UK public sector requires a suitable theoretical framework. The framework shall assist the study in identifying the relevant variables. It will also assist the study in confining its boundary. The next section provides a detailed description of this process.

2.2 The Proposed Theoretical Framework

Although RFID may be treated as simply an input device to an IS (Stair and Reynolds, 2008), deeper scrutiny of the technology has suggested that the technology is an IS in its own right. The technology has the capacity to collect data, store it, process it into information, and disseminate that information to interested parties. In addition, the technology offers its highest value to organisations when it acts as an IS (Doerr, Gates and Mutty, 2006).

As a result, the literature on IS implementation has been inevitably referred to. The IS implementation literature also includes the decision support system (Arnott and Pervan, 2005; Laudon and Laudon, 2003) and innovation diffusion (Lucas, Swanson and Zmud, 2007) studies. Reviewing these two sub-areas of IS implementation has enabled a stronger theoretical framework of the RFID implementation process to be proposed.

Before an appropriate theoretical framework can be developed, two issues need to be clarified. First, what does implementation mean? Where does it start and where does it end? Second, what is the most appropriate approach for investigating the RFID implementation in the UK public sector? The most appropriate approach should be the

one that enables the study to develop a normative framework of RFID implementation process. These two issues will be discussed in Section 2.3.1 and Section 2.3.2.

2.2.1 IS Implementation Defined

There are two major groups of definition of IS implementation (Lucas, 1981, Sabherwal and Robey, 1995). The first group identifies implementation as one of the steps in the development cycle (Avison and Fitzgerald, 2003; Whittens, Bentley and Dittman, 2004) and as one of the steps in the process of innovation diffusion (Cooper and Zmud, 1990; Lai and Mahapatra, 1997; Linton, 2002). This definition differentiates between the cognitive aspect of implementation, such as soliciting user requirements and design, and the physical aspect of implementation, such as installation and maintenance. In other words, implementation involves only the physical activities of placing the IS in an organisation.

Instead, the second group has combined the cognitive and physical aspects of IS implementation (Kwon and Zmud, 1987; Lapointe and Rivard, 2007; Zmud and Cox, 1979). Implementation includes the process of getting organizational members to commit to the use of an innovation (Klein and Sorra, 1996). The process of achieving those aims begins when the organisation is thinking of the new system and ends when the users accept the ownership of the system or the organisation terminates its development. Lucas (1981) has encapsulated the essence of IS implementation as:

> "*on-going process which includes the entire development of the system from the original suggestion through the feasibility study, systems*

analysis and design, programming, training, conversion, and installation

of the system" (Lucas, 1981)

The second definition has been selected for this study because of the limitations of the first. Limiting the scope of implementation to only its physical aspect has been argued as being too technical, narrow and restricted (Marble, 2000). Furthermore, differentiating between the cognitive and physical aspects of IS installation may imply that the two activities were less related than they actually were. By segregating the two, the literature also implies that the physical activities should be given higher priority than the cognitive activities and this may be one of the reasons why many IS implementations have failed (Klein and Sorra, 1996).

Additionally, using the second definition will enable this study to investigate the whole process of RFID implementation from the viewpoint of the project managers. They have been entrusted to lead the implementation (Fidler and Johnson, 1984) and, therefore, have to shoulder several implementation responsibilities. They are responsible for introducing procedures to manage it as well as assimilating RFID into their organisations (Meyer and Goes, 1988). Their perspective of RFID implementation will help other RFID project managers to appreciate the stages of the implementation further (the activities involved in each stage and its emerging issues). Consequently, this understanding will help other RFID project managers to lead the implementation more effectively, thus increasing the probability of success in future RFID implementations.

Choosing the perspective of the RFID project managers does not mean that the study

ignores the importance of end users in the technology's implementation. The importance of end users towards the success of IS implementations have been confirmed in many IS studies (Santosa, Wei & Chan, 2005; Winston and Benjamin, 2000). However, this study chose to focus on the RFID project managers for two reasons. First, the aim of the study is to develop a normative framework of RFID implementation process that is going to be beneficial to existing and potential RFID managers in the public sector. To achieve this aim, the study has to query the RFID managers in the UK public sector who had experience in leading RFID projects. Second, because RFID is an emerging technology, the users' knowledge on the technology would be limited. Thus, their ability to contribute constructively to the technology's implementation would also be limited.

2.2.2 Approaches in implementation studies

Most IS implementation studies can be categorised into factor or process studies (Sambamurthy and Kirsch, 2000; Newman and Robey, 1992) The factor approach employed survey research methods to identify the predictors of successful systems. Three major predictors have emerged from studies under the factor approach: organisational, users, and technology (Alavi and Joachimsthaler, 1992; Kwon and Zmud, 1987; Linton, 2002; Marble, 2000; Sabherwal, Jeyaraj, and Chowa, 2006). These predictors or factors have been used as guidelines in this study to find the most important predictors to successful implementation of RFID (Table 2.2).

On the other hand, the focus of IS implementation studies under the process approach was on the sequence of individual and collective events and activities that unfold over

time (Pettigrew, 1997). For example, some studies under the process approach have examined the interaction among stakeholders and the sequence of events surrounding the systems implementation process that were of interest (Mahring and Keil, 2008; Cule and Robey, 2004; Kwon and Zmud, 1987; Sabherwal and Robey, 1995). The sequence of events could have been caused by prescribed programmes of activities, social construction and adaptation, collision of forces, or continuous processes of variation, selection, and retention (Van De Ven, 1992).

The factor approach was found to be less suitable for this study. First, the approach will uncover a large number of predictors that renders them less useful in real-life situations (Lucas, 1981). RFID project managers may find it difficult to focus on the large number of factors that would affect the implementation. Second, managers will find that identifying the factors will not be enough without them understanding how the factors should be combined to produce a successful implementation 'recipe'. Third, some studies under the factor approach have produced conflicting findings. For example, Alavi and Joachimsthaler (1992) and Sabherwal et al. (2006) have differed in their findings on the effect of users and organisations on successful implementation. The conflicting findings may confuse the RFID project managers who are looking for a framework in of implementing the system in their organisation.

Prediction category	Predictor	Description
Organisational factors	Top management support	Top-management support and favourable attitude towards IS.
	Facilitating conditions	The processes and resources that facilitate an individual's ability to utilise IS such as technical support and information centre.
Users factors	Users' personal characteristics	User's cognitive style, personality, and demographic variables e.g. age, gender, and education.
	Users-situational variables	Users experience with IS, training in IS, attitude towards IS, and participation in the development of the specific IS.
Technological factors	System quality	The quality of the system in terms of reliability, ease of use, and response time.
	Perceived usefulness	The degree to which an individual believes that using the system enhances his or her productivity and job performance.

Table 2.1 Main factors in successful IS implementations (Alavi and Joachimsthaler, 1992; Sabherwal et al., 2006)

This study employs the process approach to narrate the entire RFID implementation process in the UK public sector. The study does that by first identifying all the key activities in the implementation process. The activities will form the building blocks of the process. Once they have been uncovered, the chronological order of the activities will be determined. In other words, the activities will be arranged according to whether they occur before or after another event. The arrangement of the activities according to their chronological order will form the entire RFID implementation process from its inception to its end.

To frame the implementation process, some implementation models were considered. Those models will be described in detail in the next section. Following the description, the model that will be used for this study will be discussed and the justifications for the selection will be explained.

2.2.3 Implementation Models

Since IS implementation process involves an organisational change process, a number of models have been reviewed as the proposed framework for the study (Thompson, 2007): Rao's PRESS (2007), Garvin and Roberto's (2005), Kotter's (1995), Kolb-Frohman's (1970), and Lewin's (1956). These models recommend a series of phases that an organisation has to go through to achieve successful change (Figure 2.2).

Kolb-Frohman's (1970) model outlines the steps that a consultant has to follow for a successful consultation project. The model consists of the following stages:

- Scouting (1): the client invites the consultant for a visit. It provides the consultant's formal entry into the client's system.

- Entry (2): the consultant and the client negotiate a contract. It defines the expectations and contributions of both parties.

- Diagnosis (3): The problematic area in the client's organisation is identified and remedied. The ability to change depends on the consultant's and client's resources.

- Planning (4): outlines the specific behavioural objectives to be achieved. At this stage, the plan will be developed.

- Action (5): the consultant and client act on this plan. They must be aware of unexpected developments of their actions.

- Evaluation (6): the goals and objectives are assessed against the results. The process will either move to the termination stage (7) or back to the entry stage (2).

Termination (7): the client will either achieve success or failure in his attempt.

Meanwhile, Kotter's (1995) model offers managers suggestions on the steps required to transform their organisations. The steps are as follows:

- Establish a sense of urgency (1)

- Form a powerful guiding coalition that is going to lead the change effort (2)

- Create an impression of what the organisation should look like after the change (3)

- Communicate this impression (4) to the entire unit, department, or organisation where the change will take place

- Empower the employees to act on the vision (5)

- Planning for short term objectives. Rewarding the employees when they manage to gain the short term objectives (6).

- Consolidate the changes and strive to produce yet more (7), and

- Institutionalise the change (8)

Lewin (1956)	Kolb –Frohman (1970)	Kotter (1995)	Garvin – Roberto (2005)	Rao's PRESS (2007)
Unfreezing (1)	Scouting (1)	Urgency (1)	Set stage (1)	Persuading (1)
Moving (2)	Entry (2)	Coalition (2)	Create frame (2)	Recruiting (2)
	Diagnosis (3)	Vision (3)		Energizing (3)
	Planning (4)	Communicate (4)	Manage mood (3)	Staffing (4)
	Action (5)	Empower (5)		
Refreezing (3)	Evaluation (6)	Short-term (6)	Good habits (4)	Sequencing (5)
	Termination (7)	Consolidation (7)		
		Institutionalise (8)		

Figure 2.2 Various frameworks of organisational change process

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Garvin and Roberto's (2005) model argues that many organisational attempts have failed because they did not prepare their employees for the change. This model asserts that for the scheme to be successful, those in charge must persuade those affected of the desirability of such a change. The task should follow these phases:

- Setting the stage (1): the change leaders have to convince the employees that radical change is imperative and demonstrate why the new direction is the most appropriate one.

- Create the frame (2): The leaders have to produce the plan to achieve the change by listening to the opinions of others.

- Managing the mood (3): the employees' mood has to be managed through constant communication.

- Reinforcing good habits (4): rules and correct conduct have to be enforced to avoid the employees reverting to the old habits.

Rao's model (2007) offers another method for achieving change in an organisation. The model follows these steps:

- Persuading (1): the change leaders have to assess the people's emotions and their strength by identifying whether they are in a comfort, resignation, passive or aggressive zone.

- Recruiting (2): the employees who resist change have to be dealt with through several measures: (1) putting them together with those who strongly support change (encirclement), (2) putting them in units that are not affected by the change (isolation), (3) not involving them in the change initiatives (sideline), or (4) putting them out of the organisation (sack).

- Energising (3): The employees who are committed to the change initiative must be rewarded. The aim is to send a strong message to the entire organisation about the seriousness of the scheme.

- Staffing the change team (4): the change leader must provide credibility, commitment, governance and structure to lead the change team. These will enable the employees to have confidence in his/her ability to administer the change effort.

- Sequencing change (5): milestones should be set to assess the progress of change and when new changes can be introduced.

On the other hand, Lewin's model of change is based on a series of papers written by Kurt Lewin, a professor of social psychology with the University of Iowa, USA (Ash, 1992). The model divides change process into three stages: unfreezing, moving and refreezing. The unfreezing stage relates to destabilizing the equilibrium before old behaviours can be discarded (unlearnt) and new behaviours successfully adopted. The moving stage relates to unlearning old behaviours and learning new behaviours while the unfreezing stage seeks to stabilize the group at a new quasi-stationary equilibrium in order to ensure that the new behaviours are relatively safe from regression (Lewin, 1947).

The Lewin's change model has been used in the investigation of IS phenomenon (Nasirin, Birks and Jones, 2003; Lin & Lee, 2005; Bozak, 2003; Lee, 2006). For example, Nasirin et al. (2003) have used the model to investigate the implementation of Geographical Information Systems. Meanwhile, Lin and Lee (2005) and Bozak (2003) have used the Lewin's change model to analyze nursing information systems.

In other study, Lee (2006) has used the model to investigate nurses' usage of personal digital assistants (PDAs).

Whilst the first four implementation models (Kolb-Frohman, Garvin-Roberto, Rao and Kotter) offer prescriptions for managing the change process, they are more useful for consultants who provide advice on a change process than for managers who manage the actual change process. On the other hand, Lewin's model offers a simpler framework to encapsulate the implementation into three broad phases – unfreezing, moving and refreezing. It is this simplicity that has appealed to a large number of researchers investigating change in an organisation or a society (Schein, 1961; Schein, 1999; Zand and Sorensen, 1975). This argument is further strengthened when a finding of a recent study shows that many recent change models have followed Lewin's three-stage model of change (Elrod & Tippett, 2002).

Furthermore, a study of an IS implementation such as RFID would be inadequate without the investigation on how it will cause changes to the individuals, responsibilities, and social-political structure of an organisation (Chu and Smithson, 2007; Krovi, 1993). Because of the changes involved, IS implementation requires an understanding of how these changes should be managed (Cule and Robey, 2004; Narasimhan and Schroeder, 1979; Van De Ven and Huber, 1990; Zmud and Cox, 1979). Change models such as Lewin's would assist the study in understanding these requirements.

As this study has employed Lewin's change model, the next section will describe it in detail.

2.2.4 Lewin's Change Model

2.2.4.1 Brief description of the model

Kurt Lewin's paper (1947) entitled *"Frontiers in Group Dynamics"* has become a seminal work in the field of change management (Sabherwal and Robey, 1995). He argued the nature of change and proposes steps in achieving permanent change. He further argued individuals and organisations generally resist change. Individuals resist it because of their own narrow perception, the need to keep old habits and fear of insecurity. Organisations resist change because of stability, prior investments, and past contracts (Hodgetts and Altman, 1979). As a result, these individuals and organisations remain in a state of equilibrium.

For the groups to change, this state must be altered according to the strength and weakness of two opposing forces: a driving force and a resisting force. An organisation that intends to change may employ one of these strategies:

- increase the driving force that favours change

- decrease the resisting force that does not favour change

Although changes may occur by employing one of the above strategies, it may not last. Therefore, the biggest challenge of the change effort is to make it permanent. Hence, Lewin introduced the concept of "force field". It is a condition where the force towards equilibrium is stronger than the forces pulling away from the state. To maintain change, all forces must be directed towards the new state of equilibrium. Consequently, the force field will ensure that the state remains balanced. To reach

that state, Lewin has proposed three stages in implementing change: unfreezing, moving, and freezing of group standards.

To enable this study to identify the key activities at the different stages of the RFID implementation process, the Lewin's change model has been translated as follows. In the unfreezing stage, this study will identify how the public sector organisations create awareness of the need to implement RFID and create a climate that is receptive to the technology's implementation. In the moving stage, the study will identify how the organisations develop the new technology and how they create new methods and learning to accommodate it. In the refreezing stage, the manner in which the organisations stabilise and maintain the RFID system will be identified (Marakas, 1999).

2.2.4.2 Criticisms of the model and how they are resolved in this study

Despite the simplicity and practicality of the Lewin's model, it has received some criticisms. First, the model was argued for being too prescriptive and simplistic in analysing and conceptualising organisational change (Pettigrew, 1990). He further argued that Lewin's conceptualisation of change lacked context and process required to truly understand organisational change. Second, the model was also argued for equating an organisation to an ice cube that can simply be frozen and unfrozen to achieve change (Kanter, Stein, Jick, 1992). Kanter et al (1992) further argued that the model was based on the traditional top-down, command-and-control style of management that was too bureaucratic, inflexible, and slow to change.

Third, the model was criticized as an ordered and linear process that ignored culture, power and politics (Dawson, 1994). He further argued that the model is more useful for small and isolated change initiatives and less useful for today's turbulent business environment where change is a dynamic process. Fourth, according to Dent and Goldberg (1999), the model was argued as fundamentally flawed in addressing change initiatives. They further argued that resisting loss of status, loss of pay, or loss of comfort are not necessarily equivalent to resisting change.

Nonetheless, Burnes (2004) has dismissed these arguments against Lewin's change model. On the argument that the Lewin's model was simplistic, Burnes argued that Lewin recognized the unpredictable (non-linear) nature of change (adopting the learning approach favoured by his critics). On the argument that Lewin's model is a top-down, management-driven approach, Burnes asserted that the model recognised that for a change effort to succeed, willing and equal participations of all involved are required. On the criticism that Lewin's work is only relevant to incremental and isolated change projects, Burnes argued that Lewin's incremental change can lead to radical transformation and the model was with behavioural change at both the individual and societal levels. Lewin's work has also addressed both racism and religious intolerance. This dismissed the criticisms that the model has ignored the role of culture, power and politics.

The criticisms on Lewin's work did not discourage the author from employing the model to frame the boundary of this study. The work model is relatively stable to frame the implementation process throughout the lifecycle of the implementation initiative.

2.3 Summary

The review of literature on RFID in the public sector has revealed three significant themes. The first theme concerns the role of the government in promoting the use of RFID; the second theme concerns the role of the government in protecting the privacy of users affected by RFID systems; the third theme concerns the government's large RFID programmes. A review of the literature on RFID in the UK public sector has been found to be insignificant, although some literature has been found on the technology' implementation in two of the sector's organisations: library and healthcare. Understanding its implementation in these two sectors offers the most viable route towards understanding the RFID implementation in the UK public sector.

The review of literature on RFID in hospitals and libraries has revealed that they are dominated by application and benefits of the technology (Ngai et al, 2008). Meanwhile, the amount of literature on RFID implementation studies has been found to be limited. Although a number of implementation factors have been identified, a description of the whole implementation process that includes the organisational issues is still lacking.

To understand the entire implementation process, a decision was made to investigate the RFID implementation from its inception to its termination. Consequently, the process approach was chosen for its ability to examine the sequence of events and the surrounding issues that lead to the successful implementation of the technology. Furthermore, because of the significant amount of change involved in a RFID implementation, the Lewin's change model has been employed to frame the process.

As a result, the process will be divided into three stages: unfreezing, moving, and refreezing.

To effectively investigate the RFID implementation process an appropriate method of research is required. The research method has to be designed to capture the experience of those involved in a RFID implementation effort. It must also be designed to enable the study to collect the data from the most appropriate person and to analyse the data so that an emerging framework of RFID implementation in the UK public sector will be formed. These will be described in detail in the following chapter.

CHAPTER 3
RESEARCH METHOD

3.0 Introduction to the chapter

This chapter describes the research method employed by this study. Section 1 presents the philosophical basis of the study. Section 2 describes the research design while Section 3 presents the data collection strategy of the study. Section 4 describes the strategy employed to analyse the data. Section 5 argues for the reliability of the findings by presenting the various strategies used to validate them. Finally, Section 6 summarises the chapter's main points.

3.1 Philosophical Underpinnings of the Study

The underlying philosophy of this study has been based upon the interpretive paradigm (Orlikowski & Baroudi, 1991). The reason being is the belief that RFID implementation process is a socio-technical reality that can only be interpreted, not measured. . The positivist's emphasis on stable and orderly social relations is not suitable as the implementation of IS, such as RFID, would involve changes to the organisation, thus, creating a certain amount of instability and conflict. Adopting a positivist stand would not help the study to investigate why some issues emerge during the implementation and how the project managers have sought ways to solve them.

This study's epistemological position (interpretive paradigm) is based upon the belief that the most appropriate way of understanding the RFID implementation is through the experience of the stakeholders who were leading the projects (i.e., the most appropriate way of collecting and analysing the data is by being in the field and examining in-depth the experience of the RFID project managers). Although close attachment to the phenomenon under investigation has been claimed to allow this researcher's prior assumptions, beliefs, values and interest to shape the investigation, this approach is the only way of understanding the intricacies and complexities of a RFID implementation

The next section describes the study's research design.

3.2 The Research Design

The selection of the interpretive paradigm as the study's philosophical underpinning has inevitably led to the selection of the qualitative research approach. The approach has enabled the encapsulation of the RFID implementation process phenomenon through the experience of those who were personally involved in leading the implementation. From their experience, the study has been able to reveal the socio-technical aspects of the implementation process (Galliers and Land, 1987). In addition, it has enabled the study to construct the knowledge of the process in the form of the RFID implementation process framework in the public sector (Stake, 1995).

Under the methods associated with the qualitative research approach (Creswell, 2003), the case study research (Stake, 1995: Gummesson, 2000) and the grounded theory approach (Strauss and Corbin, 1998; Turner, 1983; Locke, 1996) methods were adopted and combined. The case study research approach was selected to enable each public sector organisation that has implemented RFID technology to be studied as a case. The case study research approach however could not provide adequate tools to guide the selection of informants and the development of the process framework. For these reasons, the case study research approach was combined with the grounded theory approach. The grounded theory approach provided the guidance in selecting the informants for the study and the method to develop the RFID implementation process framework.

Currently, the grounded theory approach has divided into two streams: forcing and

emerging. The forcing stream is favoured by Anselm Strauss while the emerging stream is favoured by Barney Glaser (Melia, 1996); both were founders of the grounded theory approach. The forcing stream of grounded theory allows prior theory, non-technical literature, and personal as well as professional experiences to help researchers gain insights into data. On the other hand, the emerging stream of grounded theory stressed the need for passive constraint to allow only the world under study to shape theorizing (Locke, 1996).

This study chose the emerging stream of grounded theory. This stream of grounded theory was chosen because it allowed the existing knowledge on IS implementation to be used as guidance in the development of the study's framework. Being a novice researcher, it was felt that the knowledge would enable a strong implementation process framework to be developed. Achieving this aim from 'a clean slate' as suggested by the emerging stream of grounded theory would be difficult for this novice researcher. This measure followed Kendall (1999) who argues that whichever stream chosen has to be relevant to the objectives of the research.

The combination of the case study research and the grounded theory approaches prevented the research becoming method bound; in other words using a variety of approaches allows a flexibility to match the phenomena under investigation. This triangulation strength can be traced back to Campbell and Fiske (1959) who developed the idea of "multiple operationism".

3.3. The Research Process

The research process consisted of two major activities: data collection and data analysis. The strategies for each of the activity are described in detail in this section. The data collection strategy sub-section includes the consideration on the unit of analysis, sampling techniques, methods of data collection, gaining access to research sites, and a brief description of the public sector organisations that were involved in the study. On the other hand, the data analyses strategy describes how within-cases and across-cases analyses were performed.

3.3.1 Data Collection Strategy

3.3.1.1 Unit of analysis

The unit of analysis for this study has been each organisation's process of implementing RFID technology. In particular, emphasis is placed upon the viewpoint of the people leading the RFID project. Because most RFID implementations have been led by a single person, the experience of that person has formed his/her organisation's RFID implementation process. However, wherever possible, the study

has taken the opportunity to collect the data from multiple respondents in the same organisation. It has included collecting the data from the organisation's RFID vendor. However, the opportunity for such data collection has been limited. As a result, in most organisations, the data that has been gathered from the RFID project leaders has been the main unit of analysis.

3.3.1.2 Sampling techniques

Two major issues were encountered in selecting the research sample: 1) determining the size of the sample, and 2) selecting the most appropriate sample. The first issue concerns the decision on the number of informants while the second issue concerns the determination of the most appropriate informants for the study. In the first issue, consideration was given to factors such as the population size, time, cost, and restricted access to the organisations. Here, a small sample size was deemed to be suitable for the study for a number of reasons. The small size of the population size (i.e. the public sector organisations in the UK that have implemented RFID) has limited the number of organisations and consequently the number of informants that can be approached for interviews.

For the second issue, the theoretical sampling was found to be more suitable than the random sampling approach. The theoretical sampling approach (Marshall, 1996; Gummesson, 2000) allows the study to narrow the choice of informants to those that have been able to relate their experience of implementing a RFID project (i.e. RFID project managers). Therefore, when a research site was approached, the study had purposely asked for the RFID manager. When the RFID manager had been interviewed, he was asked to identify others in his organisations who were involved in

managing the project. If that person was available, he will then be approached for an interview. However, in most cases, there was only one RFID manager in the organisation who oversaw the whole implementation. His recounts of his experience formed the case study of the organisation's RFID implementation.

3.3.1.3 Data collection methods

The in-depth interview (i.e., face-to-face and telephone) method was the main tool for data collection because of the advantages it offered. It allowed a close relationship to be formed with the informants. The close relationship made the informants more comfortable to relate their experience in the RFID implementations, especially the problems that emerged during the project. The interview method also enabled the study to probe the informants deeper on issues that required more elaboration. These issues were sensitive issues that the informants might want to avoid, such as the quality of vendor support and users resistance. Probing these issues allowed a better understanding of the process to be formed and consequently a better framework to be developed.

The interviews were conducted with the RFID project leader of each organisation. The first interviews were conducted face-to-face with the informants at their workplace to make them feel at-ease and to allow the researcher to observe how the RFID systems have been utilised. These interviews were the most vital because they formed the initial understanding of the organisations' RFID implementation.   The informants were asked to relate their experiences in implementing the RFID technology.

The first interviews were also the lengthiest for several reasons. This researcher took the opportunity to uncover as much information as possible. This situation was forced upon the researcher because of the difficulty and the high cost of travelling to the informants' workplaces. Furthermore, this researcher was trying to avoid disturbing the informants frequently, which could lead them to terminate the access to the organisations. To clarify and verify the issues that have emerged from the first interviews, follow up interviews were conducted with the informants. They were conducted when the recording of the first interviews had been transcribed and analysed. The interviews were conducted either by phone or e-mail.

This study has relied heavily on the interview method to gather the retrospective accounts of the RFID project leaders on the technology's implementation process. Therefore, several steps have been taken to enhance the quality of the interviews, based upon the suggestions given by Myers and Newman (2007) and Golden (1992). First, a serious effort was made to seek public sector organisations that have recently implemented the technology, i.e. in the last one or two years. This step has allowed the study to balance the viewpoints of organisations that have implemented the technology earlier. Second, a brief amount of research was conducted before the interview to obtain more information about the interviewees and their organisations. Third, several tactics were employed to make the interviewee feel comfortable. Among the tactics employed were dressing smartly but casually and projecting a friendly impression. The interviewees own words were used to reframe the questions and re-direct the interview.

Additional measures had been taken to enhance the quality of the interviews. An interview guide was used to force the interview to both focus on the main implementation factors and explore interesting lines of inquiry. The interview also focussed on the behaviour and facts of the RFID implementation. At the end of each interview, permission was requested from the interviewees for future interviews. They served to enhance the clarity and interpretation of the findings.

3.3.1.4 Gaining access to research sites

Gaining access to research sites was crucial for the study to access the reality of the RFID implementation process from the viewpoint of the project manager (Gummesson, 2000). A significant amount of time was spent gaining access to the relevant research sites. The following sub-sections detail the process of gaining access to research sites (Figure 3.1).

3.3.1.4.1 Gaining access to the Health Protection Unit (HPU), UK (Stage 1)

The study initially intended to investigate the process of RFID implementation by the Health Protection Agency (HPA). The initial intention was motivated by the application of the technology in supporting the Severe Acute Respiratory Syndrome (SARS) contact tracing in Singapore and Taiwan. Two interviews were secured with the consultants of the Health Protection Unit (HPU), the local unit for the Health Protection Agency in Bedfordshire and North West London.
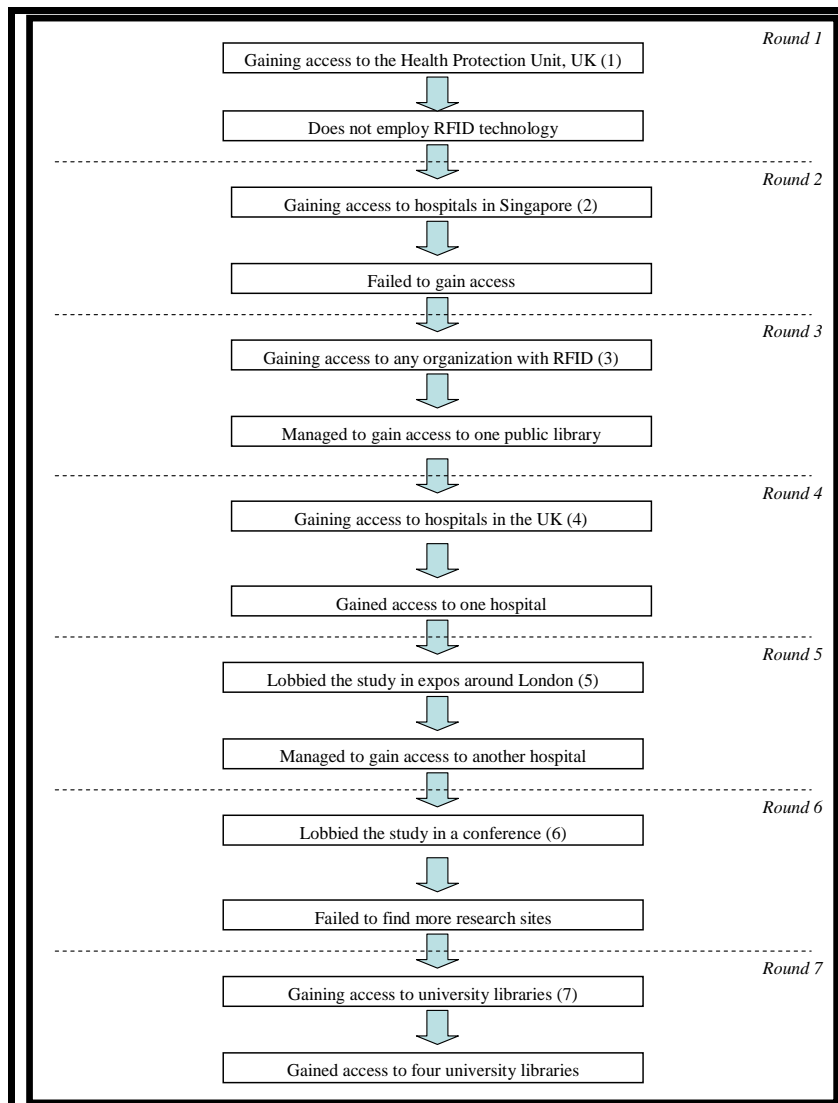
Figure 3.1 The process of gaining access to research sites

The interviews found that the UK's HPA has not embraced RFID technology for contact tracing of SARS or any other types of respiratory diseases. The HPA was still relying upon manual procedures in managing the SARS contact tracing. Because of the lack of RFID usage for SARS contact tracing, this researcher decided to try to gain access to Alexandra Hospital in Singapore, which had implemented the technology for SARS contact tracing during the SARS outbreak in 2003.

3.3.1.4.2 Gaining access to hospitals in Singapore (Stage 2)

The process of gaining access (i.e. finding the contact persons) to Alexandra Hospital went through four stages: (1) through Singapore's Defence, Science and Technology Agency (DSTA), (2) through colleagues working in Singapore's universities, (3) through the Alexandra Hospital, and (4) through the employees of DSTA.

The first stage involved finding the relevant contact person in the DSTA who, along with ST Electronics, had designed and installed the RFID system at the Alexandra Hospital. An e-mail containing a brief description of the research, the researcher, and his intention to talk to the person leading the RFID implementation was sent to the agency's general e-mail address. It reached the public relations officer of the agency, who provided the study with several newspaper clips of the RFID project. Unfortunately, the attempt to interview her and to get the names of the relevant contact persons in the agency was rejected. The newspaper clips, however, proved to be useful later.

In the second stage, assistance was sought from colleagues in Singapore's universities during an IS conference in Kuala Lumpur. They had already gained access to a number of hospitals in Singapore through their research on the use of IT during the SARS outbreak. The assistance from them, however, was not forthcoming. They claimed that they themselves have problems gaining access to the hospitals. Instead, this researcher was advised to either find research sites in the UK or to correspond directly with the hospital. The latter option was chosen.

An e-mail, stating the researcher's intention of talking to one of its consultants who was has co-authored a journal paper on SARS outbreak management, was sent to the hospital's general e-mail address. It reached the public relations officer of the hospital who passed it to the consultant's personal assistant. Unfortunately, after about three months of waiting, no response was received from the consultant or his personal assistant. Even when a formal letter with the school's letterhead was sent to the respective consultant, no response was received.

In the fourth stage, the earlier newspaper clips were reviewed. It provided a few names of DSTA personnel who were involved in the installation of RFID technology in Alexandra Hospital. Formal letters were sent to those personnel. After almost three months, one of the DSTA personnel replied with a report on the current status of RFID implementation in Alexandra Hospital. Although he agreed to answer any enquiry, the possibility of an interview was ruled out.

3.3.1.4.3 Gaining access to any organisations with RFID technology (Stage 3)

Because the study failed to gain access to the hospitals in Singapore, a decision was made to widen the scope of possible research sites by approaching any organisation in the UK that has implemented RFID. After a thorough search of the Internet, a web page of an organisation devoted to RFID technology in the UK was found. Three organisations in the UK were identified: two in the retailing sector and one in the library sector. E-mails containing a brief description of the study and this researcher's intention to talk to the RFID project managers were sent to their general e-mail address. The two retailing companies refused to give the contact details and added

that they do not entertain requests from students. However, Norfolk County Council, which manages the Norfolk and Norwich Millennium Library, provided a positive reply by providing the relevant contact person for the library. After contacting the person, an interview was conducted with her at her workplace.

Because of the difficulty in finding other organisations in the UK that have implemented RFID, this researcher asked the contact person at the end of the interview for assistance. Unfortunately, she was unable to help. However, because some groundwork on RFID in hospitals has been made, a decision was taken to approach hospitals in the UK that have implemented the technology.

3.3.1.4.4 Gaining access to hospitals in the UK (Stage 4)

A thorough research on the Internet revealed a small number of hospitals in the UK that have implemented RFID technology. However, those descriptions did not include the contact persons in the hospitals or the companies that installed the RFID system. Therefore, telephone calls to the respective hospital's IT department were made. The study managed to obtain the names of only three contact persons in the hospital and one RFID vendor. They were contacted using formal letters, phones, and e-mails. Unfortunately, the hospitals gave no replies while the RFID vendor initially agreed but opted out later.

Afterwards, this researcher made an effort to identify more hospitals in the UK that have implemented RFID. One of the RFID vendors kindly directed this researcher to web sites containing the relevant information. The web sites, however, lacked the

information on the relevant contact persons in the respective hospitals. Again, phone calls to the hospitals were made and the Internet was employed to find the information. Once the information was compiled, formal letters with the school's letterhead were sent to the relevant contact persons, followed by phone calls.

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The effort produced some amount of success when an IT Support Officer in the Wirral Hospital NHS Trust agreed to be interviewed. An interview was conducted at the hospital, followed by a tour of its RFID facility. When asked for assistance in identifying other people who could be approached for interviews, the Officer suggested a manager at Visonic Tech, the hospital's RFID vendor. After the interview, the manager was contacted. Fortunately, he agreed to the interview as long as the company's name is mentioned when the study is published. Because the company is based in Tel Aviv, Israel, the interview was conducted by phone.

Because the company has cooperated in a number of RFID installations in UK hospitals, this researcher took the opportunity to ask the manager for assistance in gaining access to those hospitals. The manager agreed to assist through two of the company's staff in the UK. An e-mail describing the study and its intention to gain access to the UK's hospitals that have implemented RFID was sent to them. They later forwarded the e-mail to their clients in the UK. When the study received no reply, formal letters were sent to the IT Directors, followed by phone calls. The study, however failed to reach the IT Directors.

3.3.1.4.5 Professional lobbying at expos in London (Stage 5)

IT expos held around London presented another opportunity to gain access to more hospitals that have implemented RFID technology. Two expos: the Wireless Technology Expo and the Government Computing Expo were attended. The vendors who were involved in installing RFID systems in hospitals were targeted. Because the number of RFID vendors was limited, the Wi-Fi vendors were approached in the hope that they could lead to securing access to hospitals that have adopted RFID. Their business cards were collected and later contacted for interviews. However, their responses outside the expos' halls were sadly lacking. They either refused to reply to this researcher's e-mails or were more interested in selling their products and services than assisting this study in getting access to the relevant hospitals. The next opportunity to gain the elusive access came from a healthcare informatics conference.

3.3.1.4.6 Professional lobbying in the Health Information Management Research Conference (Stage 6)

This researcher attended and presented a paper in a conference devoted to research and progress in health information management and health informatics. The conference was attended by a small number of participants from all over the world, including the United States, Canada, New Zealand, and Europe. Unfortunately, representatives from the UK's National Health Service (NHS) were absent. Although the presentation received a lot of attention from a number of delegates, it failed to reach the targeted audience. Even the small number of representatives from the

United Kingdom was unable to provide any contacts. After this failure, it was decided that the study should turn its attention to university libraries.

3.3.1.4.7 Gaining access to university libraries (Stage 7)

The PhD progress meeting at the end of this researcher's third term in the programme highlighted the need for a change of direction for the study to progress and be eventually completed. At the end of the meeting, a decision was made to approach university libraries that have implemented RFID because they were perceived to be more sympathetic to research students. As a result, they would be more willing to allow access to their experiences in implementing RFID technology.

Assistance was sought from the School's library representative to identify the potential research sites. Her help allowed the study to identify eight university libraries that have implemented RFID technology. Afterwards, the most appropriate contact person for each library was identified through the libraries' web sites or through e-mails sent directly to the principal librarians. Another source of information was the list of presenters for the RFID in the Libraries 2007 Conference organised by the Chartered Institute of Library and Information Professionals (CILIP).

The designated personnel in each library were contacted through e-mail. A total of six out of the eight libraries agreed to participate in this study (see Appendix 1 for some of the replies). Two libraries refused because of the absence of the person

leading the RFID project and the limited usage of RFID in their library. The list was narrowed down to only four sites to enable this study to give them in-depth focus.

3.3.1.5 The public sector organisations involved in the study

After the lengthy and stressful period of gaining access to the public sector organisations, access was arranged to two hospitals and five libraries (Table 3.1). In order to prepare for the primary fieldwork, a pilot study was conducted at the Norfolk and Norwich Millennium Library and the London Clinic. Its purpose was to identify the main RFID implementation factors that formed the RFID implementation process frameworks in hospitals and libraries. The refined framework would be used to investigate the rest of the organisations' implementation process.

Two factors have differentiated the research sites: types of RFID and stages of implementation. The libraries have employed the passive type of RFID while the hospitals have employed the active type of RFID. Four organisations have fully implemented the RFID system, one organisation has fully developed the RFID system but has not introduced the system to the users, and one organisation has piloted one RFID application while another has partially developed the system.

All the interviews were conducted solely with the persons leading the RFID projects, except for the Norfolk and Norwich Millennium Library (NNML) and Arrowe Park Hospital (APH). At the NNML, interviews were also conducted with the end-users of the RFID system while the interview at the APH also included the RFID vendor. The inclusion of the end users has enabled the study to gauge their level of involvement in

the implementation. On the other hand, the inclusion of the RFID vendor in APH has enabled the study to investigate the relationship between the hospital and its RFID vendor.

The access given and the need for more interviews caused the number of interviews to vary between sites. Some organisations allowed many of their employees to be interviewed while others limited the access to only a few designated persons. Meanwhile, the need for clarification has caused certain sites to have a greater number of interviews than others. For example, more interviews were required at the NNML because of the need to understand RFID implementation at the initial stage of the study. In another example, the interview with the RFID vendor of Arrowe Park Hospital was required because of the limited access given by the hospital to this study.

	Stage of data collection	Context	Types of RFID	Year of adoption	Stage of implementation	Informants
Norfolk and Norwich Millennium Library	Pilot	Library	Passive	2001	Has fully implemented the RFID system	[1] Assistant Head of Service (Localities), Norfolk County Council Library and Information Service [2] ICT Systems Manager, Department of Cultural Services, Norfolk County Council [3] Library Manager [4] Library and Information Assistants
The London Clinic	Pilot	Hospital	Active	2006	Has piloted one RFID application.	IT Director
Said Business School's Library, Oxford University	Primary	Library	Passive	2002	Has fully implemented the RFID system	[1] Senior Information Officer [2] Information Services Manager
University of Leicester's Library	Primary	Library	Passive	2006	Has partially developed the RFID system	Head of Public Services
De Montfort University's Library	Primary	Library	Passive	2006	Has fully developed the system but has	Manager, Library Systems and IT

					not fully introduced the system to the users.	
Nottingham Trent University's Library	Primary	Library	Passive	2002	Has fully implemented the RFID system	Deputy University Librarian
The Wirral Hospital NHS Trust	Primary	Hospital	Active	2001	Has fully implemented the RFID system	[1] The Trust's IT Support Technician (Health Informatics Services) [2] Senior Product Manager (Elpas – Eiris line of product, Visonic Technologies.

Table 3.1 The public sector organisations involved in the study

3.3.2 Strategy for Data Analyses

3.3.2.1 Within-cases analysis

Within-case analysis was performed to develop the RFID implementation process framework in each public sector organisation. To analyse and develop the process framework, the grounded theory method was employed as the main tool for analyses (Langley, 1999). The analyses resulted in the framework of the RFID implementation process in each public sector organisation and the narration of the process (Pentland, 1999).

Within-case analyses consisted of the following steps (Figure 3.2). The transcription was arranged and read line-by-line to identify initial categories (or activities) (1) in a process known as open coding (Locke, 1996; Strauss & Corbin, 1998; Walker & Myrick, 2006). The existing literature on IS implementation and RFID implementation was referred to in the process of identifying the initial categories (Orton, 1997). Referring to the literature enabled focus to be quickly directed to the relevant categories such as the role of end users and top management support. Additionally, emerging categories, such as strengthening the partnership between the organisation and its systems' partners were also identified. Once all the categories were identified, they were compared to identify their similarities and differences. Sub-categories that exhibited many similarities were merged to form main categories (2) in a process known as axial coding (Locke, 1996; Strauss & Corbin, 1998; Walker & Myrick). For example, selecting the appropriate tags, selecting materials to tag, and determining the data to input into the tag categories were combined to form a

main category called tagging process. Among the other main categories that have been formed at this stage were forming the RFID partnership, managing resistance, and promoting the RFID system.
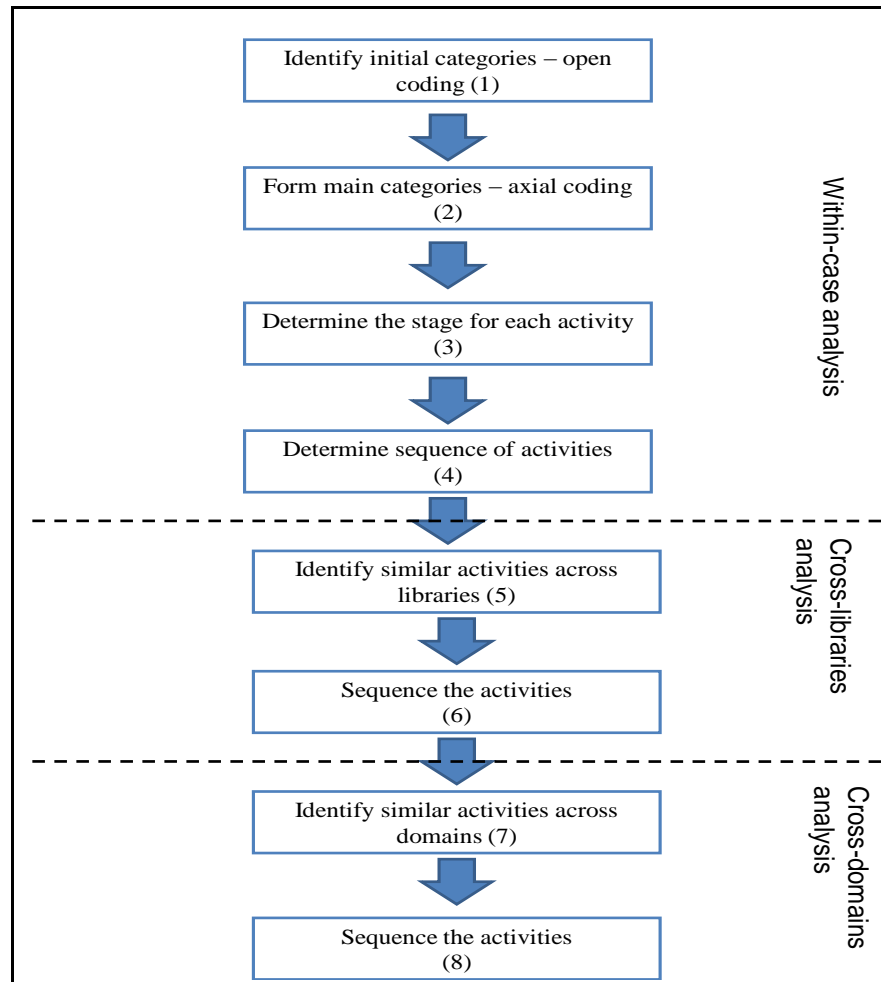
Figure 3.2 The process flow of data analysis

This stage of analysis went through several iterations to ensure that no important categories were missed. It ended when the analysis reached 'saturation'. It was a stage where no new categories were identified from the analysis (Strauss & Corbin, 1998). At this stage, further interviews and analysis added little value to the existing theoretical framework.

When the categories/activities have been exhaustively identified from the interviews data, the activities were subjected to two analyses. The first analysis involved determining in which stage the activities belong to (3), i.e. whether they occurred during the unfreezing, moving or refreezing stage of the implementation. The determination was achieved by fitting the activities with the purpose of each stage. For example, forming the RFID partnership was placed in the unfreezing stage because the activity contributed towards preparing the organisation for the new RFID system.

The second analysis involved determining the sequence of activities for each stage (4). The sequence was determined from the retrospective accounts of the informants during the interviews, where the informants related step-by-step the activities involved in their RFID implementation. However, when the informants' retrospective accounts did not clearly specify the sequence of activities, the sequence was determined logically. For example, soliciting requirement was placed before setting the implementation objectives because the organisations need to be exposed to the RFID capabilities before they can set the aims of the technology's implementation.

3.3.2.2 Cross-case analysis

The second stage of the analysis consisted of two main activities. The first main activity involved developing the normative framework of RFID implementation process in the libraries. This main activity was performed first because four of the five organisations involved in this study were libraries. Comparing the RFID implementation process of five organisations where the large majority of them come

from one type of public sector organisation would not present an accurate picture of the technology's implementation. Furthermore, there were some significant differences between the libraries and the hospital's RFID implementation, especially during the development and installation activity. Hence, the libraries normative framework was developed first, by identifying the key activities that occurred across all or the majority of the libraries (5). When these key activities have been identified, they were sequenced to form the implementation process that best represent the libraries RFID journeys (6). At this stage, the sequence of activities may also be determined logically.

The second main activity was the development of the normative framework of RFID implementation process in the UK public sector. The normative framework was developed by comparing the normative framework of the libraries and the hospital's domains. The first step in this analysis was identifying the key activities that occurred across the two domains (7). When these key activities have been identified, they were sequenced to form the implementation process that best represent the two organisations RFID journeys (8). The main result of this analysis was the normative framework of RFID implementation process in the UK public sector. The framework describes the sequence of activities that the organisations in this study have gone through in their effort to implement the RFID systems. The framework also identifies the issues involved in the implementation process and the similarities and differences between the public sector organisations' implementation effort.

3.5 Summary

The research method is based upon the interpretive research paradigm. It has been designed through a combination of the case study research and the grounded theory approach. Combining both the case study research and the grounded theory approach has allowed a more solid research design to be formed. This combined design has enabled the nature and the complexity of the RFID implementation process to be thoroughly understood, and the theoretical accounts that conform to the experience of the informants to be developed.

One of the main challenges in conducting this study was in gaining access to the sites that have implemented the RFID technology. It was a laborious, time consuming, and stressful activity, which took more than one and a half years to complete. Two hospitals and five libraries eventually gave their agreement to participate in the study. Once the access was granted, the tools for data collection were prepared. The main tool for data collection was in-depth interviews (face-to-face and telephone) with informants who led the RFID implementation projects in their respective organisations. Because the study depended heavily on interviews, several measures were employed to enhance the interview process.

The case analyses went through two main stages. The first stage involved the analysis of each organisation's RFID implementation process. The second stage involved the analysis of the RFID implementation process across all organisations. At this stage, each organisation's implementation process during the unfreezing, moving, and refreezing stages was tabulated side-by-side to identify their similarities and

differences. The analysis produced an emerging framework of RFID implementation process in the public sector. Finally, several measures were employed to enhance the quality of the framework.

A series of pilot studies were conducted prior to the primary data collection stage. Its purpose was to develop an initial framework of the RFID implementation process and to enhance the skill of this researcher. The next chapter provides a more detailed description of the pilot studies.

CHAPTER 4
THE PILOT STUDIES

4.0 Introduction

A series of pilot studies were conducted at a public library and hospital in the UK. The pilot studies have enabled this researcher to develop an initial understanding of the RFID implementation process by identifying the main factors in the RFID implementation, such as top management support and management resistance. These main factors have formed the building blocks of the initial framework of the RFID implementation process in the public sector. In addition, the lessons from the pilot study have contributed towards the refinement of the study's proposed theoretical framework and its data collection strategy. As a result, this study and researcher have been effectively prepared for the primary data collection.

This chapter is structured as follows. Section 1 provides brief background information on the public library and hospital. Section 2 gives a brief history of their RFID implementation. Section 3 discusses the initial framework of the RFID implementation process. Section 4 presents the refined framework of the RFID implementation process in the public sector. Section 5 discusses the lessons learned in refining the theoretical framework while Section 7 discusses the lessons learned in

refining the data collection strategy. Section 8 provides the discussion of the findings and concludes the chapter.

4.1. Background information of the informants

The pilot studies were conducted at two sites. The first site was the Norfolk and Norwich Millennium Library (NNML) in Norwich while the second site was the London Clinic (LC) in London. This section will start by providing a background of the NNML followed by the LC.

Site 1: The Norfolk and Norwich Millennium Library (NNML).

The first pilot study took place at the Norfolk and Norwich Millennium Library (NNML). The library is administered by the Norfolk County Council. The NNML functions as the central library for the county, which serves a population of around 800,000 people. The NNML building forms a part of the Norwich Forum building. The forum also houses the Norfolk Heritage Centre, and the 2nd Air Division Memorial Library. The library stocks around 450,000 items. It also has 220 seats and 91 public computer terminals (*Norfolk and Norwich Millennium Library.* 2005)

Site 2: The London Clinic

The second pilot study took place at the London Clinic. The hospital was established in 1935 by a group of Harley Street doctors. The main hospital site spans Harley Street and Devonshire Place in Marylebone, London. Because of its charitable status,

the hospital operates without any shareholders. The status has enabled the hospital to reinvest its financial surplus to improve healthcare for patients, instead of sharing the surplus with the shareholders. Currently, the hospital has specialties in all medical fields except cardiac surgery, obstetrics, and psychiatry (*The London Clinic, 2007*).

4.2 The RFID implementation process at the two pilot study sites

4.2.1 The Norfolk and Norwich Millennium Library (NNML).

Three major events have led to the implementation of RFID in the NNML. First, the Norfolk County Council received a huge amount of compensation from its insurers for the fire that burned down the original building of the Norfolk Central Library in 1994. Second, Norwich City Council decided to participate in the rebuilding of the Central Library by giving a significant amount of money and a piece of land adjacent to the existing library's site. The participation decision was motivated by government reforms at that time. Third, the Norfolk County Council successfully applied for grants to the Millennium Landmark Project, which had been initiated by the UK government to leave a legacy of good architecture to the people in the future. As a result of all these events, the council had a large sum of money to invest in the new library.

With more funding than anticipated, the Norfolk County Council put in place an ambitious plan for the library. The council wanted the library to act as a model for others, especially in the usage and development of electronic information services (Hammond, 1997). At the time of the implementation, there was a great deal of

publicity on the emergence of RFID as the key technology for future libraries because of its advantages over the old barcode technology. A quote by the Assistant Head of Service for the Norfolk County Council Library and Information Services exemplified the library's aim:

> *"...we chose RFID because it was an emerging technology ... we felt we could use to help us develop our service ..."*

The RFID implementation was lead by a team of three senior staffs of the library. The team comprised (1) the Assistant Head of Service (Localities), Norfolk County Council Library and Information Service, (2) the ICT Systems Manager, Department of Cultural Services, Norfolk County Council and (3) and a manager from the Norfolk County Council Library and Information Service.

4.2.2 The London Clinic

The increasing uses of RFID for tracking and tracing assets in the healthcare industry attracted the attention of the hospital's IT Director. This attraction to RFID was supported by his colleagues who were working in the private sector. However, the actual motivation for the implementation came when the IT Director realised that the existing hospital's network infrastructure could be used to track laptop computers. As the IT Director has noted,

"...The way the technology works, the tags are able to identify one tag in

the premise and by determining the signal strength between various access

points can determine the relative distance from those access points ..."

After discussion with the Chief Operating Officer, the hospital decided to implement RFID for tracking the hospital's assets. The first item to be tested in the project was the syringe pumps.

4.3. The Proposed Framework of the RFID Implementation Process (Initial)

The initial framework was based on Lewin's model of change. The model divides the implementation process framework into three broad stages: unfreezing, moving, and refreezing. The stages, however, lacked details that would enable the study to narrate the RFID implementation process. Therefore, the implementation factors that have been identified from the existing literature on RFID have been added to the framework. The factors were assigned to one of the three stages in the Lewin model. As a result, an initial framework was developed to assist the data collection and to accommodate the factors identified during the pilot study. The initial framework is as follows (Figure 4.1):

- Unfreezing: activities that have been implemented to create awareness of the need to implement RFID and to create a climate that is receptive to the technology's implementation. Examples of the activities are as planning the RFID system (1), getting the funding (2), and forming a RFID partnership (3).

- Moving: activities that have been implemented to develop RFID and to create new methods and learning to accommodate the technology. Examples of the activities are development and installation (4) and managing resistance (5).

- Refreezing: activities that have been implemented to stabilise and maintain the RFID systems. Examples of the activities are managing collected data (7) and planning future RFID applications (8).
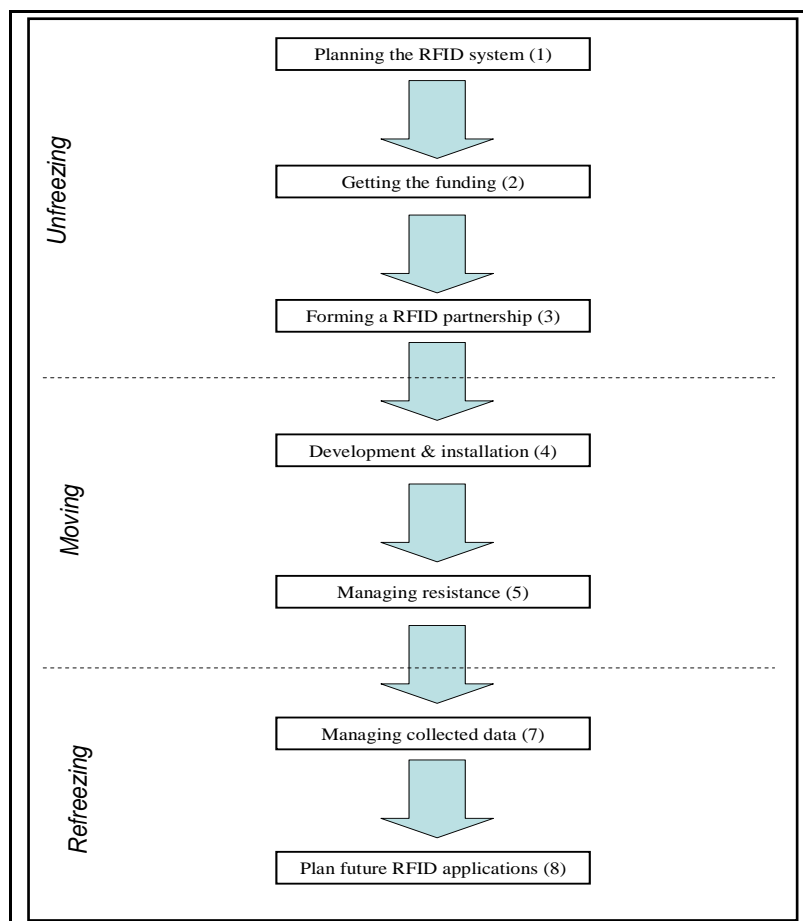
Figure 4.1 The proposed framework of RFID implementation process (initial)

4.4. The Proposed Framework of the RFID Implementation Process in the Public Sector (Refined)

The findings from the pilot study have enabled the proposed framework of the RFID implementation process in the UK public sector to be refined. One of the findings in the pilot study suggests that although the process at both sites displayed many similarities, there were also profound differences (see Table 4.1). As a consequence of the finding, a decision was made to develop a separate framework for the implementation process in the library and the hospital. The separate framework will better reflect the RFID implementation process in the two public sector organisations, thus enabling a better framework to be developed. The separate frameworks are shown in Figure 4.2 and 4.3, respectively.

Table 4.1 compares the RFID implementation process at the NNML and the LC. The table compares the two organisations' implementation activities during the unfreezing, moving, and refreezing stages. The main purpose of the comparison is to identify the similarities and differences between the organisations' implementation process.

	Site 1: The Norfolk and Norwich Millennium Library	**Site 2: The London Clinic**
UNFREEZING STAGE		
Requirements solicitation	The RFID project team discussed its requirements with its system's vendor (the company is called DS).	The IT Director had determined the requirements through discussions with experts in the IT industry and staff in the hospital.
Implementation objective	The library's management aimed to provide an easy-to-use self service facility. It hoped to redirect staff time towards providing service to the public.	The hospital's management wanted to develop a system that could identify the location of its medical devices. In addition, the management wanted to the system to utilize the hospital's existing network with only minor reconfiguration.
Forming the RFID partnership	A four-way RFID partnership between the library service, DS, Tagsys, and Intellident was formed. The partnership strategy was employed to reduce the risk associated with the implementation of an emerging technology such as RFID.	A three-way partnership between the hospital, Ekahau, and a wireless network integrator was formed.
MOVING STAGE		
Tagging process	RFID and barcode were put in all the library's materials to allow them to be returned at the Council's branch libraries which have not yet employed RFID technology. Only the ascension number was entered into the tag. All the items were tagged except the CDs and DVDs. The library has to decide on the	

	location of tag on the item to minimise data collision between items. A team of library staff and temporary agency staff performed the tagging.	
System's development		The hospital focussed on finding the right solution for the network and building infrastructure. The tags and the RFID system was supplied by Ekahau, a company which produces a Real Time Locating System (RTLS). Ekahau worked closely with the network integrator to design the network. A network integrator installed the wireless network (Cisco switches and trapeze access points). The network and all its devices were managed by the IT Department. The department also managed the databases that store the software and the RFID system's data.
System installation	The tags and readers were supplied by a company called Tagsys; the RFID software was supplied by a company called Intellident; the RFID system was linked with the library management system by a company called DS. The RFID system was programmed to handle both RFID tags and barcodes.	
Training the staff	The librarians were trained to use the RFID-based self-service machines.	The pump masters were trained to use the RFID system to locate the syringe pumps.
Vendor support	DS provided an on-duty engineer at the library.	Ekahau provided support for the software.

Managing resistance	The librarians' level of involvement and awareness of the RFID system was low. A small amount of resistance from some librarians occurred when the RFID system was not working properly.	The doctors, nurses and administrative staffs' level of involvement and awareness of the RFID system were low. The pump masters have welcomed the employment of RFID to track the location of syringe pumps.
REFREEZING STAGE		
Enhancing the system	The library's management has purchased new RFID readers and tags. The library has also upgraded the software to allow patrons to renew their items through the self-service machines.	There was no plan to extend the system because the RFID implementation was still in the initial stage.
Planning for future RFID applications	The library's management has planned to extend the RFID system to the other libraries in the county.	The hospital's management has planned to extend the network that supports RFID to the newly constructed buildings.

Table 4.1 The main RFID implementation activities in the NNML and the LC

Figure 4.2 displays the RFID implementation process in the London Clinic. It begins with the requirements solicitation activity (1), followed by setting the implementation objectives (2), forming the RFID partnership (3), system development (4), training staff (5), managing staff resistance (6), vendor support (7), and ends with planning for future RFID application (8) activity.
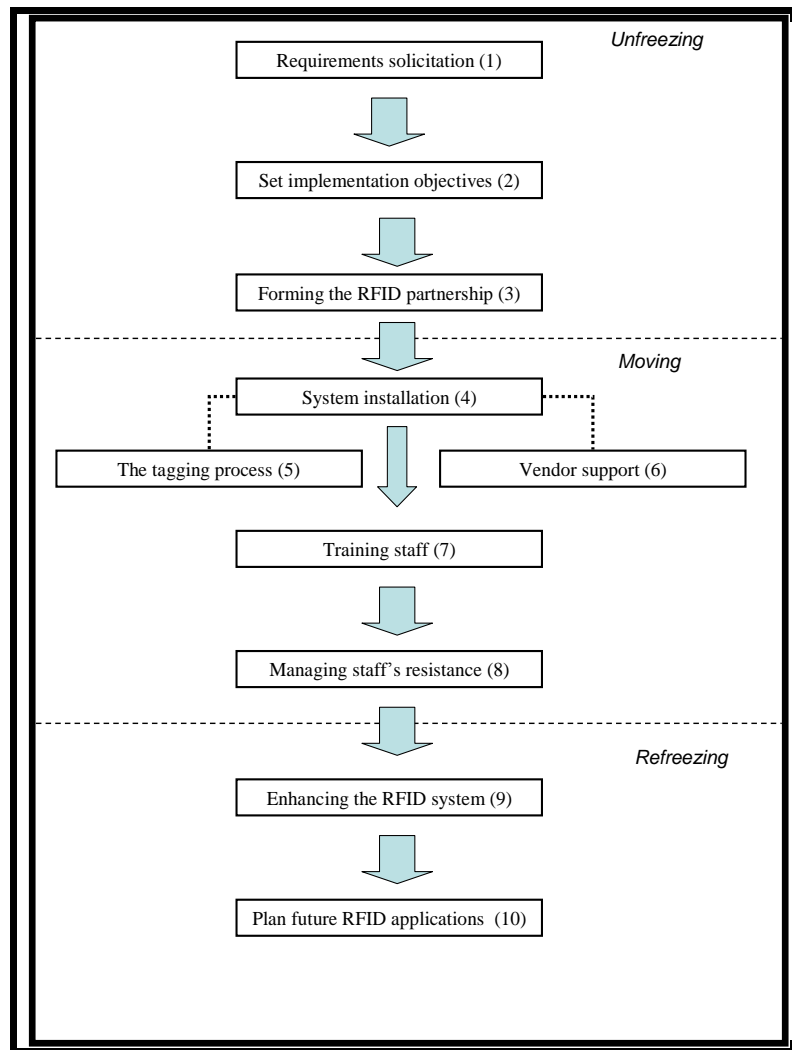
Figure 4.2. The refined RFID implementation process in the NNML.

Table 4.3 displays the RFID implementation process in the LC. The refined RFID implementation process at the library (Figure 4.3) begins with the requirements solicitation (1) activity, followed by setting the implementation objectives (2), forming the RFID partnership (3), system installation (4), training staff (7), managing staff resistance (8), enhancing the RFID system (9), and ends with planning for future RFID applications (10) activity. The tagging process (5) and vendor support (6) activities occur in parallel with the system installation activity.
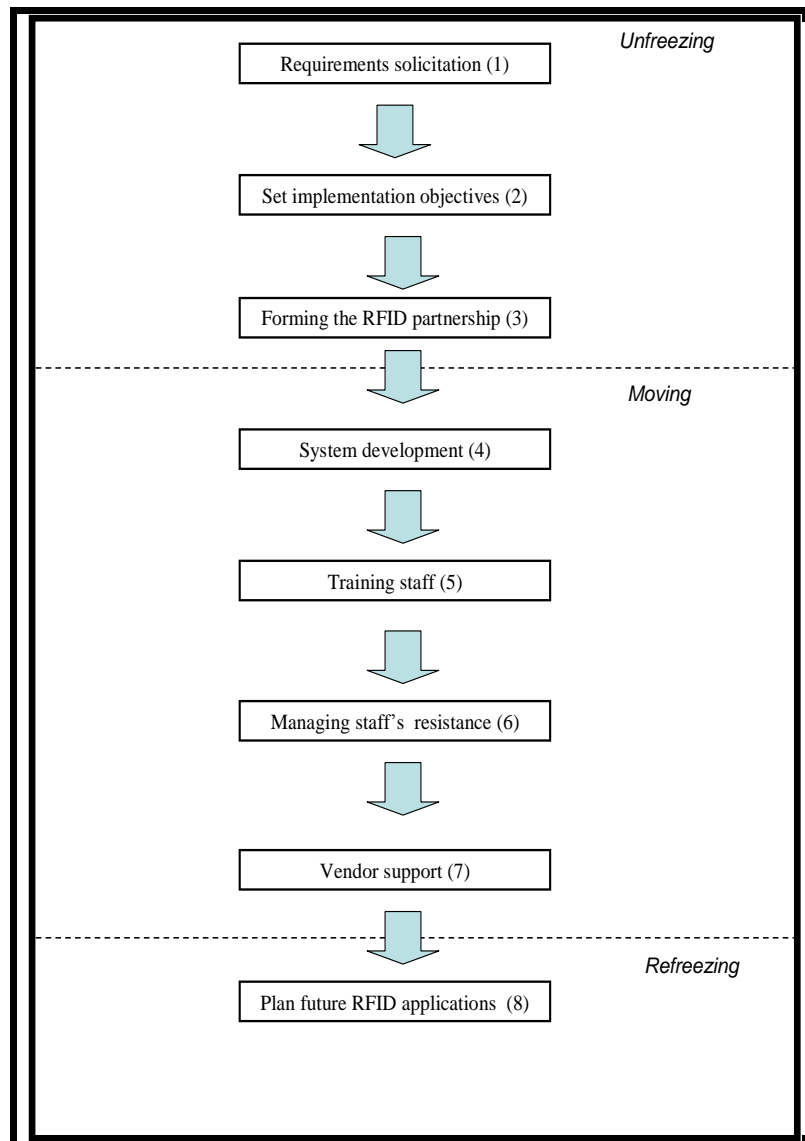
Figure 4.3. The refined RFID implementation process in the LC

Based upon the comparison of the RFID implementation process in the library and hospital, a refined framework of RFID implementation process in libraries and hospital was developed (see Figure 4.4). This refined framework merged the main implementation activities in both the NNML and LC. Additionally, several changes have been incorporated into the refined framework. This refined framework will be employed during the primary data collection stage.
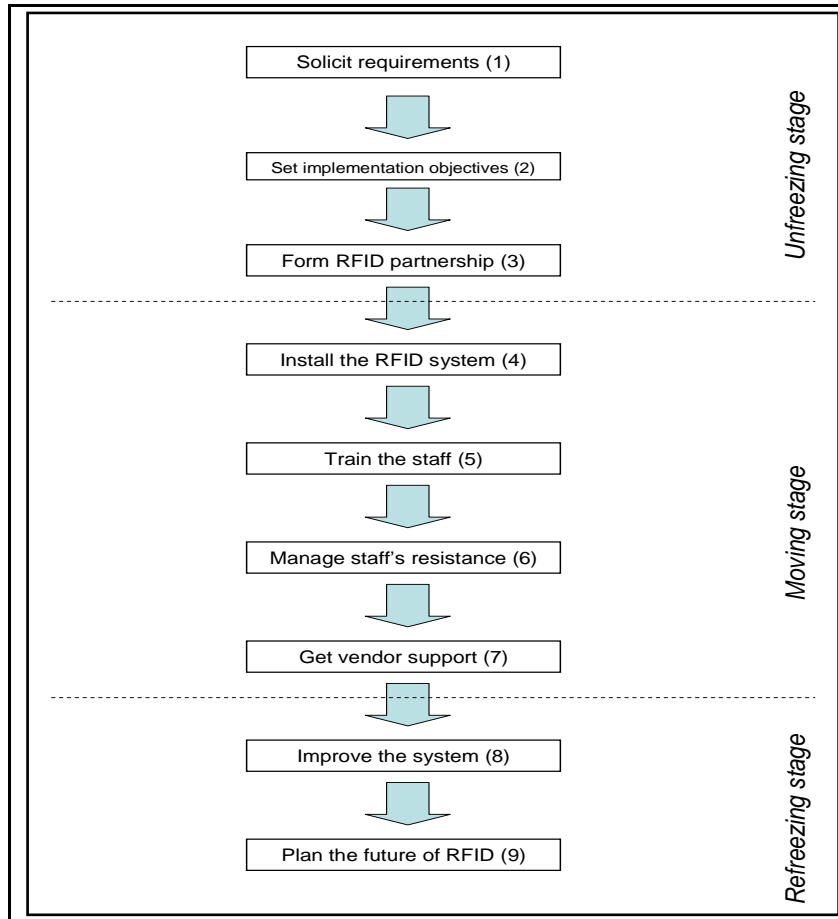
Figure 4.4 The refined RFID implementation process for both libraries and hospitals

During the unfreezing stage, the 'planning for the RFID system' activity was divided

into two activities: requirements solicitation (1) and setting implementation objectives

(2). Besides the change to the 'planning the RFID system' activity, the 'getting the

funding' activity was left out of the refined model while the 'forming the RFID

partnership' activity (3) remained. Findings from the pilot studies have suggested that

the 'getting the funding' activity was not given high priority by either organisation.

Instead, the findings strongly suggest that both organisations worked extensively

towards forming a RFID partnership.

Some changes have also been made to the moving phase of the RFID implementation

process. The 'development and installation' activity (4) has been divided into a

number of sub-activities. For the NNML, the sub-activities were system installation, the tagging process and vendor support while for the LC it was the system development.   The system development activity comprised two sub-activities: networking and database management. On the other hand, the tagging process at the NNML consisted of the following sub-activities:

- Deciding the type of data to be entered into the tag

- Determining the materials that would be included in and excluded from the tagging process

- Choosing the staff who will be performing the tagging process

- Deciding whether to combine the RFID and barcode technologies

The 'managing resistance' activity (6) was kept in the framework while the 'staff' training' activity (5) was added. The findings from the pilot studies suggest that despite the low level of staff' involvement, resistance has occurred in the implementation. As a consequence, actions were taken to manage the resistance. Additionally, the findings from the pilot studies suggest that the staff have been given training to use the RFID systems.

During the refreezing stage, the 'managing the collected data' activity was removed from the framework while 'planning for future RFID applications' activity (9) was kept. Findings from the pilot studies suggest that data management played a small part in the LC's system development and no part at all at the NNML. Meanwhile, the findings from the studies suggest that both sites have plans to extend the RFID system to other libraries or to a newly constructed building. Therefore, the 'improving the system' (8) activity has been added to the framework. The findings from the pilot

studies suggest that the NNML has actively enhanced its RFID system by purchasing new RFID readers and tags, and upgrading its software.

In addition to the study's main research question, one sub-research question has been added. The additional research question is "how does public sector organisations differ in their RFID implementation process?" The refinement was made to reflect the differences among the various public sector organisations implementation process. Differences have occurred in the type of RFID technology employed and in their implementation backgrounds. Findings from the pilot studies suggest that the implementation process for active RFID technology differs slightly from passive RFID technology. Differences in implementation backgrounds such as the maturity of the technology at the time of the implementation, the type of services offered to the public and the availability of funds have also contributed towards the variation of the implementation process.

The pilot studies have not only helped the study in forming the initial framework of the RFID implementation process. They have also allowed the study to identify important lessons that will be used as guidance in during the primary data collection. Those lessons will be described in the next section.

4.5 Lessons Learned from the Pilot Studies

A number of lessons have been learned from the pilot studies leading to the refinement of the proposed theoretical framework. First, although the NNML and LC differ in their nature of services to the public and the types of RFID technology employed, the findings suggest that their RFID implementation processes possessed

many similarities. Therefore, studying and comparing their RFID implementation is a viable strategy in developing a framework for the RFID implementation process in the public sector. In addition, the comparison allowed the differences between the organisations to be accounted for and added to further strengthen the framework.

Second, the decision to focus on the perspective of the RFID project leader/manager was vindicated. The findings of the pilot studies suggest that the roles of the RFID project leaders in managing the implementation process successfully were huge. They initiated the idea for the RFID implementation in their organisations, successfully argued for the implementation with the senior management, and persevered with the projects when they were hit with numerous technical problems. This decision, however, did not mean that the users' perspective was totally discarded. Although the users' involvement was limited to using and promoting the technology, their participation was nevertheless vital to the RFID project's success. Therefore, the contribution of the users towards the successful implementation of a RFID project would still be investigated. However, instead of studying the users' sentiments towards the RFID system, the focus would be on how the RFID managers persuade the users to accept and use the technology in their organizations.

The technical and organisational activities in the RFID implementation process were difficult to differentiate. Many of the activities combined technical and organisational elements. For example, the development and installation activity combined both technical elements such as networking and linking of the RFID system with the LMS, and organisational elements such as the training provided to the librarians and pump masters. Thus, separating the two elements may hinder the effort to view the entire

implementation process. Therefore, a decision was made not to differentiate the technical and organisational activities in the implementation of the RFID. Instead, they were simply termed as implementation activities.

There were a number of lessons learned during the pilot studies that have contributed towards the refinement of the data collection strategy, especially the interviewing method. First, the interview should start by allowing the informants to freely talk about the RFID implementation in their organisations. Lessons from the pilot studies suggest that the informants were very enthusiastic and more than willing to talk about their effort to lead the RFID projects. Second, precautions must be taken when discussing sensitive issues such as users' resistance and problems in the RFID implementation. Although probing the informants is required to delve deeper into those issues, the interviewer may proceed along that path only when the informants look comfortable in discussing them. If the informants suggest, verbally or physically, that they are uncomfortable with the discussion, the interview must proceed to less sensitive issues. Third, the interview guide should be flexible. It ensures that the interview will cover all the important issues while allowing it to probe emerging issues. Fourth, the decision to hold the interviews at the informants' workplace was justified. They seemed to be more relaxed and comfortable in familiar surroundings and thus were able to talk more freely about the RFID implementation process in their organisations.

Some key activities that have emerged in the pilot studies were found to be similar with the existing literature on RFID in libraries. Among them were: providing the justification to the senior management (Garland et al., 2005; Coyle, 2005; Ipsen,

2005), the selection of the RFID vendor (Ford et al., 2004; Moffit, 2004; Ward, 2004), the tagging process (Ward, 2003; Coyle, 2005; Fabbi et al., 2005) and system development and installation (Hopkinson & Chandrakar, 2006;). The findings have also reaffirmed and enhanced the existing literature on RFID in hospitals. Among the activities that have been identified by the literature were: management of users' resistance, system development and installation, nurturing the RFID partnership, vendor support and championing the RFID project (Janz et. al, 2005; Wang et. al, 2006; Fisher & Monahan, 2008).

4.6 Summary

The pilot studies have provided a significant number of advantages. They enabled an initial understanding of the RFID implementation process in the public sector to be formed. It also led to the refinement of the theoretical framework and data collection strategy. Personally, the experience has given me the confidence to approach the RFID project managers in hospitals and libraries for the primary data collection.

The pilot studies have also enabled the interviewing skills to be enhanced. The most appropriate tactics in starting an interview were identified to ensure that the informants are willing to impart as much information as possible to the study. In addition, the tactics required to direct the interview towards the most relevant implementation issues were identified. Furthermore, the timing of sensitive questions during the interview was also recognised. These lessons would be invaluable during the primary data collection.

The next step in this research is organising the collection of the primary data. The primary data collection took place in four university libraries and one hospital. Analysing these organisations will produce five emerging RFID implementation process frameworks. These case studies will be presented in the following chapter.

CHAPTER 5

ILLUSTRATIVE CASE STUDIES OF RFID IMPLEMENTATION IN PUBLIC SECTOR ORGANISATIONS

5.0 Introduction

This chapter presents five illustrative case studies of the RFID implementation process in the UK public sector. Four of these cases were university-based libraries while the other case study was a hospital under the National Health Service (NHS). These case studies present the activities occurred during the 'unfreezing', 'moving' and 'refreezing' phases of the RFID implementation. The libraries and hospital involved were:

- The De Montfort University, Leicester

- The Sainsbury's Library, the Said Business School, Oxford University

- The University of Leicester, Leicester

- The Nottingham Trent University, Nottingham

- The Arrowe Park Hospital, Wirral

5.1 Illustrative case study 1: The RFID implementation process at the De Montfort University's Library, Leicester

5.1.1 Background of the library

The library is managed by the university's Department of Library Services. The department is responsible for managing three libraries that form the university's library services: The Kimberlin Library, the Elfred Thomas building and the Charles Frears campus libraries. The Kimberlin Library, in the city centre main campus, acts as the central library for the university. The second library that is located at the Elfred Thomas Building contains core materials relating to Law studies. The third library, located at the Charles Frears campus, contains materials relating to nursing studies. The three libraries are served by 164 establishment staff and 20 ancillary shelvers. They are divided into three main areas of activity: Academic Services, Public Services and Technical Services. They are headed by the senior management team who are responsible for setting the library's strategic direction and priorities, management and sourcing of the department, and ensuring the quality of its services.

5.1.2 The library's RFID implementation

In 2006, the library received a significant amount of funding for the refurbishment of the University's central library. From that funding, a small amount was set aside by the library's management to invest in the latest technology for library services. The

technology that was eventually selected was RFID. The technology was developed and installed through a partnership between the library and SP Electronics.

5.1.3 Activities during the 'unfreezing' stage of the RFID implementation

Figure 5.1 shows the unfreezing stage of the RFID implementation at the De Montfort University Library. The stage starts with the RFID requirements solicitation (1) activity, followed by setting the implementation objectives (2), providing justification to the senior management (3), and forming the RFID partnership (4)

5.1.3.1 Soliciting the RFID requirements (1)

To generate the right requirements, the library's first implementation effort was directed towards increasing its knowledge of RFID. Several sources of information were heavily referred to. First, literature on RFID, especially in the context of a library was referred to. Second, correspondence was made with colleagues from other libraries that had rolled out RFID systems. It was made possible by the culture of knowledge sharing between libraries. Third, a visit to Scandinavia to view a working RFID system in a library was made.

Despite the knowledge from the literature and experiences of other libraries, the requirements for the De Montfort's library remained vague. Instead, many of the requirements emerged only during the refurbishment effort. They were caused by the need to fit the RFID system with the new building. Because the library and the

vendor did not have prior experience of installing the system, adjustments were made, for example, to the RFID-based sorting system. A number of designs were trialled before the system was set-up in the library.
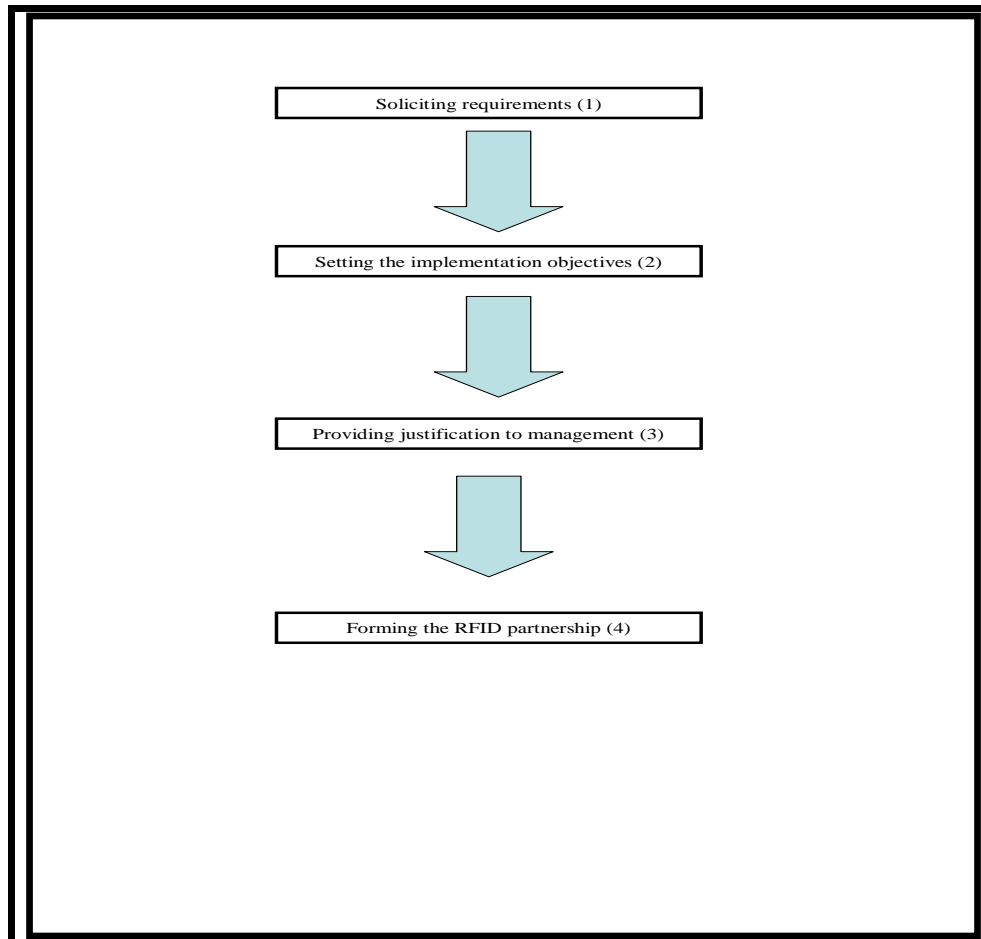
Figure 5.1 The unfreezing stage of the RFID implementation at the DeMontfort University Library

5.1.3.2 Setting the implementation objectives (2)

The library set several objectives for the RFID implementation. First, it wanted to ensure that it would have comparable capabilities with the other libraries. Second, it wanted to reap the benefits of RFID technology that were not available with barcode technology. For example, locating missing books on the shelves was possible with RFID; with barcode technology it was not. Third, as far as possible, the library would like to automate the issuing and returning of its materials, which formed the majority of its transactions. The use of RFID-based self-issue machines would allow the students to handle these basic transactions and free up the time of the librarians.

5.1.3.3 Justifying the RFID project to the senior management (3)

Justification for the RFID project was made to the senior management of the university. Despite their lack of direct input to the project, their consent was vital to the project. The consent was eventually given based on the reputation of the library. The library had served the university effectively by providing the relevant materials for staff and students. Furthermore, the library was renowned for pushing the boundary of technology implementation. As a result, the consent was received without much difficulty.

5.1.3.4 Forming the RFID partnership (4)

The tendering process was the first sub-activity in forming the RFID partnership. The amount of money involved made it compulsory for the library to invite tenders from across the European Union. As a result, the procedures for the European tendering process were studied. Second, investigations were made on the vendors tendering for the RFID project. When the tenders were submitted, they were reviewed by the library. From the review, a few potential companies were short-listed. They were invited to make presentations and the libraries that had implemented their systems were visited.

Finally, a company known as SP Electronic was selected to install the RFID system for several reasons. First, because the company was responsible for installing the turnstile at the gates, the security system they would provide would be compatible with the RFID tags. Second, and most importantly, the vendor was perceived to be "honest" in making their claims. According to the IT manager, they "did not make over the top promises". As a result, the library was persuaded to select the vendor even though it did not provide the cheapest quotation.

5.1.4 Activities during the 'moving' stage of the RFID implementation

Figure 5.2 shows the activities during the moving stage of the RFID implementation at the DeMontfort University Library. The activities started with a phase-by-phase rollout of the RFID system (1), followed by installation of the RFID system (2),

tagging process (3), assistance from University Departments (4), strengthening the RFID partnership (5), training the librarians (6), managing resistance (7), promoting the RFID system (8), and vendor support (9).
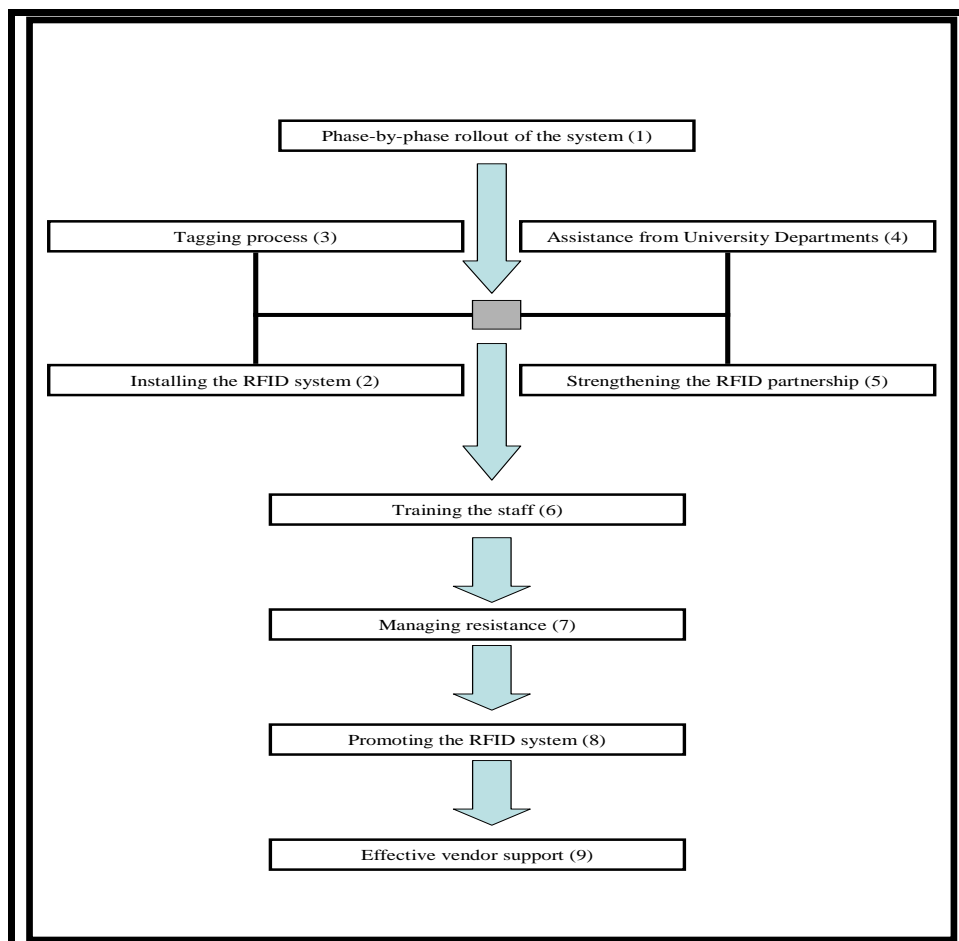
Figure 5.2 The moving stage of the RFID implementation at the DeMontfort University Library

5.1.4.1 Phase-by-phase rollout of the RFID system (1)

The phased rollout strategy was not initially planned. The initial plan was to rollout the RFID system directly at the main library. However, continuous building work prevented the system being installed in the new building. Thus, the system was installed and piloted at the Law Library first because of its small size. The piloting

turned out to be a good decision. It enabled the library to identify problems and fix them before they became less manageable in the main library. One of the problems that was identified and fixed was the reading of the EM strips and RFID tags at the hybrid RFID/EM gates.

The piloting, however, did cause some problems. The main problem centred on handling books that were borrowed from the other two libraries that were not equipped with the RFID system. As a result, the books had to be returned using the lending desk instead of using the RFID machines. The problem, however, was partly rectified because the system to handle barcodes was already installed at the main library.

5.1.4.2 Installing the RFID system (2)

The library faced three issues during the installation of the RFID system. First, the installation had to be aligned with the building work of the new library. It meant that sometimes installation had to be postponed until certain parts of the new building were completed. Second, the RFID system had to be linked with the existing library management system (LMS). The linkup became a problem because the library's LMS was provided by a different company called Talis. Third, the library incurred incidental extra costs. It had to procure the Standard Interface Protocol (SIP), the software that allows different machines to link and exchange data.

5.1.4.3 Tagging process (3)

The library faced several issues pertaining to the tagging of materials in the library. First, it had to decide which materials to tag. Second, the library had to decide whether to tag less RFID friendly materials such as CDs and DVDs. Third, the library had to decide how to tag multi part items such as audio books which comprise several sub-items. Fourth, the library had to decide who would perform the tagging. Fifth, the library had to decide what data should be entered into the RFID tags. The library could choose to enter all the data about the items such as the authors, book title, etc., or only the item's barcode data.

For the first issue, a decision was made to tag all materials except the journals. The journals remained with the old EM system to prevent them from being taken out of the library. For older materials with the EM strips, the strips were turned off. For the second issue, because of the difficulty in tagging the less RFID friendly materials, a decision was made not to tag them. Instead, they were stored behind the librarian's desk for issuing and returning purposes. For the third issue, a decision was made to tag only a few sub-items while putting dummy tags on the rest. The decision was made possible by the ability of the RFID readers to record many tags at one time. For the fourth issue, the task of performing the tagging was assigned to the cataloguing team who were already responsible for processing the stocks of the library. For the fifth issue, a decision was made to store only the item's barcode into the RFID tags while leaving out the other item's data. To obtain the full information of the materials, the information would be retrieved from the LMS.

5.1.4.4 Assistance from university departments (4)

The University's Estate Department made two contributions towards the RFID implementation. First, it assisted in wiring the RFID machines. The wiring was based on a diagram provided by the library, which indicated the location of the machines and the type of wiring required. Second, the department also ensured that the power supplies for the machines were located at the correct places.

5.1.4.5 Strengthening the RFID partnership between the library, its systems' vendors and the University's estate department (9)

The library strengthened the relationship between the vendor and the University's estate department by mediating their relationship. The mediation forced the two parties to consult each other on matters regarding the wiring of the RFID system. As a result, both parties were able to settle their differences amicably, thereby allowing the project to progress.

Meanwhile, the library also strengthened the relationship between its RFID vendor and the LMS vendor to enable the two systems to communicate and transfer data. They were encouraged to consult with each other to solve the problems regarding the linking of the two systems. Most of their correspondence was conducted through e-mails or telephone calls. Problem solving occurred mostly in an ad-hoc fashion, i.e. they were solved as they happened. This kind of problem solving was made possible by the ability of both parties to log into the system remotely to identify and fix the errors.

5.1.4.6 Managing resistance (7)

The resistance detected from the librarians was found to be minor. The minimal resistance was caused by several factors. First, the library replaced the old system with an equally efficient RFID system. As a result, the librarians were still able to manage their basic transactions without any major glitch. Second, because of the library's reorganisation effort, the RFID implementation was perceived to be a minor change. Third, the librarians' exposure to the technology through bulletins and mini presentations helped reduce their fear of the new technology. The library even went to the extent of stripping one of the machines to demonstrate to its librarians how the technology works. Fourth, the librarians were not forced to immediately accept the RFID system. Because they were given the opportunity to adjust their *modus operandi* with the new system, the librarians were willing to give it a try. As the IT manager of the library stated:

> *"... we have not made a big push with it. So, it has actually given people a little bit of time to actually say, okay, we've seen how it works, we know what it does, we're going to adjust what we do in the counter or downstairs to cope with it ..."*

Even when there were problems with the RFID system, the librarians were able to overcome them. One of the most stressful periods during the implementation occurred during the installation of the sorting system. In the activity, the librarians were asked to perform double work to check the sorting system. As the IT manager explained:

"We were asking the staff to do an awful lot of checking, extra checking

to make sure that it was doing what it was doing but they were very

good at that ..."

5.1.4.7 Training the librarians (6)

The librarians were trained to use the RFID-based self-service and sorting machines to enable them to guide the students in using those machines. In addition, short training sessions were conducted for the librarians at the beginning of the academic year. The sessions allowed the librarians to refresh their knowledge on the IT facilities in the library.

5.1.4.8 Promoting the RFID system (8)

Promoting the RFID system involved activities to persuade the library users to use the RFID self-issue machines for issuing and returning the library's materials. That responsibility fell on the librarians. However, because assisting users in finding relevant materials was a part of their responsibility, the librarians found the task of promoting the RFID system to be relatively easy. According to the library's IT manager, the librarians:

"...take people and use it so that they get used [to] using it ... But then

to try and help the others coach, and give instruction and lead people

through ..."

The task was made easier by the students' curiosity and initiative. On their own initiative, a number of students, without guidance or assistance from the librarians, used the self issue machines. According to the IT Manager:

"... even doing nothing as we done to promote it, still some students use it. They still gone, what's this? Put the card in, login, books, done. That's not so bad, is it? So, that's without any help from anybody ..."

5.1.4.9 Vendor support (9)

The vendor provided strong support to the library when it faced problems relating to the RFID system. First, the regional representative of the vendor came personally to the library to view and solve the problem. Because the same representative was also responsible for the installation and maintenance of the machines, the problems were solved immediately. In addition, the vendor had, at its headquarters, experts in particular aspects of RFID that would come to resolve the problems. As a result, the library was generally satisfied with the vendor support judging from the library IT manager's claim that the vendor had "reacted properly".

5.1.5. Activities during the refreezing stage of the RFID implementation

Figure 5.3 shows the activities during the refreezing stage of the RFID implementation at the DeMontfort University Library. The stage started with

consistent checks on the system (1), sharing the implementation experience (2), and

extending the RFID application.

Consistent checking of the system (1)

Sharing the experience (2)

Extending the RFID application (3)
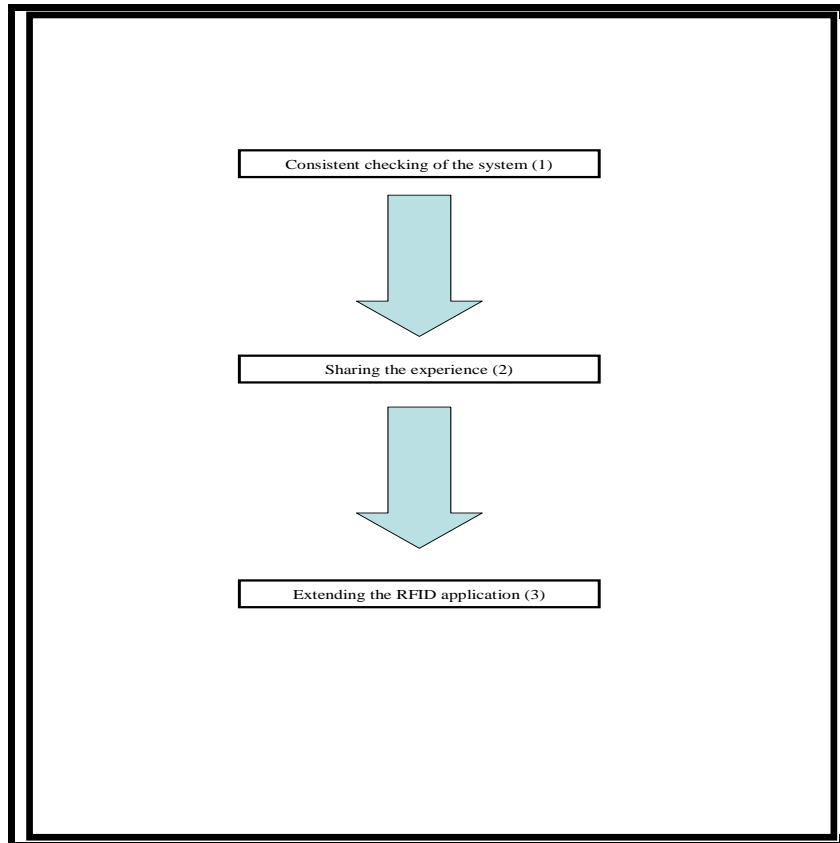
Figure 5.3 The refreezing stage of the RFID implementation at the DeMontfort
University Library

5.1.5.1. Consistent system check (1)

The system was checked consistently to ensure that it was working properly. For example, the book sorter was checked periodically to assess whether the books were sorted correctly. The RFID system was also checked periodically to determine whether there was error in the system's reading of the data. Any error would be reported and resolved as quickly as possible.

5.1.5.2. Sharing of the knowledge on the RFID implementation (2)

When the DMU's library was planning its RFID implementation, it received a lot of favours from other libraries that had willingly shared their implementation experience. The favour was returned by the library by sharing its experience with other libraries. These libraries were either planning or thinking about implementing RFID technology. They visited the library to view the RFID system at work and discuss the issues emerging from the DMU's RFID implementation.

5.1.5.3 Enhancing the RFID system (3)

The library planned to add more RFID applications to the RFID system. It is planning to implement the RFID technology to locate missing books on the shelves. It is also exploring the technology for users to navigate the main library building. The IT manager explained:

"...to help people to navigate around the building. If you have a tag on

you, then you got a mobile device ... I need to be here ... [However] A

little bit away to go yet with that kind of thing ..."

5.1.6 The contextual differences and their impact on the RFID

implementation in DeMontfort University Library

The DMU Library was one of the more recent implementers of RFID. As a result, they benefit tremendously from the lessons that have been learned by earlier RFID implementers such as the Nottingham Trent University. These lessons have enabled the library to quickly identify the requirements for their RFID system. In addition, the lessons have enabled the DMU Library to avoid the problems that the earlier implementers have to face such as technological immaturity.

As a more recent implementer of RFID, the DMU Library also benefited from the relative maturity of the RFID technology for libraries. The library was able to pick and choose the vendor to be its partner in the implementation. The RFID system was installed without much difficulty and operated without much glitch. As a result, the librarians and the students were generally satisfied with the system. Consequently, very little resistance was detected from the librarians and students.

Because the library faced very little resistance in its RFID implementation, it can focus its attention towards improving and extending its RFID system. It is just one of the two libraries in this study that has a RFID-based sorting machine. It was planning to apply RFID technology to locate missing books on the shelves and was even

exploring the possibility of using the technology to assist users in navigating the library.

5.2 Illustrative case study 2: The RFID implementation process at the Sainsbury's Library, Said Business School, Oxford University

5.2.1 Background of the library

The Sainsbury Library is a part of the Said Business School, Oxford University. It was named after its benefactor, Lord Sainsbury. The library is managed by the School's Library and Information Services, which is part of the Oxford University Library Services. However, the School's Library and Information Services operates almost autonomously and independently of the University's Library Services. The library's aim is to actively support the business school's teaching and research through its physical and virtual information services. The physical services were provided through its lower and upper reading rooms. The lower reading room includes books cited on the reading lists, the main library issue desk and an IT helpdesk. The upper reading room contains the library's research collection and includes a quiet study area. On the other hand, the virtual information services consist of electronic information resources on business and management topics. Access to the library is open to Said Business School members, staff and students of Oxford University. However, access is also given to faculty and doctoral students from other universities.

5.2.2 The library's RFID implementation

The library received a significant amount of funding for the development of the new library building. From the funding, a small amount was set aside for the library to implement a leading edge technology for library services. The search for that leading edge technology led to the selection of RFID. To develop the RFID system, the library was assisted by Intellident. It was a provider of control systems based on the RFID and barcode technologies. At the time of the implementation, the company was the only known provider of RFID systems for libraries in the UK.

5.2.3 Activities during the unfreezing stage of the RFID implementation

Figure 5.4 shows the unfreezing stage of the RFID implementation at the Sainsbury Library, Oxford University. The stage started with RFID requirements solicitation (1) activity, followed by setting the implementation objectives (2), providing justification to the senior management (3), and forming the RFID partnership (4) activities. The project was championed by a manager and a senior officer of the library (5) by leading the requirements solicitation, justification to the senior management process, and formation of the RFID partnership activities.
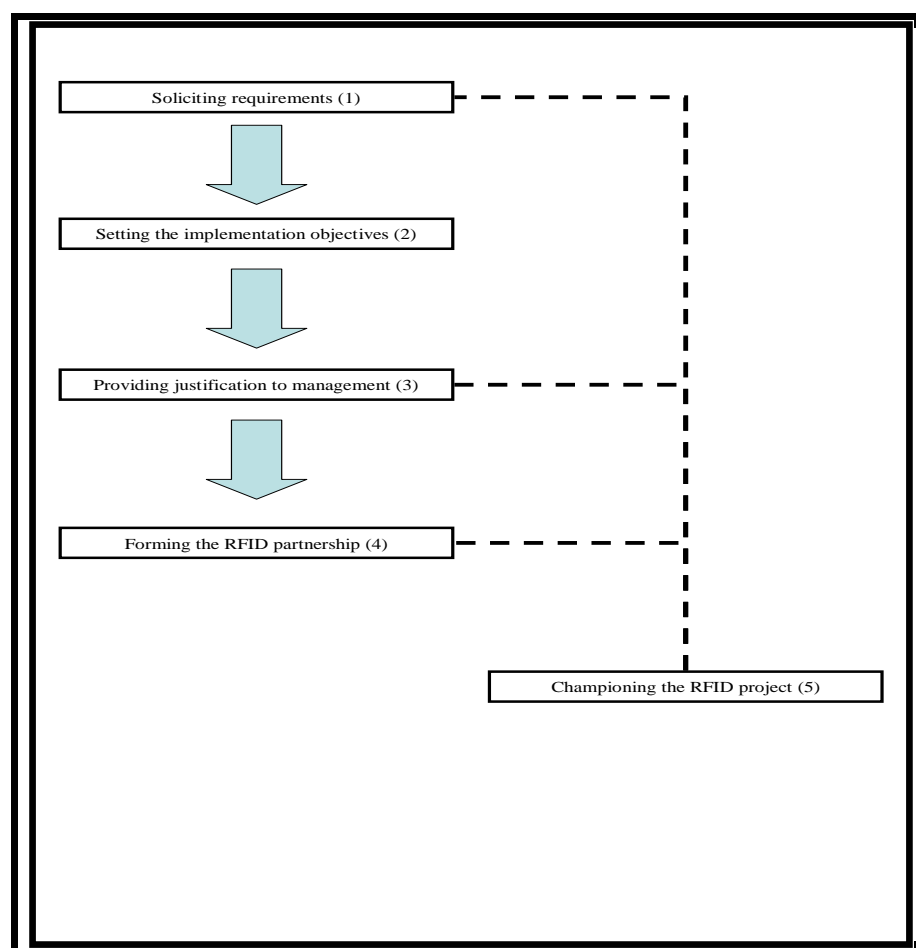
Figure 5.4 The unfreezing stage of the RFID implementation at the Sainsbury Library

5.2.3.1 Soliciting the RFID requirements (1)

During this stage, the Information Services Manager and the Senior Information Officer of the Sainsbury Library focussed their effort on enhancing their understanding of the RFID technology, especially its application in libraries. This objective was achieved through library shows and exhibitions. With a better understanding of the technology in the context of library applications they were able to determine the requirements for the library's RFID system. One of the requirements was to discard the available multiple reads capability because it had presented numerous problems to other libraries that had tried to implement the capability.

5.2.3.2 Setting the implementation objectives (2)

The library set several objectives for the implementation of the RFID system. First, the project was aimed at overcoming the problem of attending to students' transactions after office hours. The RFID-based self issue machines enabled the students to process their library transactions without staff assistance outside of office hours. Second, the library wanted to implement leading edge technology to complement the opening of the new library for the business school. Third, the library wanted to exploit the capabilities of the RFID that were unavailable through the EM technology. For example, it was now able to loan out journal articles by attaching the RFID tags to the journal folders. The manager explained:

> *"We have tried other technologies such as EM. Unfortunately, it didn't fit our purpose, especially when we want to issue out journal articles ... We can't put the EM item at the side of the folder. However, with RFID, we can put the tag at the back here and we can issue this item out easily ..."*

5.2.3.3 Justifying the RFID project to the senior management (3)

Because each school at Oxford University is administered independently, the case for RFID had to be justified to the management of the Said Business School. The task fell to the Senior Officer and the Information Services Manager. Their main argument was the benefits of the RFID technology over the EM technology. Because they were able to convince them that the RFID system offered more benefits and that

the library had the ability to fund the project, the senior management gave their consent to the project.

5.2.3.4 Forming the RFID partnership (4)

The library had very limited choices in selecting the vendor for its RFID project. Very few vendors were offering an RFID solution, especially in the library sector. In one of the shows that the officer and the manager had attended, Intellident was the only vendor found to be offering the required RFID solution. The company did have prior experience in implementing the RFID in a library because it was involved in the RFID implementation at the Norfolk and Norwich Millennium Library. Consequently, Intellident was selected as the vendor for the RFID project in the Sainsbury Library.

5.2.3.5 Championing the RFID project (5)

The Senior Information Officer and the Information Services Manager championed the implementation of RFID in the library. They generated the idea of RFID implementation after their visits to library shows and exhibitions. They argued successfully to the senior management for the adoption of the technology. Their devotion also brought the RFID project forward despite the implementation problems faced by the library.

5.2.4 Activities during the 'moving' stage of the RFID

implementation

Figure 5.5 shows the moving stage of the RFID implementation at the Sainsbury Library. It starts with the installation of the RFID system (1), followed by managing the resistance of a small number of librarians (2), promoting the RFID system (3), and vendor support. Two activities – assistance from University departments (2) and tagging process (3) – occurred when the RFID system was installed in the library.
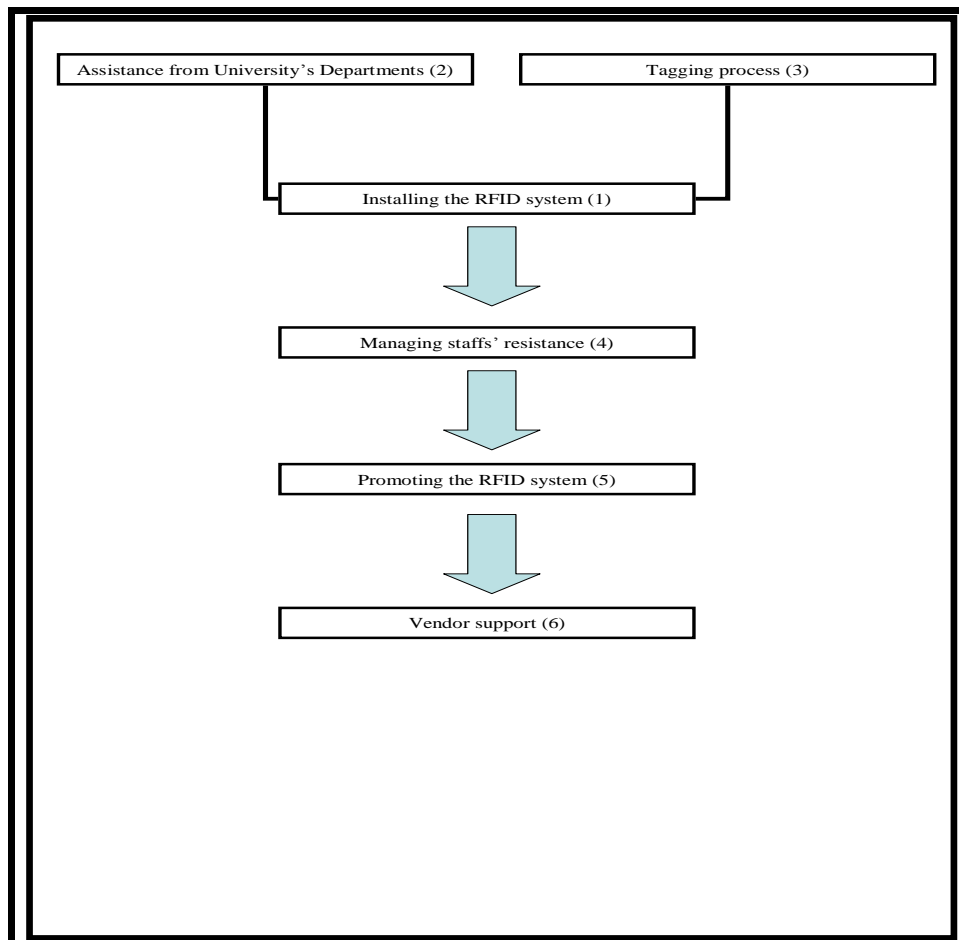
Figure 5.5 The moving stage of the RFID implementation at the Sainsbury Library

5.2.4.1 Installing the RFID system (1)

The installation activity included wiring the RFID machines and linking the RFID system with other systems in the library and the university. Most of these activities were performed by Intellident. It prepared the wiring plan, which displayed the wiring of the RFID machines to the exit/entrance doors. It also linked the RFID system to the LMS with software known as GX. The vendor along with the library also configured the linkage between the RFID system and the university wide system.

5.2.4.2 Assistance from University departments (2)

The School and the University IT Units assisted the library in its RFID implementation. The School IT unit configured the machines' user interface to portray the identity of the School. The configuration included the School logo and colour. Meanwhile, the University IT department configured the linkup between the RFID system and the other services in the university.

5.2.4.3 The tagging process (3)

As a part of their administrative duties, the library staff performed the tagging. Their tasks included putting the tag at the back of the book covers and inputting the books' barcode data into the tags. This task occurred simultaneously with the staff duties of assisting the clients in finding relevant academic materials.

5.2.4.4 Managing librarians' resistance (4)

The Senior Officer detected minimal resistance towards the system from the librarians. The lack of resistance could be attributed to two reasons. First, the library had ample time to convince the small number of librarians of the merits of RFID. Second, a series of presentations by the library had convinced the librarians of the benefits of RFID over EM. Third, the implementation represented an addition rather than wholesale changes to the procedures in the library. Although changes were made to library procedures, changes to the policies were absent. For example, students were still required to return their book on time. The change, instead, came from the procedures for returning the books. Instead of approaching the lending desk, the students were required to use the RIFD self-issue machines. The lending desk only entertained those with issues concerning their accounts, e.g. outstanding debts.

The perseverance of the librarians during a number of implementation obstacles provided further proof of the library's success in managing staff resistance. One of these obstacles was 'double tagging'. It involved taking out the old tag and putting a new tag into the library's materials. It was caused by the inability of the newer RFID readers to capture data from older RFID tags, even though the library was assured by the vendor that the task could be performed. Although the task was repetitive and stressful, the librarians committed themselves to the task until it was completed.

5.2.4.5 Training the librarians (5)

A part of the librarians' general training module was the RFID system's training. The training familiarised them with the self-issue machines. Consequently, they would be able to guide the students to use them. The familiarisation process took very little time because the system was relatively easy to use.

5.2.4.6 Promoting the RFID system (5)

During the induction week, the RFID system was introduced to the new students of the School by their facilitators. The students' facilitators brought the new students to the RFID machines to showcase their skills in using them. The promotion encouraged the students to use the RFID system later.

No particular librarians were assigned to assist the students in using the RFID system. It was made possible by positioning the RFID machines near the lending desks. As a result, the staff behind the lending desk were able to provide assistance should it be required by the students.

5.2.4.7 Vendor support (6)

Because of its status as one of the earliest implementers of RFID, the library faced numerous implementation problems. Sometimes, the RFID system failed to link properly with the LMS, thus missing some of the data being transferred between the systems. The alarm at the gates went of for no obvious reason. The library also faced

problems enforcing some its rules and regulations through the RFID system. For example, it was unable to prevent patrons from borrowing a reference book or borrowing while having an outstanding debt. As a consequence, the library had to disable its enforcement when librarians were not around to manage the system.

Although the vendor made an effort to resolve the library's RFID problems, its supporting ability was severely restricted. The vendor had a limited number of staff to deal with the problems. Also, the company did not have a regional representative to entertain the calls efficiently. As a result, there was a delay in solving the problems. Although the level of support was enhanced significantly, the delay in support caused frustration on the part of the library. The manager elaborated:

"... they could not attend to our issues as quickly as we would have wanted it to be. I was frustrated calling the helpdesk because it was engaged all the time. I used to call the project manager directly rather than going through the helpdesk because it's very difficult to get them ..."

5.2.5 Activities during the refreezing stage of the RFID implementation

5.2.5.1 Enhancing the RFID system

The RFID system went through several upgrades. A RFID machine to perform both issuing and returning functions was purchased. The LMS was also upgraded to the Windows-based interface version (the previous version used a DOS-based interface).

This move, however, raised concerns about its link with the RFID system. The manager explained:

"... I am very cautious about the impact of the new system with the RFID system. Will it still be able to read the data from the RFID system? We just have to wait and see ..."

The library also planned to further upgrade the RFID system. It was pursuing the idea of installing a RFID-based stock management system that would enable the library to perform stock taking more frequently. In addition, the library was thinking of installing a RFID-based sorting machine. However, the library's structure led to the postponement of the plan. Furthermore, the library rejected the idea of using shelf-readers. The combination of the high cost of the readers and the small number of items in the library prevented the library from pursuing the idea.

5.2.5.2 Establishing a university-wide working group on RFID

To investigate the feasibility of using RFID in the university, especially in libraries, a working group was established by Oxford University. The group consisted of a number of people from different parts of the university. It organised several activities relating to RFID: conference, luncheons and demonstrations. Feedback received from these activities was discussed in the group's meeting. Based on the feedback, the group presented a strategic way forward for RFID in the university by suggesting whether RFID was the right technology for the university and, if it was, should it be a university-wide or an individual library's initiative.

5.2.6 The contextual differences and their impact on the RFID

implementation in the Sainsbury Library

The Sainsbury Library was one of the earliest implementers of RFID. As a result, the library faced numerous problems in their implementation. It has to rely on an inexperienced vendor to become its partner in the RFID project. This reliance has made it difficult for the library to get good technical support. The lack of support problem was compounded by the relative immaturity of the technology. As a consequence, the library's RFID system had many glitches. In addition, because the library was one of the earliest implementers, it could not consult other libraries to guide the library in its RFID implementation.

These problems have put tremendous pressure on the library's RFID project. The students and academicians were complaining that the RFID system was missing some data when it was reading from the RFID tag. The librarians were restless because they could not overcome the problems faced by the students and academicians. These difficulties have led some librarians to resist the use of the RFID system. Only the intervention of the RFID project champions saved the project from incompletion.

The RFID champions were crucial to the successful completion of the RFID project in the library. Their efforts during the unfreezing stage enabled the project to get started while their efforts during the moving stage reduced the resistance towards the system and enabled the system to be completely installed and working. Their endeavour to ensure the completion of the RFID project was eventually recognized by the Oxford

University when it formed university-wide working group to study the feasibility of

introducing RFID to the whole university.

5.3 Illustrative case study 3: The RFID implementation process at the Leicester University's library

5.3.1 Background of the library

The Leicester University (UL) Library consists of the Education Library, the Clinical Science Library and the main library. The Education Library contains the collections on Education, which cater for the interests of staff and students of the School of Education and local members of the teaching profession. The Clinical Science Library contains collections on medicine, health and social care, which cater for the interests of staff and students of Leicester Medical School and NHS employees in Leicestershire. The largest of the three libraries is the main library, which contains the materials for other schools in the university.

5.3.2 The library's RFID implementation

From the 1st April, 2008, the main library had a new building. It was merged with the Education Library and was renamed the David Wilson Library. The opening of the library coincided with the introduction of the RFID system for issuing and returning the library's materials. The introduction resulted from the students request and the library's pursuance of state-of-the-art technology for the library.

5.3.3 Activities during the unfreezing stage of the RFID

implementation

Figure 5.6 shows the unfreezing stage of the RFID implementation at the Leicester University Library. The stage starts with the solicitation of the requirements of the RFID system (1) activity, followed by setting the implementation objectives (2), providing justification to the senior management (3), and forming the RFID partnership (4) activities.
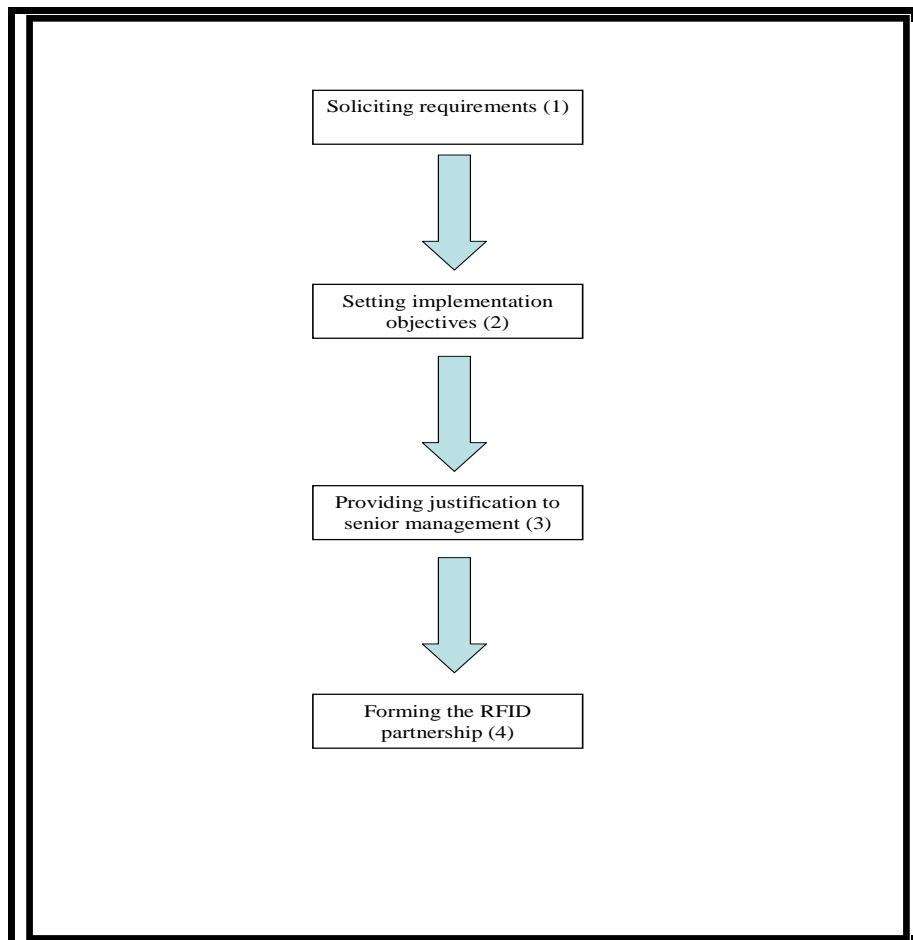
Figure 5.6 The unfreezing stage of the RFID implementation at the Leicester University Library

5.3.3.1 Soliciting the requirements for the RFID system (1)

The idea for RFID came from the visit by senior library personnel to the Nottingham Trent University, which had previously implemented the technology for self issuing and returning of library materials. Upon returning from the visit, the manager started a discussion with colleagues in the library. The discussion centred on the type of applications required in the library.

Visits to other libraries were also arranged to enhance the library's understanding of the viable applications for its implementation. Visits were made to public libraries in Essex and Colchester to view how the public were employing the RFID technology there. A visit was also arranged to the public library in the London Borough of Sutton that employed both 3M's RFID system and Cerci Dynax's LMS.

The library also gained from the experience of other university libraries that had already implemented RFID. One of them was the Nottingham Trent University (NTU). The visit to the library allowed the library staff to view first-hand how the RFID system worked in a university library. Furthermore, the visit provided an opportunity for the library to share the experience of NTU's RFID implementation.

Once the UL had gained a better understanding of the technology's applications in a library, it was able to identify the special requirements for its system. One of the requirements was retaining the use of the EM security strip for the library's physical journals. The decision allowed the library to continue lending those journals without sacrificing security. The library also decided to disable the multiple-reads feature at the self-issue machines to avoid the possibility of unread data at the machines.

Disabling the feature forced the students to only put one item on the machine at a time.

5.3.3.2 Setting the implementation objectives (2)

The library set two implementation objectives. First, it wanted to complement the opening of the new library with the state-of-the-art technology for libraries. Second, it wanted to provide easy-to-use self issue machines for students and librarians to issue and return materials in the library. The Head of Public Services explained:

"... the advantage to us of RFID is that it's much easier for the user. They don't have to work out where the barcode is. They don't have to open the book. They don't have to find it ... They just put the book on the cradle and it issues ..."

5.3.3.3 Justifying the project to the University's senior management (3)

The case for the RFID system was presented to the University's senior management by the Head of Public Services and the Principal Librarian. They justified the investment through future staff savings resulting from the RFID-based self-service machines reducing future vacancies. The library envisaged that the need for more staff would be minimal because the self-service machines would handle most of the issuing and returning tasks. Although the reception and service desk would still exist, its purpose would no longer be for issuing and returning materials. Instead, it would

serve visitors coming for research purposes or patrons experiencing problems with their accounts.

5.3.3.4 Forming the RFID partnership (4)

Forming the RFID partnership involved several stages. First, because of the size of the project and the amount of money involved, the library went through a European Union tendering process. The second stage involved working with various individuals to draw up the request for proposal (RFP). The library had outlined several criteria for the selection of the vendor including – vendor must provide a competitive cost structure, accommodate the existing LMS, complement the university IT network, accommodate the electro-magnetic (EM) technology, and implement a RFID-based sorter system.

The vendors were required to submit their proposals for evaluation by the library. The proposals need to explain how the vendors plan to meet the evaluation criteria of the library. The vendors that met the above criteria were short listed and called for interviews before the actual RFID vendor was selected. At the end of the process, 3M was selected as the vendor for the RFID project because it offered a package that met all the requirements of the library, especially the accommodation of the library's older EM technology.

5.3.4 Activities during the moving stage of the RFID implementation

Figure 5.7 shows the moving stage of the RFID implementation at Leicester University Library. The stage started with a phase-by-phase rollout of the RFID system (1) activity, followed by aligning the RFID project with the building work (2), development and installation (3), managing resistance (8), promoting the RFID system (9), and vendor support activities. Four activities − strengthening the RFID partnership (4), University departments' assistance (5), the tagging process (6), and training the staff (7) − occurred in parallel with the development and installation activity.
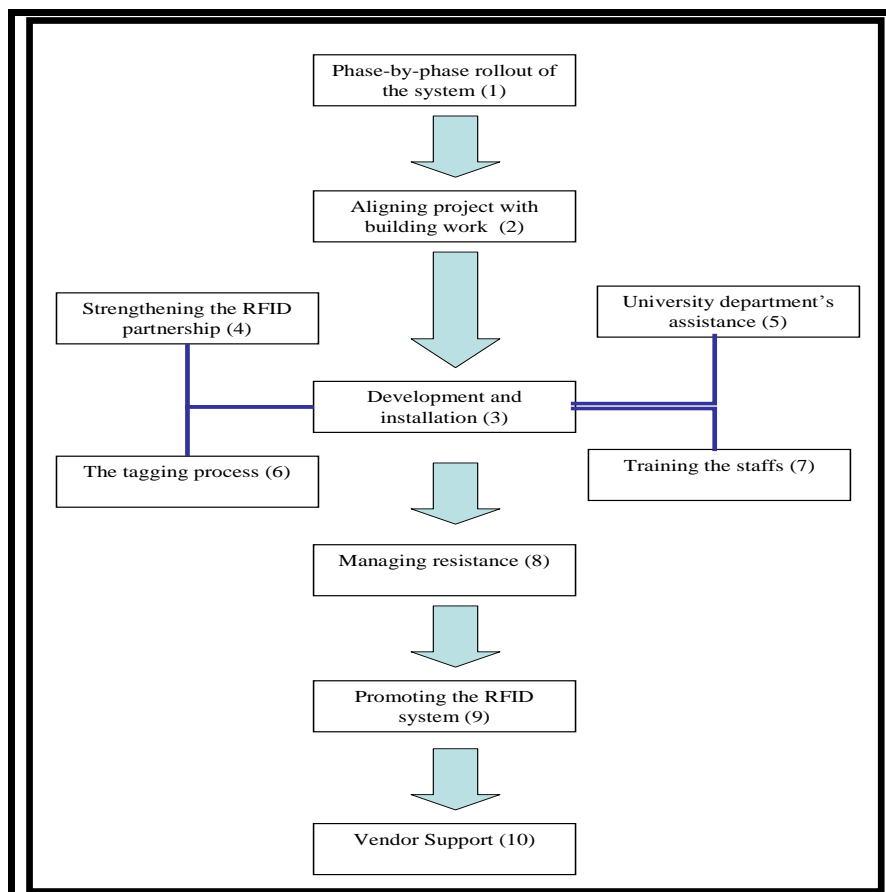
Figure 5.7 The moving stage of the RFID implementation at Leicester University Library

5.3.4.1 Phase-by phase rollout of the RFID system (1)

The RFID system was piloted at the Clinical Sciences Library. The library went live with combined RFID-based self issuing and returning machines early in 2007. The pilot provided many benefits to the library. It showed that the system could work well in the university's library. It provided further proof that students and librarians would be able to use and accept the RFID system. Moreover, it provided an avenue for librarians who had no previous experience of an RFID system to view and try the system.

5.3.4.2 Aligning the RFID project with the new building work (2)

The library worked closely with the building contractor in aligning the RFID project with the building work. The contractor's technical officer was shown the specification for the RFID system to ensure that the new building would not contain materials that would disrupt the RFID's signal. As a consequence, the contractor avoided installing material that would interfere with the signals of the RFID machines. In addition, from the specification, the contractor allocated a space to install the RFID-based sorting machine. The space would enable the library to efficiently move the sorted items into their respective floors for shelving.

5.3.4.3 Installing the RFID system (3)

The library and the RFID vendor worked together to put a working RFID system in the library. The library provided the networking and electrical points, while the

vendor brought in and installed the RFID machines. The vendor also ensured that the librarians faced little difficulty in issuing and returning materials with the system.

The vendor also had to reconfigure the system for the library's short loan area. In this area, materials were loaned for a very short period of time and they were not allowed to be taken. Any attempt to take a book out of the area would trigger the alarm. Unfortunately, the alarm would also be triggered if books from other areas were taken into the short loan area. To avoid these scenarios, the system had to be reconfigured.

One of the most important activities during this stage was linking the RFID system with the library management system (LMS), which was supplied by Sirsi Dynax Unicorn. In order to link the two systems, the library had to ensure that its LMS was SIP compliant. The library received this assurance through visits to sites that were using both systems.

5.3.4.4 Strengthening the RFID partnership (4)

Strengthening the partnership between the library, the RFID vendor and the LMS vendor was given high priority by the library. Meetings with the RFID and LMS vendors were held regularly after the tender was awarded. The progress of the RFID project and activities that were being undertaken to move the project forward were discussed at the meetings as well as the resolution of problems experienced by either party.

5.3.4.5 Assistance from the University's departments (5)

The University's IT Services ensured that the RFID networking complied with the university's standard. When the self-issue machine was about to be installed for the pilot project in the Clinical Sciences library, the IT Services outlined the standards required from the system before it could become operational. The unit ensured that the standards were fulfilled by the library before the system was certified and the software was installed into the system.

5.3.4.6 The tagging process (6)

Avoiding the need to rush the tagging process helped reduce the cost of the RFID project. It was caused by the time gap between the time the RFID tender was awarded and the completion of the new library building. The library took this opportunity to distribute the tagging task across one whole year. The task was performed by the librarians as part of their general duties. Four university students were employed to assist in the tagging process. The use of a few casual workers reduced the cost of implementation.

The library also made several decisions regarding the materials that required tagging. A decision was made to tag all the items except its journal collection. The huge number of journals under its roof had prevented the library from tagging all of them. Instead, the journals retained the EM security strips. Retaining the EM technology enabled the library to loan the journals to the library members without sacrificing security.

The process of tagging all the items while they were still operational presented the library with a huge challenge. Initially, the library tagged the items in phases and kept the items that were returned for tagging later. However, the task proved to be too tedious for the librarians. Consequently, the library decided to only tag the items on the shelves, floor by floor. A librarian with a mobile RFID machine went through the shelves to check whether the items were tagged. This process, however, was halted when the library had to move its materials to the new building.

5.3.4.8 Managing resistance (8)

The Head of the Library's Public Services only detected a minor resistance from the librarians towards the RFID system. It was partly due to the tactics employed by the library to reduce their anxiety. Librarians were made aware of the intention to introduce RFID from the initial implementation stage. They were assured that they would not be made redundant. Instead, their jobs would change from managing library transactions to assisting the users. Furthermore, the changes were made incrementally and did not involve a redesign of the librarians' job descriptions. For example, the librarians were periodically asked to move from their desk and to offer assistance to new students on the library floor. This kind of exposure prepared the staff for when they would really be required to be on the library floor to assist students. As the Public Services Manager added:

> *"...when the library's finished, they will be more than capable: a) of*
>
> *helping people use the new library, and b) of helping users use self*

service because they are used now to being out from behind the desk

helping people ..."

Some resistance was detected when the RFID system had a technical difficulty during the piloting stage. Because the library only had a single machine during the piloting, the librarians at the pilot site had no alternatives when that machine was faulty. As a consequence, they immediately thought that the RFID system had failed. They even asked users to stay away from the RFID system because it was not working. The inability of the system to implement multiple reads had added to the frustration of the librarians. In order to reduce the tension, the manager had to reason with the librarians that the system had worked well in the Nottingham Trent University. The manager had also clarified to the librarians the weakness of the combined RFID-EM system and that despite its limitations the benefits of the system far outweighed its drawbacks.

5.3.4.9 Training the librarians (7)

Training helped the librarians in their transition to the new RFID system. The library provided customer service training to the librarians to prepare them for the implementation of the self-issue machines. The training included handling the queries expected from the students. In addition, the library provided support to the librarians who were acting as floor workers by having two librarians in an area at any one time. As a result, one member of staff could help the other in serving the patrons.

5.3.4.10 Promoting the RFID system (9)

Promotion of the RFID system started during the piloting at the Clinical Sciences Library. The librarians in the library took some students to the RFID machines and showed them how the system operated. The promotion enticed the students to use the machines when they returned to the library. The more difficult part was demonstrating the use of the RFID machines for returning materials to the library. Students tended to put the book in the returning slots without first returning them through the machines. Librarians had to stop them from simply putting the books in the slots by demonstrating to them the correct procedures for returning the books using the RFID machines.

5.3.4.11 Vendor support (10)

The vendor assisted the library by developing a relevant RFID solution and by solving the problems caused by the system. For example, the vendor provided the solution to the issue of RFID tags in the short-loan area. The solution enabled materials from other sections of the library to enter the short-loan section while ensuring that the materials in the section would not be taken out of the area.

5.3.5 Activities during the refreezing phase of the RFID implementation

5.3.5.1. Enhancing the RFID system

The decision to delay the setup of the sorting machine was caused by the library's inability to determine the exact location of the materials in the new building. The setup had to be delayed because the location of the item had to be stored in the LMS first before the sorting machine could work. Thus, the library postponed the development and use of the RFID-based sorter until the materials had fixed locations in the library.

5.3.6 The contextual differences and their impact on the RFID implementation in the Leicester University Library

Similar to the DMU Library, the LU Library was one of the more recent implementers of RFID. Just like DMU, the LU Library benefitted from the lessons that have been learned by earlier RFID implementers such as the Nottingham Trent University. The lessons have enabled the library to quickly identify the requirements for their RFID system. In addition, the lessons have enabled LU to draft a more detailed requirement in selecting the vendor as its partner in the technology's implementation.

Although other organisations in this study have made some effort to strengthen the RFID partnership, none were as conscious and strong as the LU Library's effort to

strengthen the RFID partnership between the library, the vendor, the university's departments, and the building contractor. Findings from this study suggest that this library believes that contractual relationship alone is not enough to ensure a smooth implementation of the technology. Instead, a strong relationship between the parties involved ensured that any problems can be quickly resolved and the implementation will proceed as scheduled.

When this study was conducted in the library, it is still in the process of completing the new main library building. As a result, little conclusions can be made about the refreezing stage of the RFID implementation process. Most importantly, no conclusions can be made about the possible extensions of the library's RFID system as this often requires the existing RFID system to operate seamlessly first.

5.4 Illustrative case study 4: The RFID implementation process at the Nottingham Trent University (NTU)'s Library

5.4.1 Background of the library

The Nottingham Trent University library consists of three libraries. The first library is the Clifton Campus Library that provides services to the School of Arts and Humanities, School of Education and the School of Science and Technology. The second library is the Brackenhurst Library, which provides services to the School of Animal, Rural and Environmental Sciences. The third library, which is also the largest library, is the Boots Library. This is located on the City Campus. It provides library services to other disciplines such as art, architecture, social science, business and law.

These libraries are managed by the University Library and Learning Resources Department. The department is one of the most important components in supporting the university's Institutional Learning and Teaching Enhancement Strategy (ILTES) 2006-2010. The library's contribution to the strategy is through 'supporting students and staff to acquire information literacy and higher order skills. The department is headed by the Director of Libraries and Knowledge Resources. He is supported by four managers: the Deputy University Librarian for Customer Services, the Deputy University Librarian Information Resources, Head of Educational Development Unit and Manager of Business Support Unit.

5.4.2 The library's RFID implementation

The inspiration for the implementation came from the NTU Deputy Librarian's visit to the Singapore Public Library, which at that time had implemented RFID technology. The Deputy Librarian and his colleague were amazed by the ability of the technology to deliver self-service capabilities to the patrons of the library. He also saw the technology working at the National University of Singapore and met staff at the Temasek Polytechnic, which was considering implementing the technology. Upon his return to the UK, he prepared a business case for the implementation of RFID in the NTU library.

5.4.3 Activities during the unfreezing stage of the RFID implementation

Figure 5.8 shows the key activities during the unfreezing stage of the implementation. Activities during the unfreezing stage started with the solicitation of the RFID requirements (1), followed by setting the implementation objectives (2), justifying the project to the senior management (3), and forming the RFID partnership (4). The RFID project manager championed the implementation when the requirements for the system were solicited, the implementation objectives were set and the business case was presented to the senior management.

5.4.3.1 Soliciting requirements (1)

The initial requirements for the RFID system were formed through the visits of the Deputy Librarian to the public and university libraries in Singapore. However, upon his return to the UK, he faced a huge challenge in developing a similar RFID system. The company that had provided the RFID system in Singapore was not operating in Europe. To further complicate matters, the only RFID vendors available at that time had no prior experience in providing a RFID solution for a library. As a result, the potential vendors were unable to suggest the requirements for a good RFID system for the library.
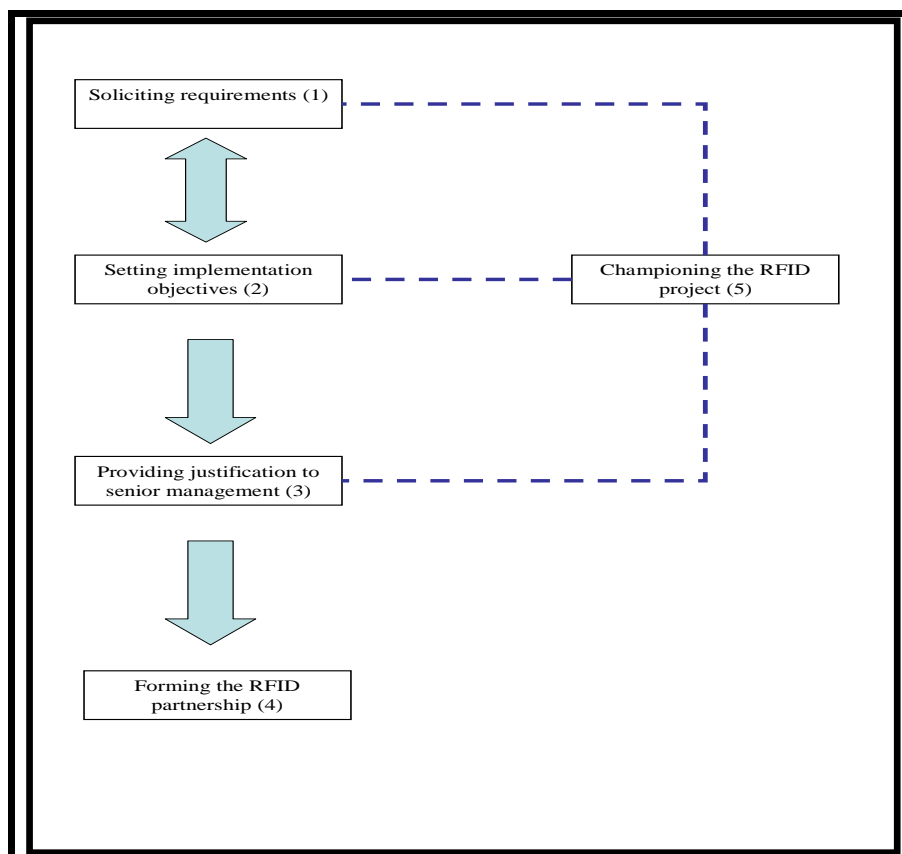
Figure 5.8 The unfreezing stage of the RFID implementation at the Nottingham Trent University Library

The library finally chose three RFID-based applications that were deemed to be crucial to its aim of enhancing the students' experience: a self-service system, a stock management system and a sorting system. Among the three, the library implemented the self-service system successfully and was still in the process of fine-tuning the stock management system. However, the sorting system was rejected due to its high cost of purchase, installation and maintenance.

5.4.3.2 Setting the implementation objectives (2)

The main objective of the implementation was to enhance the experience of the students and librarians in using the library. A part of that enhancement included allowing the students and academicians to take responsibility for managing their basic library transactions, including the issuing and returning of library books. The RFID was perceived as the best technology at that time to achieve the objective.

5.4.3.3 Justifying the project to the senior management (3)

The Deputy Librarian prepared a business case for the implementation of RFID in the library. In the business case, the RFID implementation was linked with the enhancement of the students' experience by providing them direct support. That kind of support would be costly without RFID because it would require the recruitment of a large number of library staff to provide the personal support and the handling of basic library transactions. It was asserted that the only way to provide personal support, without the need for recruitment of new staff, was through the implementation of RFID-based self-service facilities.

The commitment of the senior management towards improving the students' experience helped in securing their support and funding for the project. Initially, they were surprised by the large amount of funding required for the project. However, the senior management eventually accepted the idea that the RFID was the only viable technology to achieve the library's objective of enhancing the students' experience. They conceded that the existing barcode technology did not have the capabilities required to achieve the library's objective.

5.4.3.4 Forming the RFID partnership (4)

When the library was planning the implementation, a vendor that specialised in RFID solution for libraries was not found. As a result, the library decided to work with Intellident, a vendor who had no experience in implementing RFID solutions for libraries but had extensive experience in implementing the technology in the retailing sector. Before the library could work with Intellident, the project had to be opened for European tender. After the potential vendors were short listed, an announcement was made by the library that it would be working with a preferred partner. From then onwards, the library worked closely with Intellident to develop a viable RFID solution.

5.4.3.5 Championing the RFID project (5)

The RFID project was championed by the manager in three ways. First, he came with the idea of implementing the technology after seeing it work in libraries in Singapore. Second, he fought for the commitment and funding for the project from the university's senior management. Third, he was instrumental to the successful implementation of the technology in the NTU library. He was closely involved in selecting and negotiating with the RFID vendor and in directly overseeing the running of the project. His direct involvement was crucial in ensuring that the project progressed despite the many technical difficulties.

5.4.4 Activities during the moving stage of the RFID implementation

Figure 5.9 shows the key activities during the moving stage of the implementation. The activities during the moving stage started with the installation of the RFID system (1), followed by the tagging process (2), strengthening the RFID partnership (3), the assistance from other departments (4), managing resistance (5), promoting the RFID system (6), and vendor support. Activities (1), (2), (3) and (4) occurred in parallel.

5.4.4.1 Installing the RFID system (1)

The vendor, Intellident, was contractually responsible for ensuring the successful completion of the RFID project. One of its responsibilities was linking the RFID system to the existing library LMS. To link the two systems, the vendor had to ensure that both complied with the Standard Information Interchange Protocol (SIP). The

protocol allowed the RFID and LMS systems to exchange data over the network. Although both parties claimed that they were SIP-compliant, their degrees of compliance varied. Consequently, a number of discussions were held between the two parties to overcome the technical difficulties of linking the RFID system to the LMS.
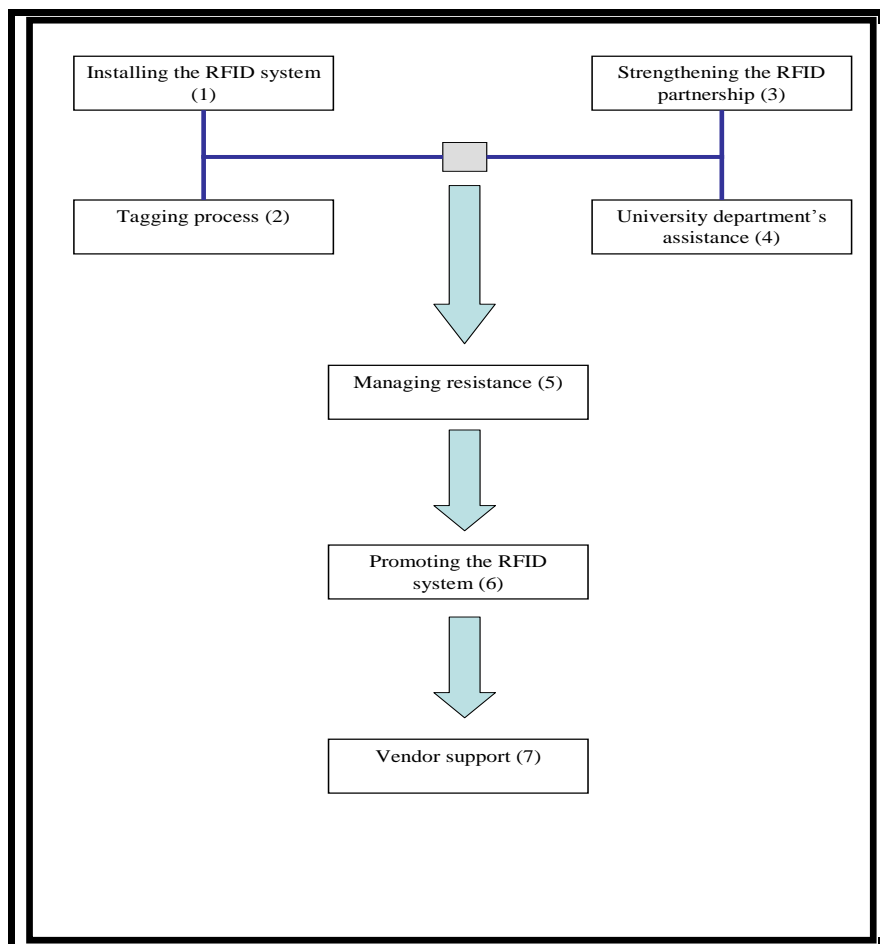
Figure 5.9 The moving stage of the RFID implementation at the Nottingham Trent University Library

5.4.4.2 Tagging process (2)

The first task in the tagging process was selecting the appropriate tags. The library identified two criteria for the selection of the tags. First, the library searched for tags that complied with the ISO 15963 standard and the area interface standard of ISO 18000. Second, the library searched for tags that were manufactured by quality manufacturers and were encapsulated properly in their casing. These criteria led to the decision to use the tags manufactured by Phillips. Its tags were found to be thoroughly tested before they were released to the market, which resulted in a very low rate of failure. The selection of the tag was also included in the negotiation with Intellident to ensure that the tags from Phillips would be chosen and that the library would obtain the tags at discounted rates.

The next sub-activity involved performing the tagging of the library's materials. It was performed during the summer vacation because the volume of transactions during the period was low. Most of the tagging was performed by temporary staff. To assist them in managing the tagging process, a simple workflow was designed. The process started with taking the books from the shelves, followed by applying the tags onto the books, writing the data into the tags and returning the books to the shelves. Only the books' barcodes were entered into the RFID system, hence, acting as unique keys in the LMS.

One glitch in the tagging process related to the old EM strips. Because the library had chosen to have a single state EM strip when they were first put in the books – strips that are always in the 'on' state – they could not be simply switched off. Instead, they

had to be removed manually from all the books. As a result, the library incurred additional cost because the library had to assign the task to a library book binder. The Deputy Librarian added:

"…The moral of the story was that there can be false economy sometimes. When those tags were put in, those tapes, some of them twenty years ago, the university took the view that we could save a little bit of money by putting single state and then twenty years later we spent an enormous amount of money having to remove the stuff …"

5.4.4.3 Strengthening the RFID partnership (3)

The library had put the onus in strengthening the RFID partnership on Intellident by making the company contractually responsible in completing the RFID project. The contract 'forced' the vendor to cooperate with different parties in the development of the library's RFID system. For example, the vendor had to work closely with the library's LMS provider to link the RFID system to the LMS. The vendor even made additional payments to the LMS provider for some development work to ensure that both systems linked efficiently. Although the tactic meant the library incurred additional cost, putting the burden of completing the project on the vendor ensured its completion. In addition, it allowed the library to focus on its core business of providing information services to the university community.

5.4.4.4 Assistance from other university departments (4)

The role of the university's IT department in the project was small because of the 'simplicity' of the RFID system. It was not a complex system requiring complicated linkages between the servers and the software. As a result, less assistance was required from the university's IT department. The manager explained:

> *"...The responsibility in terms of implementing this on behalf of the university was relatively small. Implementing RFID is not a big complex server based system. It just runs on PCs, the kind of PCs that most people have on their desk ..."*

5.4.4.5 Managing resistance from the librarians (5)

The librarians only displayed some resistance to the employment of RFID for managing the basic library transactions. The resistance came mostly from the library assistants who feared that the RFID implementation would jeopardise their jobs. The resistance from the library assistants however had been anticipated. As a consequence, the focus of the library management was towards reducing the anxiety and eventually defusing the resistance from this particular group of staff. The Deputy Librarian explained the effect of the RFID technology on their jobs. He clarified that they would not be made redundant by the technology. Instead, he asserted, it will assist them to spend more time working and assisting students in finding relevant materials in the library. In other words, rather than being bogged down with monotonous and minute simple transactions, they would be able to perform more

worthy and valuable tasks. This reduced the assistants' anxiety and, eventually, their resistance to the system.

5.4.4.6 Promoting the RFID system (6)

To promote the RFID system, the library management took a radical approach. The lending desk at the library was removed, thus forcing the students and academicians to use the RFID-based self service machines for issuing and returning library materials. To assist the students and academicians, a few librarians were positioned near the machines to assist the users should they need help.

5.4.4.7 Vendor support (7)

The lack of knowledge on RFID in libraries had limited the ability of the vendor to provide good support to the library. An enormous amount of time was spent explaining the library's operation to the vendor before it could produce a viable solution. For example, it took some time for the vendor to understand and produce a solution for multi-part items with parent-child relationships. The situation had complicated the effort to fix the technical problems with the RFID system. The Deputy Librarian manager said:

> *"...We were effectively trying to teach Intellident about library*
>
> *operations and that's not a good position to be in when you're trying to*
>
> *fix these things. They were committed to making it work but we did have*

a number of implementation issues. Some of which took quite some time

to resolve ...”

5.4.5 Activities during the refreezing stage of the RFID

implementation

The activities during the refreezing stage of the RFID implementation consisted of enhancing the RFID system, monitoring the interoperability standards, and putting pressure on the book industry. These activities occurred in parallel.

5.4.5.1 Enhancing the RFID system

The library intended to implement a stock management system from a different vendor. The library rationalised that the arrangement would still work because of the interoperability of most current RFID equipment. Hence, the complexity of the linkage between the stock management system and the RFID system could easily be resolved.

The move for a RFID-based sorting system was rejected. It was felt that the benefits from such a system were unjustifiable due to its high cost of installation. In addition, the system required a significant amount of space that was not available in the existing library's infrastructure.

The library was seriously considering the implementation of smart shelves using RFID technology. The system would allow the LMS to interrogate the shelves to

identify whether a material searched for by a student was available or loaned to another student. In addition, it would also identify the location of the shelf where the book resides, thereby reducing incidents where books were intentionally or unintentionally put on the wrong shelves.

5.4.5.3 Monitoring interoperability standards

The library had monitored the development of RFID standards for libraries. The current standards confined the library to the proprietary system of Intellident. In other words, the library was prevented from using equipment supplied by different vendors for fear of inefficient data transfer. It was hoping that future standards for RFID in libraries would allow efficient data transfer between equipment supplied by different vendors.

5.4.5.4 Putting pressure on the book industry

The library, in alliance with a number of other libraries, was putting pressure on the book publishers to attach library-standard tags inside their books. The industry's practice was to put the tags onto the cart or palette level as opposed to the book level. In addition, the industry was using tags with different RFID standards. This practice put the burden on the library to tag the books individually. The Deputy Librarian believed that this was an unnecessary step that could easily be avoided if the publisher or distributor tagged the books with their barcode information using the RFID standards for libraries.

5.4.6 The contextual differences and their impact on the RFID implementation in Nottingham Trent University Library

The NTU Library was also one of the earliest implementers of RFID technology. Just like Oxford, they had to face numerous difficulties in implementing the technology. The RFID technology for library at the time was relatively immature, there was very little guidance on how to apply the technology in the library and there were very few vendors who were able to apply the technology in a library setting. The library's RFID vendor could not provide satisfactory guidance in the implementation. Instead, the library had to educate the vendor about library's processes and procedures. As a result, the RFID project progressed slower than the library's expectation.

Despite these problems, the project was eventually completed because of the active role played by the project champion. He brought back the idea for the RFID, obtained the consent of the university's management to implement it, and led the implementation until its completion. He also had the technical know-how to specify the technical requirements of the RFID system. The project champion in this library was also actively promoting the use of RFID in library through talks with other libraries and the book industry. His action has put the library at the forefront of RFID implementation in UK libraries.

The library's relationship with its RFID vendor was unique because the vendor was made to be contractually responsible for the completion of the RFID project. The vendor in this case, therefore, had to shoulder more responsibilities than the vendors in the other case studies. Among those responsibilities were liaising with the library's

management system vendor and the RFID equipments providers. Although this

measure was different to other organisations in this study, it still achieved its desired

effect, i.e. the completion of the RFID project.

5.5 Illustrative Case Study 5: RFID Implementation at the Arrowe Park Hospital (APH)

5.5.1 Background information of the hospital

The hospital is located in Upton, Wirral. It is a part of the Wirral University Teaching Hospital, along with the Clatterbridge Hospital, Bebbington, Victoria Central Hospital, Wallasey, and St Catherine's Community Hospital, Tranmere. The hospital provides a full range of emergency, maternity, and acute services for adults and children.

5.5.2 The hospital's RFID implementation

The idea for the RFID implementation came from a visit by the hospital's IT Director to an IT expo. There, he came across the application of RFID technology in healthcare. He brought back the idea to the hospital and persuaded the hospital's senior management to adopt the technology. The RFID system had since been applied at the A & E, the Paediatric, and the Gynaecology Departments.

The RFID system was developed in partnership with Visonic Technologies. The vendor is a manufacturer of RFID tags and readers, and a developer of RFID software. The hospital and the vendor formed a beta site agreement where the hospital became a testing site for the vendor's latest RFID equipment and software.

In return, the hospital was able to procure the equipment and software at a discounted price.

5.5.3 The activities during the unfreezing stage of the RFID implementation

Figure 5.10 shows the activities during the unfreezing stage of the implementation. The activities started with the hospital setting its implementation objectives (1), followed by justifying the project to the hospital's senior management (2), forming the beta site agreement (3), prioritising the RFID implementation (4), assigning the person in-charge of the implementation (5), soliciting RFID requirements for the hospital (6), and determining the most appropriate process (7).
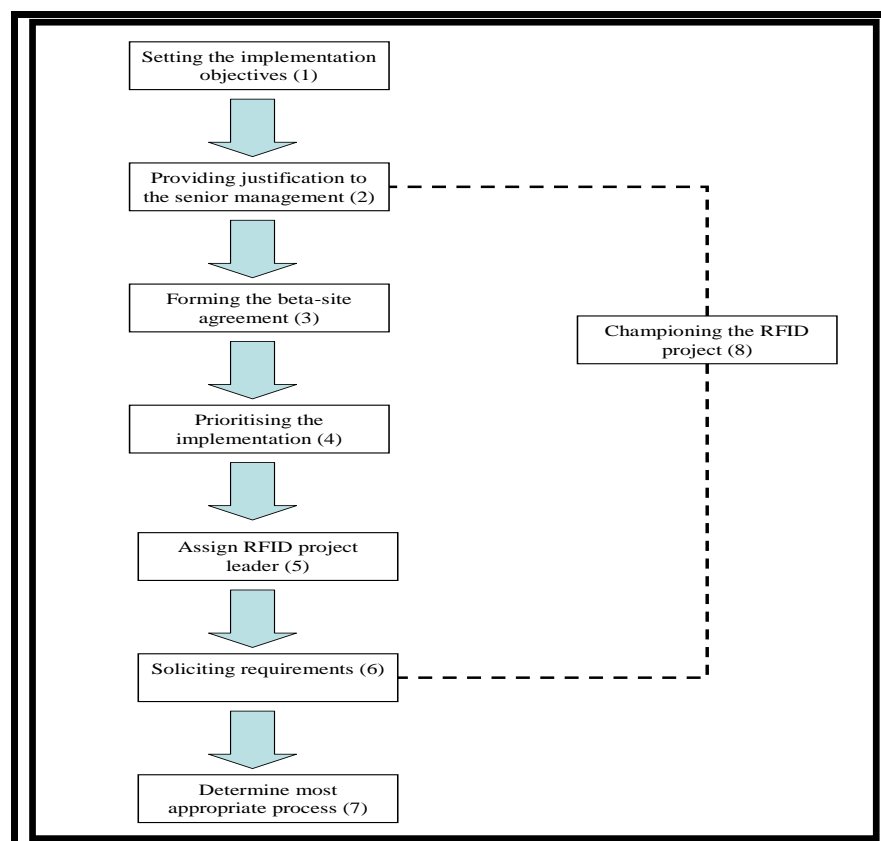
Figure 5.10 The activities during the unfreezing stage of the RFID implementation at the APH.

5.5.3.1 Setting the implementation objectives (1)

Three implementation objectives were set for the RFID project. The first objective was aimed towards improving the care of patients in the hospital through the use of RFID. For example, the use of RFID in the A & E Department would allow the hospital to quickly locate the doctors in the department. The second objective was aimed towards the security and safety of patients, doctors, nurses and administrative staff at the hospital. For example, the use of RFID to tag babies would prevent the possibility of abduction in the hospital. The third objective was aimed towards improving the working life of the hospital doctors, nurses and administrative staffs. The hospital had hoped that the use of the technology would ease the work of the staff.

5.5.3.2 Justifying the project to the hospital's senior management (2)

The justification for the RFID investment was presented by the IT director to the senior management of the trust. The justification came in the form of benefits expected by the hospital from the investment. Among them, it would improve patient care, ensure the security of the staff and patients and improve the working life of the staff. In other words, the technology would help the trust and its patients. The justifications were merged into a proposal that was presented to the senior management of the trust.

5.5.3.3 Forming the beta-site agreement (3)

An agreement was formed between the APH and Visonic Technology to make the APH the beta site for Visonic to test its RFID equipment and software. The agreement offered these benefits for both parties. Visonic was able to test its RFID equipment in a live site before it was released on the market. The hospital environment is a very good testing site because it has around 130 staff using the RFID system at any one time. On the other hand, the hospital was able to procure the vendor's RFID equipment at a discounted rate. Moreover, the hospital was able to test the vendor's latest RFID equipment and software.

Another component of the agreement was the procedure for reporting faults in the RFID system. The hospital was responsible for reporting the system's faults directly to the vendor while the vendor was responsible for fixing them. However, the vendor welcomed any effort by the hospital to find the solution to the problems.

The hospital also provided feedback on the design of the RFID tags to Visonic. One example of the feedback was the tag design for nurses. The first batch of tags malfunctioned after only a few days of usage because of their inability to resist water. As a result, they were unsuitable for nurses whose duties involved a lot of water usage e.g. cleansing babies and patients. This feedback from the hospital assisted the vendor in coming up with a better designed waterproof tag for nurses.

5.5.3.4 Prioritising the RFID implementation (5)

Because of cost constraints, the RFID project was sequenced stage-by-stage according to the hospital's priority. The A & E department got first priority because the technology would help the department locate its doctors quickly; this, in turn, would enable the department to provide immediate medical assistance to its patients – an important success factor for the department. When the hospital was planning to extend the use of RFID for baby tagging, it received instruction from the UK government to increase the security of the paediatric department. As a consequence, the RFID project had to be redirected towards securing the access to the paediatric department. Once the department was secured, the RFID implementation returned to preventing the abduction of babies in the maternity ward.

5.5.3.5 Assigning manager of the implementation (5)

The task to lead the implementation was assigned to the IT Support Officer in the Wirral Health Informatics Service (WHIS). He was selected for three reasons: his academic background, his experience and his previous training. The Officer had an academic background in IT, specialising in IT security. He possessed almost thirty years of experience in a hospital environment, most of it being spent in APH itself. Third, the IT officer received training from the vendor on the RFID system design philosophy and method. These factors enabled him to generate and manage a RFID solution for the hospital.

5.5.3.6 Soliciting the RFID requirements for the hospital (6)

The idea for the RFID implementation came from a healthcare IT expo attended by the IT Director of the hospital. Initially, the industry provided most of the ideas to the RFID project. When the IT officer was designing the RFID system, some doctors and nurses and the electro-biomedical engineering unit (EBME) contributed important ideas for implementation of the technology. These ideas formed the initial requirements of the hospital's RFID solution.

The vendor assisted in generating the RFID solution through the problem solving process. When a problem relating to the RFID system occurred, the hospital consulted the vendor. The vendor proposed a solution, which later became the new requirement for the hospital.

5.5.3.7 Fitting RFID into the hospital's existing procedures (7)

The hospital had to ensure that the technology will fit into its existing procedures. The task fell on the IT Officer whose understanding of the hospital's process was vital for him to perform this task. His understanding came from two sources: research and experience. For example, through his research, the scenarios in which abduction of babies may occur were identified and tested using baby-like dolls. In the first scenario, the baby was wrapped in an aluminium foil and carried through the RFID system. In the second scenario, the baby was put in a bag and smuggled through the

hospital windows. In both scenarios, the system either successfully alerted the hospital or the method was found to be too risky for the abduction to occur. Thus, the IT officer came to the conclusion that the RFID system was reliable enough to prevent the abduction of babies. On the other hand, his extensive experience in a hospital setting bred familiarity and common sense in generating the right RFID solution. In one example, his experience shone when determining the duration of the opening of access doors. As the IT officer explained:

"...It sounds pretty heavy but it's familiarity. I know what they're trying to achieve ... I stand there and I watch the staff go past and find the slowest member of staff and see how long it takes them. I'll be timing it to them. Now, if you walk slowly, it's just knowledge. It's familiarity ... You have to have a common sense to think, somebody says, oh, just open the door twenty minutes while I get this parcel through. Well that takes seven seconds and about the rest of the times, it's always free use..."

5.5.3.8 Championing the RFID project (8)

The IT Director championed the RFID project in the hospital, particularly during the unfreezing phase of the implementation. He was instrumental in moving the implementation initiative forward, for instance, by bringing back the idea of using RFID for the hospital after attending an expo that showcased the technology. He successfully persuaded the hospital's management to implement the technology when

its use in a hospital environment was still in its infancy. He also negotiated the funds for the RFID project.

5.5.4 The activities during the moving stage of the RFID implementation

Figure 5.11 shows the key activities during the moving stage of the implementation. The activities started with the development of the RFID system (1) which occurred together with the support of the IT Department (2), followed by setting the system's backup (4), producing instruction manuals (5), training the staff (6), managing resistance (7), obtaining users' feedback (8), and vendor support (9). Throughout the moving stage, the role of the RFID champion (3) was crucial to keep the implementation running despite the technical glitches and the nurses' and administrative staff's anxiety about their privacy.
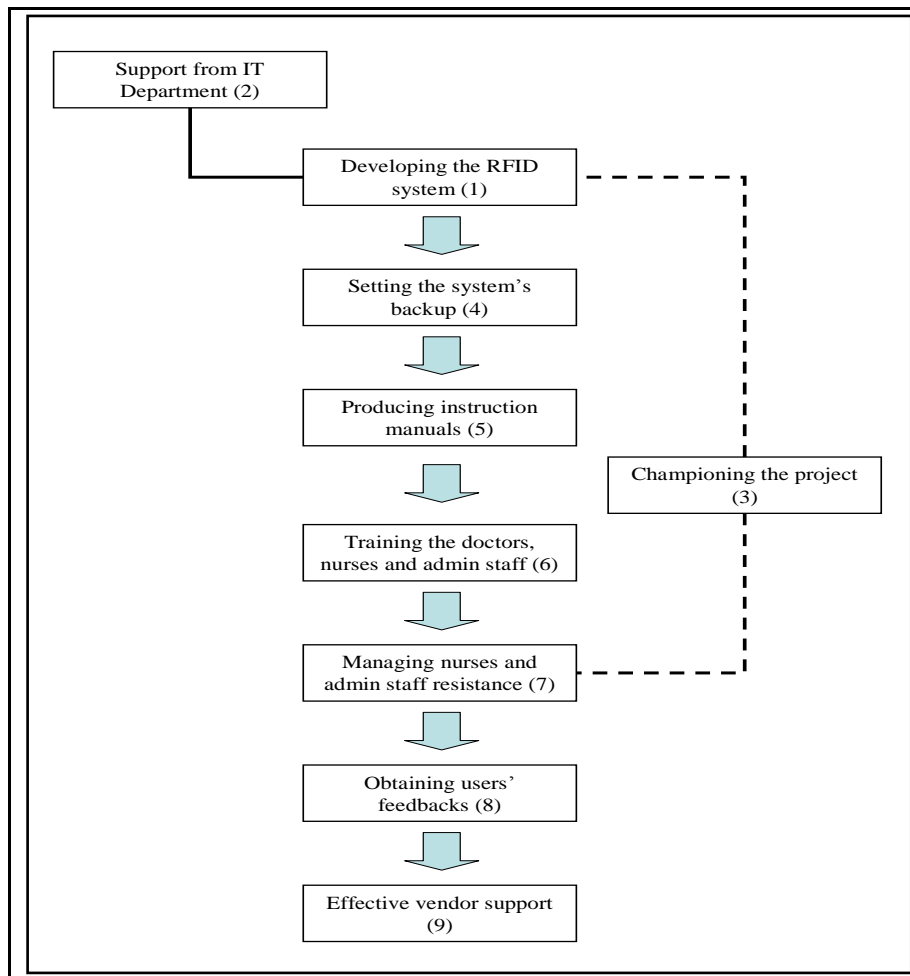
Figure 5.11 The activities during the moving stage of the RFID implementation at the APH

5.5.4.1 Developing the RFID system (1)

The development of the RFID system consisted of two sub-activities: programming the system and programming the RFID readers and tags. Programming the system comprised the initial setup, writing the alerts for the system and creating time zones. During the initial setup, the RFID software was setup on one of the servers in the hospital to identify the RFID readers and tags in the hospital. A SQL database was setup to store the data collected through the RFID system. Meanwhile, an alerting system that informs the hospital of problems regarding the RFID system was developed. If a problem is identified e.g. a server communication problem, a box will

appear on all the computers to inform the staff about the incident. In addition, the creation of time zones allowed the control of staff access to the hospital. Using the system, staff access to restricted areas was confined to their working hours.

Programming the system also involved determining the location of the readers and the required wiring. The floor plan provided the size of the area where the RFID readers would operate. Based on the size of the space, the strength of the RFID tags and readers, and the strengths and weaknesses of the RFID equipment, the location of the readers was determined. Next, a rough diagram of the floor plan was drawn to identify the location of the readers. Subsequently, the wiring for the readers was drawn on the diagram. While the wiring was drawn, the readers were named according to the rooms in which they were allocated. For example, the first reader in the A & E department was named A&E1. The wiring of the RFID readers was commissioned by the IT officer. At the same time, the RFID readers and tags were programmed to have unique identities. These identities were later added to the RFID application.

5.5.4.2 Support from the IT Department (2)

The RFID project received assistance from the hospital's IT department. The department provided cover to run the RFID system when the IT officer was absent. A database administrator managed the SQL database for the RFID system. The vendor even communicated directly to the IT department's database administration on matters pertaining to the RFID database.

5.5.4.3 Developing a reliable system (4)

To develop a reliable system, the IT officer has strived to develop a strong backup to the system. The backup to the RFID system possessed two important features. First, the system had a long backbone that was designed to be bomb proof. Second, an alerting system was developed to notify the hospital of broken cables. The system would point to the exact location where the cable was broken. As a result, the problem could be rectified in less than three minutes. Consequently, the hospital system was able to operate twenty-four hours a day.

5.5.4.4 Instruction manual development (5)

The IT officer produced a simpler version of the RFID instruction manual as the instruction manual from the vendor was found to be too complicated for the end users to understand (i.e. it may cause difficulty for the IT staff to solve the RFID problems when the IT officer is away from the hospital).

The manual was designed to be user-friendly. First, the manual was written in plain and simple English to enable the users to quickly understand its content. Second, the manual was divided into many short procedures and employed an action oriented style that enabled the users to quickly find the method of executing certain procedures. Third, feedback from IT staff was used as guidance in the refinement of the manual. The IT staff usually consisted of those with the least knowledge of the RFID system. When the users identified the difficult parts in the manual, the IT officer sought ways in which they could be clarified. The required changes were then made to the manual and installed on the clients' PCs.

5.5.4.5 Training the doctors, nurses and administrative staff (6)

Once the RFID setup was completed, the RFID system training commenced. A Microsoft Power Point slide presentation describing the workings and the usage of the RFID system was prepared. The presentation was installed in the PCs at the A & E department for later reference. The presentation was followed by hands on training to the doctors, nurses and administrative staff who will be wearing the tags. Meanwhile, the nurses were trained to manage the RFID screen. The IT officer explained:

> *"...We got a file on exit. But you can't just file on exit. It's file, exit, and then you have to be sure, and then you have to close. You can't just close the programme..."*

Demonstrations on the handling of the RFID tags were also provided to the doctors, nurses and administrative staff. For example, they were trained to avoid pressing the badge in certain areas, as it would trigger the alarm. In another example, they were trained to ensure that unauthorised people were not tailgating them when they were opening the access doors with their RFID tags. They were trained in a group of ten to fifteen people at one time. Using the sheets from the training manual that had been prepared earlier, the IT officer walked them through the RFID system. At the end of the training, they were instructed to contact the IT officer should any problem with the RFID arise.

5.5.4.6 Managing the resistance of the nurses and administrative staff (7)

A small number of nurses and administrative staff initially resisted the use of the RFID system because of concerns that the system would enable the hospital's management to track their movements. They feared that the management would, consequently, try to restrict their actions and limit their freedom. This fear is also known as the 'big brother' syndrome. The resistance was countered by earning the trust of the staff, which was gained through three measures: showing benefits, providing assurance and providing a personal confidant. The nurses and administrative staff were shown the benefits of the system through how the system assisted their work. Second, they were assured that their movement would not be monitored by the RFID system. Third, the IT officer was employed as the staff personal confidant for matters concerning privacy. The hospital's success in managing users' resistance was manifested in the interest of other departments to RFID. According to the vendor:

"...What's interesting is that when you sell it to one ward, let's say

there's a certain, I don't know, geriatric or a special care ward that

gets the technology, than the neighbouring ward also they want it too.

So, you get a snowball effect within the hospital..."

5.5.4.7 Obtaining users' feedbacks (8)

Obtaining users' feedbacks allowed the IT Officer to improve the RFID system. Users' feedback often followed the reporting structure of the hospital. The nurses and administrative staff forwarded their feedback to their ward managers. The ward managers forwarded the feedback to the directors. The feedback was later forwarded by the directors to the IT officer.

Direct feedback from the nurses and administrative staff to the IT officer was rare, thus limiting the Officer's ability to improve the system. The IT officer had to probe them before they would provide any feedback. The direct feedback was found to be very useful in enhancing the system's user interface. As the IT director explained:

"...They won't make it official. They would just say I prefer it did that.

Very rare they say it but then if I lead the questioning, I can sort out to

get a bit more information. When I get that information, then, great.

And then, we can do some changes. Sometimes, it's just a GUI change.

It might be the way an alert works. They may want to do something

slightly different..."

The feedback was not incorporated blindly into the system. The person who proposed the changes have to provide the justification before the necessary changes was made to the system. For example, the proposal on the opening duration of the access doors was rejected because the ten-second was deemed to be too long. In addition, a demonstration was provided by the IT officer to show the infeasibility of opening the door for more than three seconds.

5.5.4.8 Vendor support (9)

Effective support from the RFID vendor enabled the hospital to solve the system's technical problems quickly. As the IT officer noted:

> *"…Took me two days to find the fault. It took me a day to identify the problem, get in touch with the parent company, which is Visonic now … told him what was going on. He got in touch with somebody and it turns out the programme we were using have been written in C++ and it needed to be written in current script, it need to be rewritten all the scripts…"*

5.5.4.9 Championing the RFID project (3)

Meanwhile, the enthusiasm of the IT officer kept the RFID project running. He ensured that the system operated continuously despite the infancy of the technology when it was adopted and despite his existing work commitments. Two instances exemplified his determination to ensure the success of the RFID implementation. In one instance, the IT officer had gone through 1,600 pages of report, line by line, to find the cause of a problem with the RFID system. In another instance, the IT officer had come to the hospital every night, including weekends, at half past nine in the evening to reboot the RFID server. The IT officer's devotion ensured that the RFID system was implemented.

5.5.5. Activities during the refreezing stage of the RFID implementation

The activities started with the hospital securing its RFID system (1), followed by the consistent monitoring of the system (2), regular correspondence with the RFID vendor (3) and continuous improvement to the system (4).
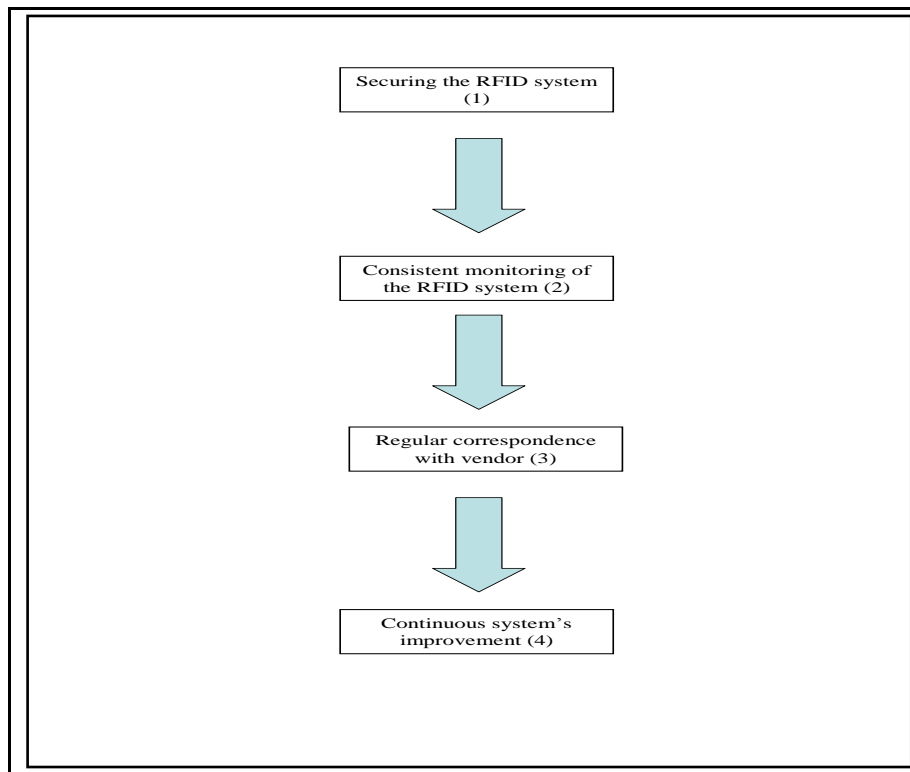
Figure 5.12 The activities during the refreezing stage of the RFID implementation at the APH

5.5.5.1 Securing the data (1)

The system's data was tightly secured by the hospital. Access to the data was protected by a series of passwords. The passwords were kept by the IT officer, the IT manager and the database manager. One sealed copy of the passwords was kept by the hospital while another was kept by a neighbouring hospital. These sealed passwords were kept in fire proof safes to ensure safety. In addition, a decision was made to keep the data up to only twenty-eight days. This decision ensured that the system would not be burdened by the accumulation of daily data.

5.5.5.2 Consistent monitoring of the system (2)

The system was setup to enable the IT officer to monitor the 'health' of the RFID system from his room. When a problem with the system occurred, an e-mail concerning the problem would be sent by the system to the IT officer immediately. The alerting system allowed the IT officer to identify and rectify the problem quickly, thus minimising the system's downtime. In addition, a number of programmes were installed to check the system's health. The IT officer explained:

> *"...I do this all day and everyday ... This is the beta system. Come up ... status ... visualise everything, that information there, if that wasn't working, it won't be there. That would be greyed out. Two reasons can be greyed out. One it's not working. Have to take that, test device, test pass. Now, that's going on all the time. That goes on every couple of minutes..."*

5.5.5.3 Regular communication with the RFID vendor (3)

The IT officer kept regular correspondence with the RFID vendor. During the correspondence, issues relating to the RFID system were discussed transparently. The hospital disclosed all the problems of the RFID system and whether the problems had been fixed. The RFID vendor disclosed its latest RFID equipment and software.

The feedback from the hospital provided important lessons to the RFID vendor in refining their products. One of the most important lessons learned by the RFID vendor was minimising human error by automating most of the RFID features. The vendor provided an example:

> *"…let's say an infant is born and they are in the delivery area, and now that they need to send baby and mother up to the maternity wards. What they'll do is they'll suspend the tag. Now, when the system detects that the tag that is in a suspended state moves into the maternity ward and remains there for a certain period of time, they'll automatically activate it. So, they don't need to remember to reactivate the tag…"*

The feedback from the hospital provided impetus for the vendor to refine the tracking system. For example, from the feedback, the hospital learned that the initial infrared (IR) technology was unable to track staff movements. There were times when the IT technology lost the location of the staff. To overcome the problem, the IR and the RFID technologies were combined. The IR provided precise room location while RFID provided continuous communication. However, later feedback from the hospital identified the technology's weakness in access control. To enhance the reliability of the access control, the vendor later added the Lower Frequency (LF) technology to the existing IR and LF technologies.

5.5.5.4 Enhancing the RFID system (4)

Related to the enhancement effort was the RFID system's upgrade. The system's software received an upgrade when a newer version of the tags was received. The system also received an upgrade when new RFID applications were installed. In addition, the upgrading effort included employing the newer high-end servers to enhance the system's capacity.

One of the main aims of the upgrading activity was to minimise the disruption faced in the day-to-day operations of the hospital. To achieve this aim, the system was programmed to avoid rebooting for upgrading activity. Instead, the system required rebooting only for less frequent updates such as server migration. The more frequent upgrades, such as the installation of new software or application did not involve rebooting the system. As a result, disruption to the RFID system was minimised.

Another important aspect of the continuous improvement effort was the accommodation of both old and new RFID equipment. The hospital's tracking system was the result of the integration of three different technologies: infra-red, low frequency (LF) and radio frequency (RF). When the hospital implemented the RFID system, the infra-red and LF technologies were maintained. This decision led to a major technical problem where the older readers were unable to read the new RFID tags. To overcome this deficiency, the RFID equipment and software were reconfigured so that the system could accommodate the old and new equipment. The

microchips in the older readers were replaced with newer microchips to enable the readers to read the more recent version of multiple-frequency tags.

The hospital planned to extend the use of RFID technology into two areas: the new call centre and asset management. The new call centre would utilise around eight thousand RFID tags covering all the public and patient areas. Meanwhile, the hospital also planned to implement a RFID system for asset management. It was believed that such a system would reduce the costs associated with maintaining hospital assets and the investment would be recouped in one year.

5.5.6 The contextual differences and their impact on the RFID implementation in the Arrowe Park Hospital

Two factors differentiate the APH and the other case studies. First, instead of using passive RFID like the libraries, the APH employed active RFID technology. As a result, the hospital's RFID development and installation activities were different and more elaborate than the libraries. The RFID readers have to be carefully located to ensure that the whole floor will be covered with the signal. The readers and the tags have to be programmed before they can become operational. A database has to be developed to store the data captured by the RFID system.

Second, instead of tagging things such as books, the APH tagged humans such as its doctors, nurses, administrative staff and babies. As a result, the hospital's RFID implementation was more controversial than the technology's implementation in the libraries. The nurses and administrative staff especially were worried about the

potential misuse of the technology by the management to 'spy on their movement'. Reducing the nurses and administrative staff fear of the technology required an elaborate measure from the IT Officer in charge of managing the RFID implementation.

Third, the APH was the sole case study where the RFID system was developed internally. Although the hospital chose a RFID vendor to be its partner in the implementation, the vendor did not directly develop and install the RFID equipments and software in the hospital. Instead, the vendor only supplied the RFID tags, readers and software to the hospital. The task of applying the RFID equipments and software in the hospital fell to its IT Officer who oversaw the design, development and installation of the RFID system throughout the hospital.

The availability of a person such as the IT Officer was one of the major reasons why the hospital was able to develop the RFID system internally. He has the relevant academic background and has received training from the vendor on its RFID design philosophy. Most importantly, the IT Officer was highly motivated to complete the technology's implementation in the hospital. This motivation ensured that the project moved forward despite the minor resistance from some nurses and administrative staff.

5.5 Summary

The review of the literature on RFID implementation in libraries and hospitals has lead to the discovery of the factors that influence the success of RFID

implementation. The review of the literature had also led to the development of the proposed theoretical framework for the study. The implementation factors and the proposed theoretical framework were merged and tested during the pilot studies. The pilot studies have lead to new and relevant implementation factors to be included while those that were found to be less relevant were excluded. The refined theoretical framework was employed during the primary field study to understand the RFID implementation process in five public sector organisations.

The refined theoretical framework has allowed this study to encapsulate the RFID implementation process in the five public sector organisations. The framework has enabled this study to narrate the key activities in their RFID implementation efforts. In addition, the framework has also enabled the key activities to be differentiated into whether they occurred during the unfreezing, moving, and refreezing stages of the implementation. The refined theoretical framework has also enabled the study to identify the similarities and dissimilarities in the factors found in the literature review, pilot studies and the primary fieldwork.

One important finding that was found to be similar across the literature review, pilot studies and the primary fieldwork is the importance of social and organisational factors in a RFID implementation. Among the social and organisational factors were top management support, the availability of resources, system's training and the system's ease of use. On the other hand, some factors were not found in the literature review but emerged during the pilot studies and the primary fieldwork. Among them were the formations of partnerships between the public sector organisations, promoting the RFID system, and determining the future direction of RFID.

Meanwhile, a number of key activities were found to be occurring in all the organisations' RFID implementation process. These key activities have also been found to occur in different ways between the organisations. These similarities and differences need to be accounted for in developing a normative framework of RFID implementation process in the UK public sector. The sixth chapter will compare the five organisations' RFID implementation process to identify their similarities and differences.

CHAPTER 6

THE PUBLIC SECTOR RFID IMPLEMENTATION FRAMEWORK

6.0 Introduction

Prior to developing a normative framework of an RFID implementation process, a cross-case analysis will be performed on the primary case studies. The cross case analysis will be performed in two stages. In the first stage, the RFID implementation in the four libraries will be cross-analysed to identify the similar activities in all four case studies. The identification will enable the RFID implementation process framework for the libraries to be formed. At this stage, the APH case study was excluded from the comparison because of some significant differences between the hospital's implementation process and the libraries. Instead, the comparison will be performed in the second stage of the analysis when a single framework of RFID implementation process in libraries has been developed. The comparison will allow the study to form a single framework of RFID implementation process in the UK public sector.

The chapter is structured as follows. The first section will present the comparison of the key activities across the organisations during the unfreezing stage of their implementation. The second section will present the comparison of the key activities across the organisations during the moving stage of their implementation. The third section will present the comparison of the key activities during the freezing stage of their implementation. In the first three sections, the implementation process for the four libraries during the unfreezing, moving, and refreezing stages will be put side-by-side to identify the activities that have occurred in all four sites. These activities will be selected to form a single RFID implementation process framework for the libraries. In the fourth section, this single framework will compared to the RFID implementation process in the APH. This comparison will lead to the development of the RFID implementation process framework in the UK public sector. The chapter's summary will be presented in the fifth section.

6.1 Main activities during the unfreezing stage of the RFID implementation

The activities involved during the unfreezing stage of all five organisations' RFID implementation are described in Table 6.2. By presenting the activities next to each other, the similarities and differences between these organisations can be identified.

Key activities	De Montfort University Library (DMU)	Sainsbury Library, Said Business School, Oxford University (SBS)	University of Leicester's Library (UL)	Nottingham Trent University's Library (NTU)	Arrowe Park Hospital (APH)
Soliciting Requirements	The requirements were generated from the trade's RFID literature and from visits to libraries that had implemented RFID. The requirements were later adjusted during the installation.	Library shows and exhibitions were the main sources of identifying the requirements for the library.	The requirements were generated through visits to and knowledge sharing sessions with libraries that had implemented RFID. Special requirements were later added to the RFID system.	The requirements were formed through the manager's visits to libraries in Singapore. Afterwards a decision was made on the type of RFID application required by the library.	The requirements came from the IT Director's visit to IT expos. Additional requirements were later added from feedback from the hospital nurses and administrative staff and from the EBME department. The vendor assisted the hospital in turning the requirements into RFID solutions.
Selecting the RFID vendor	The selection process went through a European tendering process. The compatibility of the proposed solution with the existing library's system and the vendor's honesty were the main reasons for the selection of the RFID vendor.	The vendor was chosen because it was the only one providing a RFID solution for libraries at that time. Furthermore, the vendor had some experience in developing a RFID solution for a library in the UK.	The activity went through a European tendering process. To select the most appropriate vendor, several criteria were outlined. The final selection was based on the vendor's ability to accommodate the library's old EM technology.	The activity went through the European tendering process. Before the tendering process was completed, the library found a suitable RFID vendor and announced that it's working with a preferred partner.	Instead of outsourcing the development to a system integrator, the hospital decided to develop the system internally. This strategy enabled the hospital to have more control in the implementation effort. Consequently, the hospital searched for a vendor that could provide good RFID equipment

					and software to the hospital.
Setting the implementation objectives	The objectives were to sustain capabilities with other libraries, to automate basic transactions, and to reap the benefits of RFID.	The objectives were to allow students to process basic transactions after office hours, to complement the new library with leading edge technology, and to reap the benefits of RFID.	The objectives were to complement the new library with the state-of-the-art technology and to provide easy to use self service machines.	The objective was to enhance the students' experience in the library by allowing them to manage their basic library transactions.	The objectives were to help improve patient care, to ensure the security of the doctors, nurses, administrative staff and patients, and to improve the working life of the nurses.
Justifying the RFID investment to the senior management	Consent was granted by the senior management based on the library's reputation of providing excellent service and pushing the boundary of technology.	The senior management of the School gave their consent when they were convinced that the RFID system could offer more benefits. In addition, funds were available to proceed with the implementation.	The consent was granted by senior management based on the possible cost-savings through the smaller number of future librarians recruitment by the library.	The consent was granted by the senior management when they were successfully persuaded of the system's crucial role in providing personal support to the students.	Senior management gave consent after they were convinced that the technology would help the trust and its patients.
Championing the RFID project	The analysis suggested that the project did not have a clear RFID champion	The managers championed the project by generating the idea for the RFID project, by justifying the project to the senior management and by persevering with the implementation.	The analysis has suggested that the project did not have a clear RFID champion	The manager championed the project by bringing back the idea for RFID, securing the funding for the project, and directly overseeing its implementation.	The hospital's IT Director championed the project by bringing back the idea for RFID to the hospital and by successfully arguing for its implementation in the hospital
Forming the beta-site agreement					The hospital has agreed to become the beta site for Visonic Technologies in the United Kingdom
Prioritising the project					The RFID system was implemented first in the A&E Department, followed by the

				paediatric department and the maternity ward.
Assign manager of the project				An IT officer was assigned the task of developing the RFID solution for the hospital because of his academic background, experience and training.
Fitting the RFID system into the organisation				The IT officer's understanding of the hospital processes affected by the RFID system came from his research and experience.

Table 6.1 Cross-sites comparison of the activities during the unfreezing stage of the RFID implementation.

6.1.1 Setting the implementation objectives

The implementation objectives have outlined the aims and purposes of the RFID implementation. Allowing the students to manage their own loaning transactions of library materials was one objective which was found to be similar across the library cohort. Another implementation objective that was found to be similar across most organisations (DMU, SBS, UL, and APH) was enhancing the experience of their clients, librarians, patients, doctors, nurses and administrative staff. In the APH, the recipients of the RFID benefits were its doctors, nurses and administrative staff. The hospital wanted to improve the care and security of its patients and to improve the doctors, nurses and administrative staff working life. In addition, two organisations (SBS and UL) wanted to introduce the state-of-the-art technology in their libraries.

6.1.2 Soliciting RFID requirements

All the organisations depended on a number of sources to solicit their RFID requirements. Additionally, many of them employed the same sources of information. The DMU, LU and NTU based most of their RFID requirements on those of other libraries that had implemented the technology. Their requirements were refined by other sources of information such as trade literature. These requirements were further refined by feedback from the RFID vendors.

Meanwhile, the APH and SBS had depended on trade shows, exhibitions and expos to solicit the initial requirements of their RFID system. However, these organisations differed in

refining their RFID requirements. The APH refined its requirements with its nurses and those from the Engineering and Biomedical Department. In addition, the RFID vendor assisted the hospital in refining its requirements. The SBS, however had limited resources to refine its RFID requirements. The library could not depend on its librarians because their knowledge of the technology was very limited. Neither could it depend on its RFID vendor because the vendor lacked the experience in implementing RFID in libraries.

6.1.3 Forming the RFID partnership

To select the partners (i.e. RFID vendors) in the RFID implementation, the organisations either went through the European tendering process or chose one particular RFID vendor. Because of the huge amount of money involved in their implementations, the DMU, and the NTU went through the European tendering process in selecting their RFID vendors. Through the tender process, potential vendors proposed RFID solutions that would correspond with the libraries request for proposals (RFP). Several vendors who met the criteria set by these libraries were short listed. The selected vendors were invited for interviews and presentations, and one was finally selected to be the partner in the project.

The final decision on the RFID vendor was often based upon additional criteria that were not listed in the earlier selection process. For example, the DMU based its selection upon the vendor's 'honesty' in presenting its solution. On the other hand, the DMU based its selection upon the vendor's ability in accommodating the library's old EM technology.

Meanwhile, the LU, SBS, and APH intentionally chose one particular vendor to partner them in their RFID implementation. However, their reasons for choosing this particular method in

selecting their partners differed. The LU and SBS chose this approach because of the lack of

RFID vendors in the market, especially those specialising in the library sector. The APH

chose one specific vendor because it would enable it to develop the RFID system internally.

The hospital felt that this approach would allow it to have more control of the implementation

process.

The vendor's level of support depended on their knowledge and ability to apply the RFID

technology in their respective client's internal environment. The level of support also

depended on the vendor's available resources. In the DMU, the vendor had a regional

representative that was able to personally come and fix the RFID problems. Although such

personal service was not available to the UL, its vendor was able to provide the required

assistance when needed. In the APH, the vendor was able to provide quick assistance to the

hospital in solving the technical problems of its RFID system. However, the same level of

support was lacking in the SBS and NTU. In the SBS, the vendor lacked the resources and

knowledge to provide an adequate level of support while in the NTU, the vendor's limited

knowledge of RFID in a library context made it difficult for the company to provide good

support.

The maturity of the technology when it was implemented affected the vendor's ability in

providing good technical support to the organisations, thus influencing their level of

satisfaction with the support received. The DMU and UL implemented RFID when the

technology was relatively mature compared to the SBS, NTU and APH. In these three

organisations, the RFID systems were 'tweaked' a number of times to get them running. In

this respect, the APH may be considered luckier than the SBS and NTU because its IT officer

had the knowledge and training required for configuring the system. The SBS and NTU had

to depend on their RFID vendors to perform the configuration. However, their vendors' lack of knowledge and experience in handling library RFID systems made it difficult for them to provide an adequate level of support. As a result, the DMU, UL, and APH were more satisfied with the support provided by their vendors compared with the SBS and NTU.

The IT officer at the APH has kept regular correspondence with the RFID vendor. During this correspondence, issues relating to the RFID system are discussed. This discussion requires full transparency from both parties. The hospital discloses all the problems of the RFID system and whether the problems have been fixed. The RFID vendor discloses its latest RFID equipment and software.

6.1.4 Justifying the RFID investment to the senior management

The organisations had to justify their RFID projects to their senior management to obtain permission to proceed with the projects. The justifications given by each organisation were different. For instance, the SBS argued to its senior management that the RFID system would offer more benefits to the library while the UL argued that the RFID project would lead to cost-savings as the library would reduce the number of future recruitments. The NTU argument was on the importance of the RFID system in providing personal support to the students and the APH argued that the technology was crucial in helping the hospital and its patients.

The permissions were eventually granted for a number of reasons. For most organisations (the DMU, SBS, and LU), the permission was given because there were available funds to

finance the RFID project. For the DMU, permission was granted because of the library's good reputation.

6.1.5 Championing the RFID project

The cross-case analysis has suggested that not all implementations involved RFID champions. Compared with the DMU and UL, the roles of RFID project champions were more prominent for the RFID implementations in the SBS, NTU, and APH. Because the three organisations implemented the technology earlier, they faced more difficulties in managing the project. The senior management were more difficult to convince and were more sceptical because the benefits of RFID were not as widely publicised as today. The implementations were also more expensive because the RFID components cost more. The RFID system was also full of technical problems such as tag failure (e.g. some of the tags could not be read properly) and failure in the system's linkup (e.g. some data disappeared when it was transferred from the RFID system to the library management system). These technical problems caused some restlessness among the librarians, nurses and administrative staff which later resulted in a small amount of resistance.

Because of these difficulties, the roles of the RFID champions were more prominent. The implementation in the SBS was championed by the Manager and the Senior Officer of the library's Information Services. The implementation in the NTU was championed by the Deputy Librarian while the implementation in the APH was first championed by the hospital's IT Director and then the RFID Project Manager.

6.1.6 Forming the beta-site agreement

The hospital and Elpas (now Visonic) signed a beta-site agreement. The agreement made the hospital the beta site for the testing of Visonic's latest RFID hardware and software. Because a large number of people would use the RFID equipment and software, the hospital became a suitable site to test the technology. In return, the hospital was able to procure the equipment and software at a discounted price. It also enabled the hospital to obtain the latest RFID technology from Visonic.

6.1.7 Prioritising the project

Unlike a library, a hospital such as APH consists of a number of departments. Among the departments receiving the RFID technology were the Accident and Emergency (A & E), Gynaecology, and the Paediatric departments. However, implementing the technology in all three departments at one time would require an enormous amount of human and financial resources. Therefore, the decision was made to implement the RFID department-by-department. It was first implemented in the Accident & Emergency (A & E) Department, followed by the Paediatric Department and the Gynaecology Department. The prioritisation was due to the need to manage the cost of the RFID implementation and to conform to the government's direction.

The A & E department was selected as the first department to receive the system because of the large number of A & E cases the hospital received. The use of RFID allowed the department to get assistance in a timely manner, which was crucial to the success of the department. Afterwards, when the hospital was planning to extend the use of RFID for baby tagging, it received instruction from the UK government to increase the security of the paediatric department. As a consequence, the RFID project was redirected towards securing the access to the paediatric department. Once the department was secured, the RFID implementation focussed on preventing the abduction of babies from the maternity ward.

6.1.8 Fitting RFID into the hospital's existing procedure

The hospital had to ensure that the technology will fit into its existing procedures. The task fell on the IT Officer whose understanding of the hospital's process was vital for him to perform this task. His understanding came from two sources: research and experience. For example, through his research, the scenarios in which abduction of babies may occur were identified and tested using baby-like dolls. In the first scenario, the baby was wrapped in an aluminium foil and carried through the RFID system. In the second scenario, the baby was put in a bag and smuggled through the hospital windows. In both scenarios, the system either successfully alerted the hospital or the method was found to be too risky for the abduction to occur. Therefore, the IT officer came to the conclusion that the RFID system was reliable enough to prevent the abduction of babies. On the other hand, his extensive experience in a hospital setting bred familiarity and common sense in generating the right RFID solution. In one example, his experience shone when determining the duration of the opening of access doors. As the IT officer explained:

"...It sounds pretty heavy but it's familiarity. I know what they're trying to achieve ... I stand there and I watch the staff go past and find the slowest member of staff and see how long it takes them. I'll be timing it to them. Now, if you walk slowly, it's just knowledge. It's familiarity ... You have to have a common sense to think, somebody says, oh, just open the door twenty minutes while I get this parcel through. Well that takes seven seconds and about the rest of the times, it's always free use..."

6.1.9 Forming the libraries RFID implementation process during the unfreezing stage

	DeMontfort	**Said**	**Leicester**	**Nottingham Trent**
Step 1	Solicit the RFID requirements	Solicit the RFID requirements / champion the RFID project	Solicit the RFID requirements	Solicit the RFID requirements / champion the RFID project
Step 2	Set the implementation objectives	Set the implementation objectives / champion the RFID project	Set the implementation objectives	Set the implementation objectives / champion the RFID project
Step 3	Justify the RFID project to the senior management	Justify the RFID project to the senior management / champion the RFID project	Justify the RFID project to the senior management	Justify the RFID project to the senior management / champion the RFID project
Step 4	Form the RFID partnership	Form the RFID partnership / champion the RFID project	Form the RFID partnership	Form the RFID partnership / champion the RFID project

Table 6.2 Comparison of the libraries key activities during the unfreezing stage

Table 6.2 compares the key activities during the unfreezing stage of the libraries RFID implementation process. From the table, some key activities have been found to occur across all four libraries. In addition, these key activities have also been found to occur in the same sequences. Therefore, these activities have been selected to form the RFID implementation process during their unfreezing stage (see Figure 6.1). The first step in the libraries RFID implementation process was soliciting the RFID requirements (1). That activity was followed by setting the implementation objectives (2), justifying the RFID project to the senior management (3), and ended with the formation of the RFID partnership (4).

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Soliciting requirements (1)

            ⬇

Soliciting requirements (2)

            ⬇

Soliciting requirements (3)

            ⬇

Soliciting requirements (4)

                        Championing the project (5)
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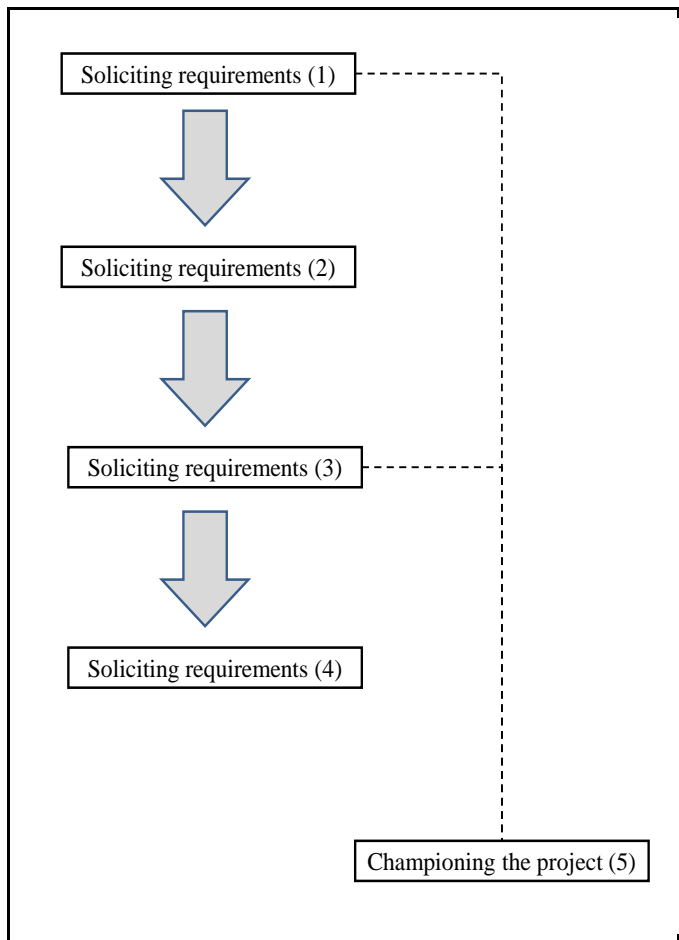
Figure 6.1 The normative framework of the libraries RFID implementation process during the unfreezing stage

6.2 Main activities during the "moving" stage of the RFID implementation

Table 6.2 describes the activities involved during the moving stage in the implementation of all five organisations. By laying the key activities of each organisation's implementation process next to each other, the similarities and differences between the organisations can be identified.

Key activities	De Montfort University Library	Sainsbury Library, Said Business School, Oxford University	University of Leicester's Library	Nottingham Trent University Library	Arrowe Park Hospital
Installing the RFID system	The Standard Information Interchange Protocol (SIP) software was utilised to link the library's Library Management System (LMS) with the RFID system.	The linking of the RFID system with the LMS and other systems in the university was performed by the RFID vendor.	The networking and electrical points were provided by the library to enable the vendor to install the RFID machines. A RFID system that was linkable to its LMS was purposely selected to ease the linkup between the two systems.	The RFID vendor was made contractually responsible in completing the project. Consequently, the vendor had to initiate the move towards linking the RFID system with the library's LMS.	
The tagging process	All materials except the journals and items that were not RFID-friendly such as CDs were tagged. For multi-part materials, only half of the items were tagged. The tagging was performed by the cataloguing team. Only the materials' barcodes were entered into the tags.	The tagging was performed by librarians as part of their administrative duties.	The tagging was performed by librarians and some students for one whole year. All the library's materials with the exception of the journals were tagged. The journals have instead retained the EM strip.	The tagging activity was performed by the library's temporary workers. To assist them with the task, a simple workflow for the activity was prepared. Only the materials' barcodes were entered into the tags.	
Developing and installing the RFID system					The activity comprised programming the system and programming the RFID readers and tags sub-activities. The programming the system sub-activity comprised putting the initial setup, writing the alerts for the system, and creating time zones. Programming the

					RFID readers and tags sub-activity consisted of activities such as determining the location of the readers and designing its wiring and creating unique identities for the tags and readers.
Developing instruction manuals					The IT officer produced a simpler instruction manual to ease the IT Department's task of managing the RFID system when the officer is on leave.
Developing a reliable system					A reliable RFID system was developed by installing a long system's backbone and a quick error-alerting system.
Testing the RFID system in a branch library	The RFID system was tested at the Charles Frears Library before it became operational in the main library. The purpose of the testing was to identify and rectify the problems with the RFID system.	Testing the RFID system in a smaller branch library was not possible for the Sainsbury Library because it does not have one.	The RFID system was tested at the Clinical Science Library before it became operational in the main library. The purpose of the pilot was to identify and rectify the problems with the RFID system	The RFID system was tested at the Clifton Campus Library before it became operational in the main library. The purpose of the pilot was to identify and rectify the problems with the RFID system.	
Cooperation of departments within the organisations	The estate department cooperated by performing the wiring of the RFID system and by ensuring that the power supplies were at the correct locations.	The School's IT unit cooperated by incorporating the School's colour and logo onto the RFID machines. The university's IT department cooperated by linking the RFID system with the university's IT services.	The university's IT services cooperated by ensuring that the RFID networking complied with the university's standards.	The cooperation of the other departments within the university was small.	The hospital's IT Department cooperated by covering for the IT officer when he was on leave. In addition, the IT Department's database administrator managed the RFID system's database.
Managing	Because the system	A minor resistance was	A minor resistance from a	A minor resistance came	A minor resistance was

resistance	represented very little change to the procedures in the library, there was very little resistance from only a small number of librarians. To reduce the resistance, the librarians were made aware of the RFID implementation through presentations and short training sessions. The librarians were given time to adjust to the new system. As a result of the above actions, the librarians persevered with the difficulties in the system's implementation.	identified when the librarians experienced a stressful period, during which they were required to remove the old tags and attach the newer tags onto the library's materials. However, because the number of librarians was small, the task of convincing them of the merits of the RFID system and consequently minimising the librarians' resistance was made easier. Furthermore, because the system represented a change to the procedure rather than wholesome changes to the library's policies, the librarians' resistance was further minimised.	small number of librarians was detected when the system faced a little glitch during the testing period. To reduce the resistance, the RFID manager reiterated the benefits from the RFID system and provided examples where the system has worked. In addition, they were made aware of the new technology and were exposed to the RFID system when it was tested. The librarians were given further assurance when the move to the RFID system was implemented incrementally.	from the library assistants who were afraid of losing their jobs. To reduce the resistance, the library management gave its assurance that the assistants' jobs would not be affected and convinced this group of workers that the RFID system would allow them to concentrate on assisting students.	detected from some nurses and administrative staff who were concerned with the system's ability to monitor and control their movement. To minimise their concerns and consequently their resistance to the system, the IT officer has employed three tactics: showing benefits of the system, providing assurance that the system would not be used to monitor their movement, and making himself the personal confidant on the issue of privacy.
Strengthening the RFID partnership	The RFID and LMS vendors were encouraged to frequently consult each other. Meanwhile, the RFID manager mediated the relationship between the estate department and the RFID vendor.	The library's ability to strengthen the partnership was limited because of the difficulty in getting access to the RFID vendor.	Periodic meetings with the RFID and LMS vendors were held after the tender was awarded.	Because the RFID vendor was made contractually responsible for delivering the RFID system, it was 'forced' to cooperate with different parties that were involved in the implementation.	The RFID partnership was strengthened through regular communication between the hospital's IT officer and the RFID vendor.
Promoting the RFID system	The librarians promoted the RFID system as a part of their responsibility in assisting users to find relevant materials in the library. An aggressive promotion campaign was not required because the curiosity of	The students' facilitators introduced the RFID system to the new students during the orientation week. The RFID machines were placed near the lending desk to allow the librarians manning the desk to attend to problems relating to the machines.	The librarians took some students to the RFID machines to show them how to operate the system. The more difficult task was demonstrating how to use the system for returning materials to the library.	The library removed its lending and issuing desk. For a limited period of time, librarians were stationed near the RFID machines to demonstrate to the patrons how to lend and return the library's materials using the machines. The librarians	

	some students led them to use the RFID machines on their own initiative.			also assisted in solving problems pertaining to the RFID system.	
Vendor support	The vendor's regional representative personally came to the library to view and fix the problems.	The vendor's knowledge and resources in assisting the library to overcome the problems with the RFID system were limited.	The vendor assisted in the generation of the RFID solution and in resolving the problems pertaining to the system.	The lack of knowledge on RFID for libraries hampered the ability of the vendor to provide effective support.	The vendor provided quick assistance to the hospital in overcoming the problems with the RFID system.
Training the users	Librarians were trained to use the RFID-based self-service machines.	Librarians were trained to use the RFID-based self service machines.	Librarians were trained to use the RFID-based self-service machines. In addition, they were given training on customer services.	Librarians were trained to use the RFID-based self service machines.	Doctors, nurses and administrative staff were trained to manage the RFID screen and handle the tags correctly.
Obtaining users' feedback					The IT officer received feedback on the RFID system from the ward manager, nurses and administrative staff.

Table 6.3 Cross-sites comparison of the activities during moving phase of the RFID implementation

6.2.1 Installing the RFID system

Compared to a hospital, the system installation was a more pressing issue for the libraries because of the need to link the RFID system with the Library Management System (LMS). In this respect, the approach taken by the libraries differed. In the SBS and the DMU, the two systems were linked by the RFID vendors. However, in the DMU and UL, the libraries had to link the two systems by themselves. They employed a protocol − Standard Information Interchange Protocol (SIP) − to enable the two systems to 'talk to each other'. Meanwhile, the UL took a proactive step in ensuring the transferability of data between the two systems by selecting the RFID system that was linkable to its LMS.

6.2.2 The tagging process

The emergence of a number of issues in the tagging process made this activity more prominent for the libraries than the hospital. Among the issues were: 1) what data should be entered into the tag, 2) which items to be tagged, and 3) who should perform the tagging? The DMU, UL, and the NTU came to similar decisions on the data to be entered into the tags. They decided to only enter the materials' barcodes into the RFID tags. To allow the materials to be identified, the data was linked with the LMS. Meanwhile, in selecting the materials to be tagged, the libraries have to decide whether to tag their journals. Most libraries decided to tag the journals while some (the DMU and UL) left them out of the tagging process for different reasons. In the DMU, the journals were left out of the tagging because they were not loaned to the users. In the UL, the journals were left out of the tagging because the library retained the use of the electro-magnetic (EM) strip.

In addressing the issue of who should be doing the tagging, the SBS, UL, and NTU employed different strategies. The SBS only used its librarians to perform the tagging. On the other hand, the UL employed students to perform the task. Meanwhile, the NTU employed temporary staff to perform the tagging. A simple workflow was prepared to assist them in understanding the tagging process.

6.2.3 Developing and installing the RFID system

Whilst the physical installation of the RFID system was carried out by contractors with the supervision of the IT officer, the IT officer was the sole person to program the RFID system. The programming activity was more prominent in the hospital than in the library because of the significant amount of effort to programme the RFID system. The programming process consisted of setting up the system, writing system alerts, and creating time zones. Setting up the system involved installing the RFID software on one of the servers in the hospital and designing a database server to store the collected data. Writing system alerts included creating an alerting system that informed the hospital of problems regarding the RFID system. Creating time zones involved programming the system to restrict the movement of doctors, nurses and administrative staff in the restricted areas to their working hours.

Unlike in the libraries, the RFID readers and tags in the APH's active RFID system required extensive programming before they became operational. The activity started with the design of the readers' locations to ensure that the system's signal covered the whole area of implementation. The activity proceeded with the design and commissioning of the wiring to ensure that the electrical supply and network cables reached the readers. The RFID tags and

readers were then programmed with unique identities to enable the system to identify the exact tag and reader. These unique identities were later incorporated into the RFID software.

6.2.5 The instruction manual development at the APH

The complexity of the RFID system in APH required the development of an instruction manual. It enabled the other IT staff to solve the problems of the RFID system when the officer was absent. Therefore, a simplified version of the RFID instruction manual was prepared. To simplify the manual, the writing process went through several steps and iterations.

6.2.6 Developing a reliable RFID system

Due to the importance of the RFID system for locating doctors in the A & E Department and for preventing babies' abduction, a strong backup to the system was developed with two important features. First, the system has a long backbone that was designed to be bomb proof. Second, an alerting system was developed to notify the hospital of broken cables. The system has the ability to indicate the exact location of the broken cable. As a result, the problem can be rectified in less than three minutes. Consequently, the hospital system is able to operate twenty-four hours a day.

6.2.7 Testing the RFID system through phase-by-phase implementation

Instead of implementing the system department-by-department, all the libraries except the SBS implemented the RFID system phase-by-phase. The SBS could not do so because of its lack of branch libraries to pilot the system. In the DMU, UL, and NTU, the RFID systems were piloted in the smaller branch libraries before they were implemented in the central library.

The reason for employing the phase-by-phase strategy was similar. The RFID systems were piloted to identify and rectify the problems with the RFID systems before they became operational in the main libraries. Consequently, the problems that could arise when the systems went live in the main libraries were reduced. The piloting initiatives also allowed the libraries to prepare contingency plans for problems faced during the piloting phase arising during the subsequent installation.

6.2.8 Cooperation of departments within the organisations

Although the other departments in these organisations performed a minor role in the implementation, their assistance was nevertheless important to the successful implementation of RFID. The forms of assistance, however, varied between organisations. In the DMU, the Estate Department performed the wiring of the RFID system. In the SBS, the School's IT services inserted the School's colour and logo onto the RFID machines while the university's IT department assisted in linking the system with the university's services. In the LU, the IT Department assessed the compliance of the RFID network with the organisation's standards. On the other hand, the IT Department at the APH provided cover and database administration support to the RFID system.

6.2.9 Managing resistance from librarians, nurses and administrative staff towards the RFID system

The causes of resistance from librarians, nurses or administrative staff differed between the organisations. Resistance in the DMU, SBS, and LU occurred because of the anxiety faced by the librarians when the RFID systems were faulty. This anxiety caused them to avoid using the systems and warning the patrons not to use the RFID system. This observation was supported by the apparent lack of anxiety on the part of the librarians when the systems were functioning well. When the systems were fully functioning, the librarians employed and promoted the use of the RFID systems. On the other hand, some librarians in the UL feared that their services would be terminated when the new RFID system was implemented. Meanwhile, nurses and administrative staff's resistance in the APH occurred because of their

concern about the 'big brother' threat of the RFID system. They feared that the system would be used to track their movements and used against them in the future.

As the causes for the resistance varied, the tactics employed to reduce the resistance also varied. In the UL and NTU, the RFID project managers decided to talk to the librarians involved personally. In the UL, the RFID project manager reiterated the benefits of the RFID system and pointed out examples of where the system was working satisfactorily. In the NTU, the RFID project manager provided assurance to the affected library assistants that their jobs would not be affected by the new system. In the DMU, the librarians were informed about the RFID implementation through presentations and were given time to adjust to the new system.

On the other hand, the hospital employed three tactics to reduce the nurses and administrative staff's resistance to the RFID system. First, the IT officer convinced the nurses and the administrative staff of the benefits of the RFID system. Second, they were given assurances that the system would not be used to monitor their movement. Third, a personal confidant was provided for them should they still have concerns about their privacy.

The ability of the organisations in managing the librarians' resistance was further assisted by the small amount of change involved in the RFID implementation. In the DMU, SBS, and UL, the RFID systems represented very little change to the existing procedures for issuing and returning library materials. The implementation involved neither wide scale changes to the procedures nor a radical change to the libraries' policies. The combination of the small amount of change and the tactics employed to reduce the librarians' anxiety contributed to the organisations successful management of the librarians' resistance.

6.2.10 Strengthening the RFID partnership with the RFID vendors

The RFID projects were carried out by partnerships of the implementing organisations, their RFID and system vendors, and other departments within the organisations. Strengthening the relationships between the partners enabled them to work closely and effectively together. That aim was achieved by each organisation in different ways.

Some organisations chose to use encouragement while others chose to use force. The DMU, UL, and NTU encouraged their RFID and LMS vendors to arrange periodic meetings and to frequently consult each other. They also mediated the meetings between the university's Estate Department and the RFID vendors. On the other hand, the NTU forced the nurturing of the partnership by making the RFID vendor contractually responsible for the delivery of the system. It put the onus on the vendor instead of the library to strengthen the relationship between the partners in the project. Both methods proved to be equally effective in nurturing the partnerships.

On the other hand, the nature of the relationship between the APH and its RFID vendor was different. In the relationship, Visonic, the RFID vendor, acted more as a supplier of RFID equipment and software than a RFID system developer. In addition, the relationship was dictated by the beta-site agreement between the two parties. This agreement was strengthened by the transparency of both parties. The hospital was transparent about the problems with the RFID system while the vendor was transparent about its latest RFID technology for hospitals. The transparency came from close and frequent communication between the hospital's IT manager and the vendor.

6.2.11 Promoting the RFID system

This activity was more crucial to the libraries (the DMU, SBS, UL, and NTU) compared to APH because the success of the system in libraries is dependent upon the students and academicians employing the system. The libraries hoped that the promotion would get more users to employ the RFID system. Instead, promoting the RFID system in the APH was not a major issue because its usage was compulsory for the doctors, nurses and administrative staff of the departments where the technology was deployed.

The promotion was divided into two sub-activities. The first sub-activity involved promoting the system to the students and academicians while the second sub-activity involved providing assistance to them in using the RFID system. Some libraries chose to merge the two activities while others chose to divide them. In the DMU, UL, and NTU, the two sub-activities were combined. The respective libraries' positioned their librarians near the RFID-based self service machines to promote the RFID system and to assist the users experiencing difficulty in using the machines. On the other hand, in the SBS, the two sub-activities were divided between the student facilitators and the librarians. The student facilitators introduced the RFID system to the new students during the orientation week while the librarians manning the lending desk attended to the students' problems in using the system.

6.2.13 Training the librarians, nurses, doctors and administrative staff

Training also contributed towards reducing the librarians' fear and anxiety of the RFID system in the DMU, SBS, UL, and NTU. The librarians in these organisations received system training to introduce them to the correct usage of the RFID systems. The training

came in the form of technical and/or customer service training. Librarians in the DMU, SBS, UL, and NTU received training on the usage of the RFID-based self service machines while the doctors, nurses and administrative staff in the APH received training in using the system's interface and handling the RFID tags. In addition to system's training, the librarians in the UL received customer services training to enable them to function effectively in promoting the RFID system to the library's users.

6.2.14 Obtaining feedback from nurses and administrative staff

Obtaining user's feedback was an important activity in the APH compared to the other four organisations in this study. Because the APH has developed an active RFID-based system, the technology involved was more complicated and expensive. Getting the feedback of the doctors, nurses and administrative staff was crucial in developing the RFID applications that do meet their needs. Applications that fail to meet the needs of the doctors, nurses and administrative staff would not be employed, thus wasting the hospital's investment on the technology. There were two sources of feedback: feedback given by the ward managers and direct feedback from the doctors, nurses and administrative staff. . The IT officer evaluated the feedback before incorporating it into the RFID system. The feedback that was justifiable was incorporated into the system while those was unjustifiable will be rejected.

6.2.15 Forming the libraries RFID implementation process during the moving stage

	DeMontfort	Said	Leicester	Nottingham Trent
Step 1	Phase-by-phase rollout of the RFID system	Install the RFID system / assistance from university departments / tagging process	Phase-by-phase rollout of the RFID system	Install the RFID system / tagging process / strengthening the RFID partnership / assistance from university departments
Step 2	Install the RFID system / tagging process / assistance from university departments / strengthening the RFID partnership	Manage resistance	Aligning project with building work	Manage resistance
Step 3	Train the librarians	Promote the RFID system	Development and installation / strengthening the RFID partnership / university department's assistance / tagging process / train the staff	Promote the RFID system
Step 4	Manage resistance	Vendor support	Manage resistance	Vendor support
Step 5	Promote the RFID system		Promote the RFID system	
Step 6	Vendor support		Vendor support	

Table 6.4 Comparison of the libraries key activities during the moving stage

Table 6.4 compares the key activities during the moving stage of the libraries RFID implementation process. Some key activities have been found to occur across all four libraries. These key activities have been coded using different colours to enable each of them to be spotted easily. However, the sequences of the key activities differ slightly between the libraries. Therefore, the RFID implementation process developed at this stage represented the most approximate framework from the four libraries RFID implementation.

Figure 6.2 displays the libraries RFID implementation process during the moving stage. The process starts with the phase-by-phase rollout of the RFID system (1). This activity was seen to be crucial in two of the libraries in the study while one library would have followed a similar path if it has a branch library. The activity is followed by four activities that occur in parallel: installing the RFID system (2), tagging the libraries' materials (3), obtaining the assistance from the university's departments (4), and strengthening the RFID partnership (5). These four activities were grouped together because they were found to occur almost simultaneously. They represented the libraries' efforts to develop and install their RFID system. Once the RFID systems have been developed and installed, the process proceeds with training the librarians (6) activity. The introduction of RFID to the librarians received some minor resistance from a small group of them. As a result, the next activity in the process is managing resistance (7). When the resistance has been reduced or eliminated, the librarians are ready and willing to promote the RFID system to the libraries patrons (8).
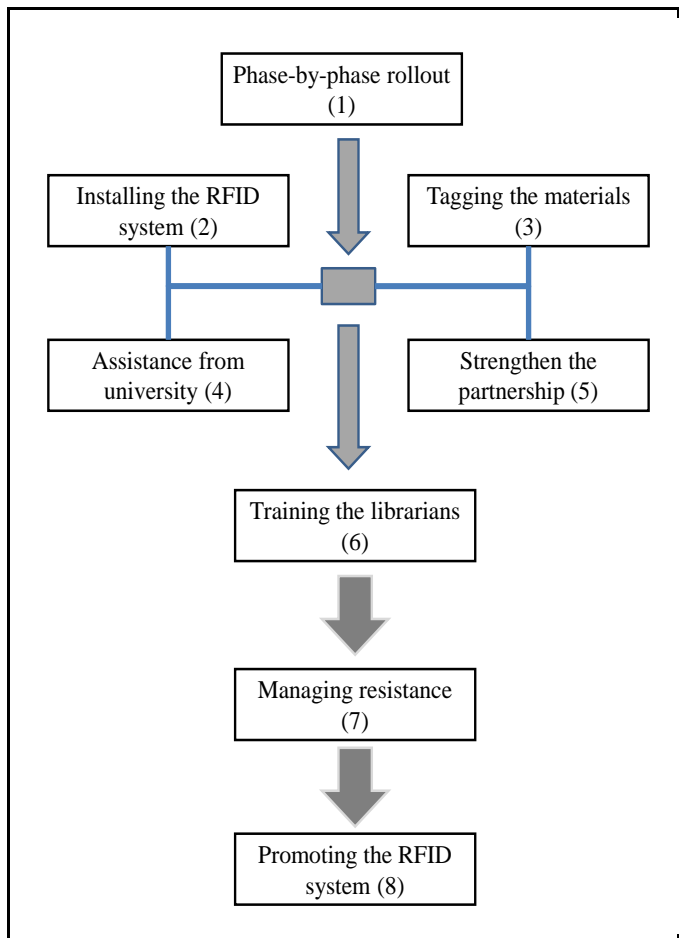
Figure 6.2 The normative framework of the libraries RFID implementation process during the moving stage

6.3 Main activities during the refreezing stage of the RFID implementation

Table 6.5 describes the activities that have taken place during the refreezing phase of RFID implementation. The activities for each organisation were tabulated next to each other to allow the similarities and differences between these organisations to be identified.

Key activities	De Montfort University Library (DMU)	Sainsbury Library, Said Business School, Oxford University (SBS)	University of Leicester's Library (UL)	Nottingham Trent University Library (NTU)	Arrowe Park Hospital (APH)
Refining the system	Because the system has been refined during the installation, more focus was given on maintaining the system.	Because the system has been refined during the installation, more focus was given on maintaining the system.	The setting up of the RFID-based sorting machine will be finalised when the new library is completed	Because the system has been refined during the installation, more focus was given on maintaining the system	The data was tightly secured through a series of passwords and by limiting the storage of the data to 28 days.
Determining the future direction	The future direction was determined by the RFID manager and the library's management	A university-wide working group on RFID was established to present a strategic way forward for RFID.	Because the library had just implemented the technology when this study was conducted, it may be too early to assess the impact of RFID and determine its future direction in the library	The library did not set up a committee to assess the impact of RFID and to determine its future direction in the library. However, the library aggressively lobbied the book industry to include RFID tags in books.	The hospital did not setup a special committee to assess the impact of RFID and determine its future direction in the hospital.
Extending the system	The library planned to add a RFID-based application to locate missing books and navigate the library.	The library planned to pursue a RFID-based stock management system. The suggestion to install a RFID-based sorting machine was rejected.	The library has yet to plan to extend the RFID application.	The library planned to implement a stock management system and has been seriously considering the employment of RFID-based smart shelves. However, the implementation of RFID-based sorting was rejected on cost basis.	The hospital planned to extend the RFID technology to their new call centre and for asset management.
Communicating with vendor					The hospital and the vendor communicated frequently after the RFID system has been setup.

Table 6.5 Cross-sites comparison of the activities during refreezing stage of the RFID implementation

6.3.1 Refining the RFID system

Some organisations completed the refinement of the system during the installation while others completed it afterwards. At the DMU, SBS, and NTU, the refinement of the system was concluded during the installation of the RFID system. However, the UL and APH had to continue the refinement of their systems after the implementation.

Meanwhile, the refinement effort at the UPH involved securing the data collected by the RFID system. The system has two layers of security mechanism. In the first layer, the system itself has been programmed to clear all the data beyond twenty-eight days. In the second layer, a series of passwords were programmed into the system to ensure that only the authorised personnel in the hospital will be able to access the data. The passwords are kept in two hospitals: at the APH itself and a nearby hospital.

6.3.2 Determining the future direction of RFID

The SBS was the sole organisation that setup a special committee to study the impact of RFID and to determine the technology's future direction in the university. It was a university-wide working group that comprised members from different parts of the university. Its task was to evaluate the feasibility of RFID technology and present a strategic way forward for RFID in the university.

Although other organisations have not setup such a committee, their future directions were determined by their RFID managers. One of these organisations was NTU. The university's Deputy Librarian has been aggressively lobbying the book industry to adopt the RFID tags in their books (i.e., to avoid the need to re-tag the books when they arrived in the library). Meanwhile, the UL library is still finalising the setup of its RFID system. Thus, it is too early for the UL library to assess the impact of RFID and determine the future direction of the technology.

Apart from the UL, which has yet to finalise the setup of its RFID system, the other organisations have planned for future RFID applications. The plans involved the decision on whether to add more RFID applications or to reject the ones that were available in the market. The DMU and NTU plan to implement RFID-based smart shelves to locate missing books and navigate their libraries. The SBS and NTU plan to implement a RFID-based stock management stock. The APH plans to implement the RFID technology in its new call centre and also to manage its assets. Meanwhile, the SBS and NTU have rejected the implementation of RFID-based sorting machines on the basis of their high cost.

6.3.4 Monitoring the system at the APH

Unlike the libraries, system's monitoring was a more prominent activity in the APH as the RFID system is closely linked with the hospital's security system. The failure of the RFID system may lead to the failure of the hospital's security system. The RFID system was also installed in the hospital's critical departments and the failure of the RFID system to function could negatively affect these departments' effectiveness.

Therefore, the RFID system at the APH was setup to enable the IT officer to monitor the health of the RFID system from his room. When a problem occurs, the officer will be alerted on the problem. Consistent monitoring has enabled the system to be operated efficiently with minimum downtime. The system does possess a programme that enables it to check its own health.

6.3.5 Forming the libraries RFID implementation process during the refreezing stage

	DeMontfort	Said	Leicester	Nottingham Trent
Step 1	Consistent system check	Enhancing the RFID system	Enhancing the RFID system	Enhancing the RFID system
Step 2	Sharing the knowledge on the RFID implementation	Establishing a university-wide working group on RFID		Monitoring interoperability standards
Step 3	Enhancing the RFID system			Putting pressure on the book industry

Table 6.6 Comparison of the libraries key activities during the refreezing stage

Table 6.6 shows the key activities during the unfreezing stage of the libraries RFID implementation process. From the table, only one key activity (enhancing the RFID system) was found to occur in all four libraries. Therefore, some induction has to be made to develop a more conclusive implementation process at this stage. As a result, the implementation process in can be represented by three activities (see Figure 6.3). The first activity is refining the system (1), which includes all the efforts of the libraries to ensure that their RFID systems are operating smoothly such as consistently checking the system for errors. This activity is followed by determining

the future direction of RFID in the libraries (2). There is ample evidence from the libraries case studies to show that the determination was done by either a working group in a university or by the RFID managers themselves. This activity is logically followed by extending the RFID system (3) activity where the libraries plan for more RFID applications such as RFID-based sorting and navigation systems.

Refining the system (1)

Determine future direction (2)

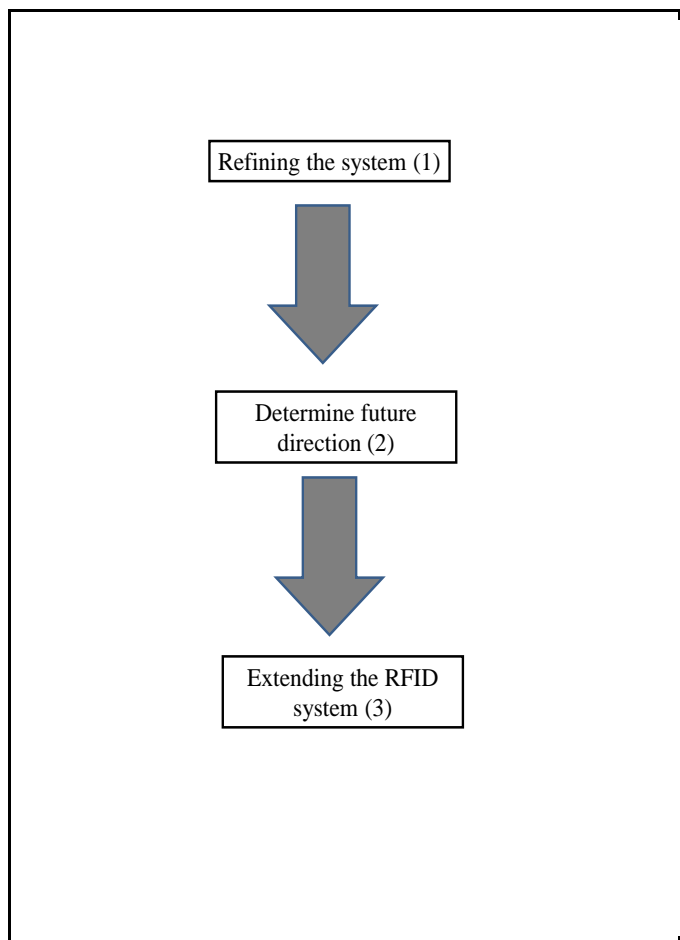Extending the RFID system (3)

Figure 6.3 The normative framework of the libraries RFID implementation process during the refreezing stage

6.4 Towards a Normative RFID Implementation Process Framework

In this section, the normative framework of RFID implementation process framework will be developed. The framework will be developed by comparing side-by-side the

sequence of activities in the libraries and hospital implementation activities. The comparison will allow the study to determine the sequence of activities during the unfreezing, moving and refreezing stage for the normative framework. The basis for the formation of the normative framework will also be described.

6.4.1 The normative framework during the unfreezing stage

	Library	Hospital
Step 1	Soliciting requirements	Setting the implementation objectives
Step 2	Setting implementation objectives	Justifying the RFID investment / championing the RFID project
Step 3	Justifying the RFID investment / championing the RFID project	Forming the beta-site agreement
Step 4	Forming the RFID partnership	Prioritising the project
Step 5		Assigning the RFID manager
Step 6		Soliciting requirements
Step 7		Fitting RFID into the existing process

Table 6.7 Comparison of the libraries and hospital's key activities during the unfreezing stage of the RFID implementation

Table 6.7 compares the libraries and hospital's key activities during the unfreezing stage of the RFID implementation. From the table, some activities have been found to occur across the two organisations. However, the sequence of those activities differs. Therefore, the normative framework that will be formed will be the one that best represent the implementation process of both organisations. This framework is shown in Figure 6.4. The implementation process during the unfreezing stage starts with the

solicitation of requirements (1) activity, followed by setting the implementation objectives (2), justifying the RFID investment to the senior management (3), and ends with the formation of the RFID partnership (4). Meanwhile, championing the RFID project (5) was found to be crucial when the justification from the senior management was required for the project to move ahead.

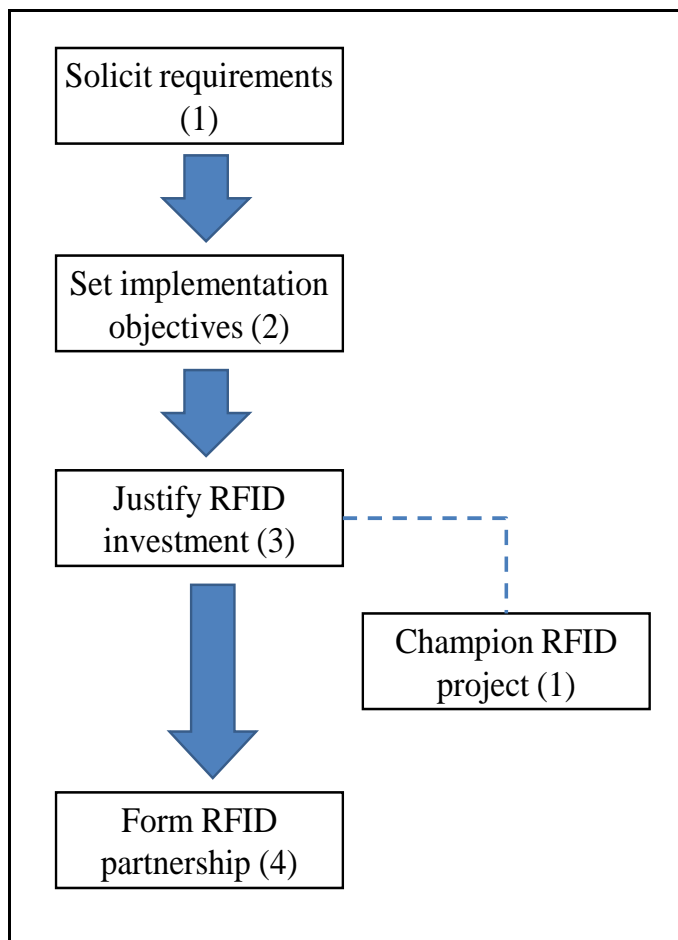Figure 6.4 The normative framework of RFID implementation process during the unfreezing stage

Soliciting requirements (1) activity has been chosen as the first step in the process because it is the most crucial activity. At this stage, the organisations will be exposed to RFID and afterwards will decide whether to adopt or not to adopt the technology. When a decision has been made to adopt RFID, the process will move to setting the

implementation objectives (2) activity. In this activity, the organisations will underline the aims and purposes of employing RFID. This activity leads logically to justifying the RFID investment (3) activity. In this activity, the aims and purposes underlined in the second activity will form important components in getting the consent from the organisations' senior management to implement the RFID project. The consent will enable the organisations to proceed to the formation of the RFID partnership (4). In the hospital, the RFID partnership was formed through the signing of the beta-site agreement between the hospital and its RFID vendor. Meanwhile, in the libraries, the partnership was formed through the appointment of the RFID vendor.

6.4.2 The normative framework during the moving stage

	Library	Hospital
Step 1	Phase-by-phase rollout	Install the RFID system / IT Department's support / championing the RFID project
Step 2	Installing the RFID system / tagging the materials / assistance from university / strengthen the partnership	Develop resilient system
Step 3	Training the librarians	Produce instruction manuals
Step 4	Managing resistance	Training the doctors, nurses and administrative staffs
Step 5	Promoting the RFID system	Managing resistance / championing the RFID project
Step 6		Obtaining users' feedback

Table 6.8 Comparison of the libraries and hospital's key activities during the moving stage of the RFID implementation

Table 6.8 compares the libraries and hospital's key activities during the moving stage of the RFID implementation. From the table, some activities have been found to occur across the two organisations. However, the sequence of those activities differs. Therefore, the normative framework that will be formed will be the one that best represent the implementation process of both organisations. This framework is shown in Figure 6.5. In this figure, the implementation process starts with the development and installation (1) activity, which occurs together with the assistance from other departments (2) and strengthening the RFID partnership (3) activities. These activities are followed by training the staff (4) activity and ends with managing resistance (5) activity.
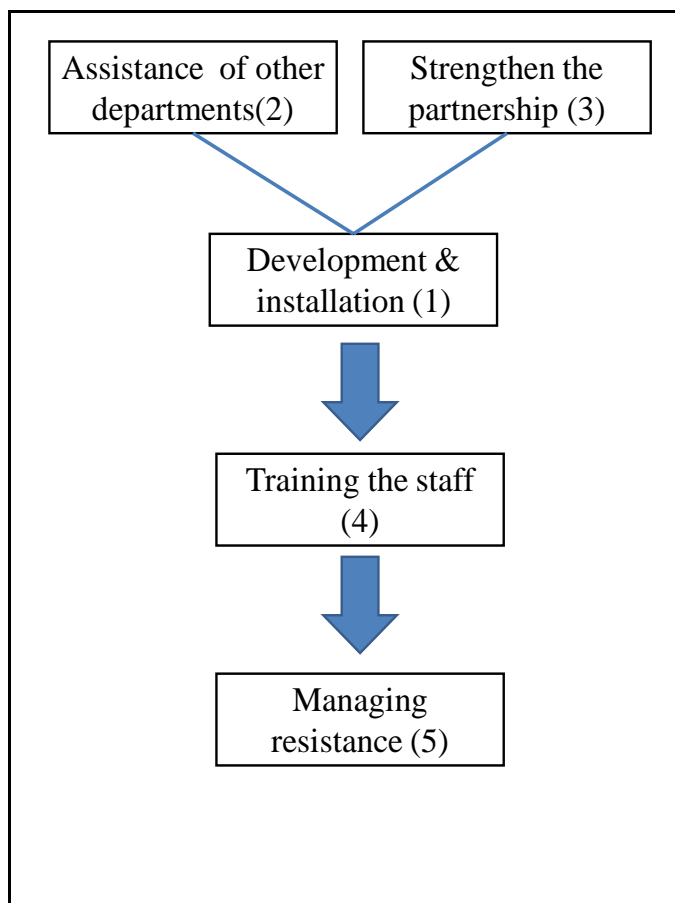
Figure 6.5 The normative framework of RFID implementation process during the moving stage

The development and installation activity is chosen as the first activity because of its importance during the moving stage. That activity enabled the RFID system to be installed and operated in the organisations. Without this activity, the implementation process would not proceed to the following activities such as training the staff. On the other hand, because of their significant contribution towards the development and installation activity, the assistance from other departments (2) and strengthening the RFID partnership (3) activities were combined with the first activity in the moving stage's process. Assistance from other departments such as the IT department enabled the organisations to perform tasks that fell outside of their agreements with the RFID vendors. Among those tasks were managing the data from the RFID system, wiring the buildings and linking the RFID system with the organisation-wide systems. Meanwhile, strengthening the RFID partnership was chosen because the two organisations have made conscious efforts to strengthen the relationship between the parties in the RFID projects such as the RFID vendor and the IT department. More importantly, this activity occurred during the development and installation activity because the organisations felt that forging a closer relationship between the partners would enable the RFID projects to progress smoothly.

The next activity chosen is training the staff (4) activity. This activity is placed after the development and installation activity because the training was possible only after the system has been setup and operating. The training activity led to the following activity in this stage's process: managing resistance (5). The exposure received during the training has caused minor resistance from some staffs in the organisations. The minor resistance was managed by the RFID project managers to prevent it from halting the technology's implementation in their organisations.

6.4.3 The normative framework during the refreezing stage

	Library	Hospital
Step 1	Refining the RFID system	Refining the RFID system
Step 2	Determining the future direction of RFID	Monitoring the system
Step 3	Extending the RFID system	Communicating with the RFID vendor
Step 4		Extending the RFID system

Table 6.9 Comparison of the libraries and hospital's key activities during the refreezing stage of the RFID implementation

Table 6.8 compares the libraries and hospital's key activities during the refreezing stage of their RFID implementation. From the table, two activities have been found to occur across the two organisations: refining the RFID system and extending the RFID system. The two activities have also occurred in the same sequence where the refinement of the system occurs before the extension to the system occurs. Therefore, these two activities have been chosen for the implementation process in this stage (see Figure 6.6).
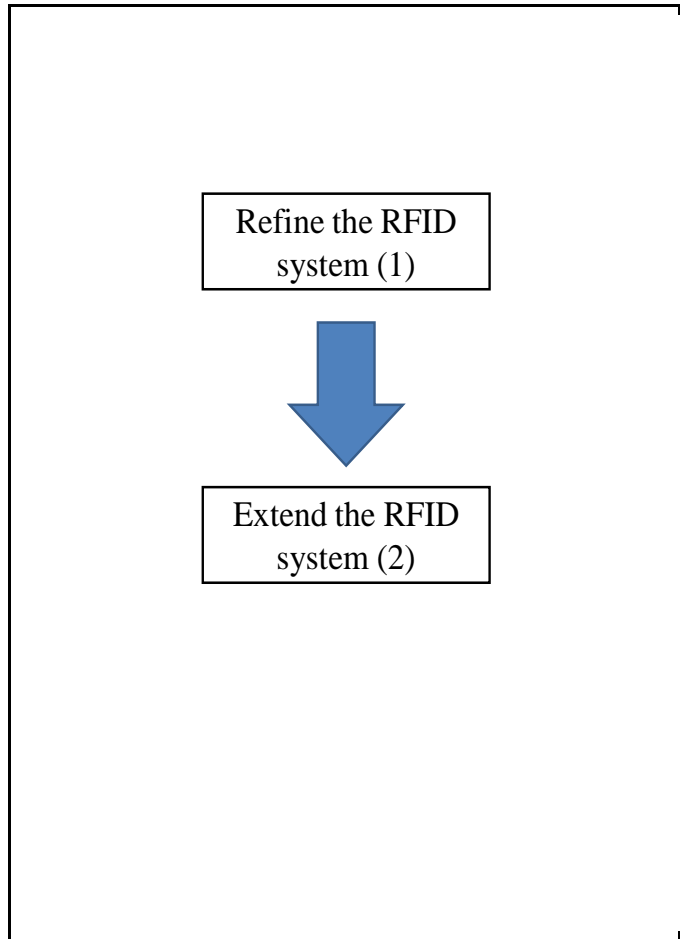
Figure 6.6 The normative framework of RFID implementation process during the refreezing stage

The refining the RFID system (1) is chosen as the first activity because it enables the RFID systems to be fully and properly installed and operated. Only when the systems have been fully and properly installed and operated could they be extended. Among the sub-activities under the refining the RFID system are developing a backup system and monitoring the system. When the system has been properly installed and fully operational, the implementation proceeds with the extension of the system. Among the extensions that may be carried out are RFID-based sorting system, navigation system and call centre.

6.5 Summary

This chapter compares the key activities during the unfreezing, moving, and refreezing stages of the RFID implementation process. The comparisons have allowed these activities to be fully understood, enabling the development of sub-framework at three different stages of the RFID implementation. In addition, the similarities/dissimilarities of these activities throughout the implementation process were described.

During the unfreezing stage, the organisations sought to create awareness of the need to implement RFID and create a climate that is receptive to the technology's implementation. This aim was achieved through a number of key activities. The key activities were soliciting the RFID requirements, setting the implementation objectives, justifying the investment on RFID technology, forming the RFID partnership and championing the project. On the other hand, the key activities in the hospital were more extensive because it has decided to implement the technology own its own than passing the responsibility to an external party. Those activities were prioritising the RFID project, assigning a RFID project manager and understanding the affected process.

During the moving stage, the libraries and hospital develop the RFID based systems and create new methods and learning to accommodate the new technology. This aim was achieved through a number of key activities such as developing and installing the RFID based systems, training the doctors, nurses, administrative staff and librarians to use the RFID system, managing the resistance of some nurses, administrative staff

and librarians, and strengthening the RFID partnership. In the hospital, the moving stage also included activities such as setting the system's backup, producing the instruction manuals, training the doctors, nurses and administrative staff, managing resistance from some nurses and administrative staff, obtaining users' feedback and championing the RFID project.

During the refreezing stage, the organisations sought to stabilise and maintain the RFID based systems. This aim was achieved by the libraries through three key activities: refining the RFID system, determine the future direction of the technology in the organisation, and extending the RFID-based systems. Instead, the hospitals achieve the aims of stabilising and maintaining the RFID based systems by refining, monitoring, and extending the system.

Comparing the RFID implementation across the five organisations has enabled the validity of the research framework of RFID implementation process in the UK public sector to be enhanced. The comparison has also reduced the possibility of bias because the key activities that form the framework were not taken from just a single public sector organisation. Instead, the framework was developed from the key activities that were found to occur across five public sector organisations. The inclusion of a hospital in the primary fieldwork has also increased the validity of the framework because it has enabled the implementation process between passive and active RFID technologies to be compared. The comparison has reduced the study's potential bias towards passive RFID technology that was implemented in libraries. It has also allowed a truer picture of the RFID implementation process to be presented.

As this chapter has presented the normative framework of RFID implementation process in the UK public sector, the next chapter will present the major and minor contributions of this study. The next chapter will also discusses the study's limitations, the tactics employed to overcome some of those limitations, and the implications of the study on RFID project managers and future studies of RFID implementation process in the public sector.

CHAPTER 7

CONCLUSION

The objectives set in the first chapter have been fulfilled. The first objective was achieved through the development of the normative framework of the RFID implementation process in the UK public sector. The framework divides the implementation process into three stages: unfreezing, moving and refreezing, with each contributing differently to the implementation. The unfreezing stage allows the awareness of the need to implement the technology to be created and a climate that is receptive to the technology's implementation to be shaped. The moving stage enables the new technology to be developed and new methods and learning to accommodate the new technology to be formed. The refreezing stage allows the RFID system to be maintained and stabilised.

The second objective was achieved through the identification of the key activities within the three stages of the implementation process. These key activities fit the contribution of the stage they are in. For example, the key activities in the unfreezing stage such as setting the implementation objectives, justifying the project to the senior management and forming the RFID partnership allowed the organisations to create a climate that was conducive to the implementation of the technology. The third

objective was achieved through the identification of key activities where their deployment by the public sector organisations may differ. Additionally, the different approaches taken by each organisation to manage those key activities was explained.

7.1 Contributions of the study

7.1.1 Contribution 1: The RFID implementation process framework in the UK public sector

The most significant contribution of this study is its RFID implementation process framework in the UK public sector. The framework was developed stage-by-stage from chapter four (the pilot study) to chapter six (the normative framework). The framework possesses theoretical and practical contribution. Theoretically, the framework contributes by adding the social and organisational factors to the knowledge on RFID implementation. The social and organisational factors that have emerged from this study are forming and strengthening the RFID partnership, championing the project, managing resistance, promoting the RFID system, and determining the future direction of the technology in the organisation. These social and organisational factors were merged with the technical factors to form the implementation factors in the framework.

Practically, the framework contributes by providing guidance to the existing and potential RFID managers in the public sector in the form of key activities in the technology's implementation process. The key activities are divided into three stages: unfreezing, moving and refreezing, where each stage contributes differently to the

implementation process. In addition, the framework also identifies and explains the key activities where the implementation may differ between organisations. Figure 7.1 shows the normative framework of RFID implementation process in the UK. The summary of the framework is hereby presented.

During the unfreezing stage, the key activities that were found to be crucial to the implementation's success were soliciting requirements (1), setting the implementation objectives (2), justifying the RFID investment (3), forming the RFID partnership (4) and championing the RFID project. The organisations first sought to solicit the requirements for the RFID system. The requirements were solicited through visits to trade shows, exhibitions, expos, and other libraries that had implemented the technology. The vendors also assisted in determining the requirements for the RFID systems. These requirements were then translated into implementation objectives. The implementation objectives outlined the aims and purpose of the RFID implementations. All the organisations wanted to enhance the experience of their staff and clients. The libraries achieved this aim by allowing their patrons to manage their own loaning transactions, while the hospitals managed it by enhancing the care and security of their patients.

When the requirements had been solicited and the implementation objectives have been set, they were incorporated into the business cases that were presented to the organisations' senior management. The senior management scrutinised the respective business case providing the justification for the implementation of the technology. Most business cases justified the implementation through cost savings and user satisfaction. These reasons, along with the availability of funds and the organisations'

good reputation led senior management to grant their approval for the implementation.
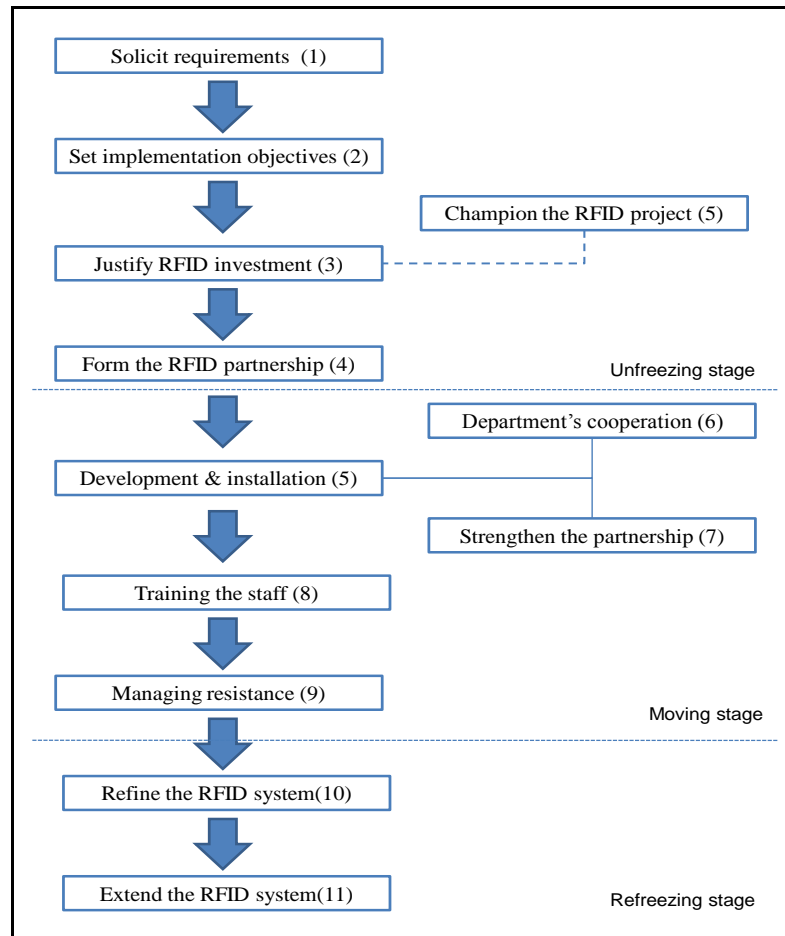
Figure 7.1 The normative framework of the RFID implementation process in the UK public sector.

Forming the RFID partnership included selecting the appropriate RFID partner for the respective organisation. The most popular method for selecting the RFID partner was through an open tendering process. During this process, the vendor that met the criteria set by the organisations and possessed certain 'qualities' was chosen as the partner. However, some organisations chose to bypass the tendering process and appointed a RFID partner directly. This action was caused by the lack of RFID vendors or the need to develop the RFID system internally. For instance, the APH

signed a beta-site agreement with its RFID vendor resulting in the hospital being the site for the vendor to test its latest RFID devices and software.

The role of an RFID project champion was found to be more prominent in certain organisations. These organisations were the earlier implementers of RFID technology and, consequently, had to endure a number of implementation issues including the high cost of the technology's devices, the immaturity of the technology, the RFID vendors' lack of experience, and resistance from the staff. Despite these difficulties, the technology was eventually implemented because of the diligence and tenacity of the RFID champions. They argued to the senior management for its adoption, and then led the implementation effort, especially during the technical difficulties where a small amount of resistance from staff was encountered.

During the moving stage, the following key activities were found to be crucial to the implementation's success: development and installation (5), cooperation of other departments (6), strengthening the RFID partnership (7), training the staff (8) and managing resistance. The development and installation sub-activities for the libraries differed markedly to the hospitals. The differences were attributable to the contrasting technology employed by the organisations; the libraries employed a passive RFID while the hospitals employed an active RFID. The sub-activities for the libraries consisted of the installation of the RFID system and tagging the library materials. The most important sub-activity during the installation was linking the library's management system (LMS) and the RFID system. The tagging sub-activity consisted of a number of sub-activities: (1) deciding which materials to tag (2) who will perform the tagging and (3) what data to store in the tag.

The sub-activities for the hospitals consisted of programming the system, programming the RFID readers and tags, producing instruction manuals and developing a resilient system. Programming the system enabled the hospitals to install the required applications while programming the readers and tags enabled them to operate in the hospital. A simpler instruction manual was developed for the benefit of the IT department, especially for when the RFID project leader was absent. A resilient system was developed to ensure that the system would be able to operate without interruption.

Although the assistance provided by other departments such as the estate and the IT departments in the RFID implementations was small, it was important. The estate department assisted in wiring the IT network and power supplies, while the IT department ensured that the RFID system complied with the organisation's standards for linking with the organisation's system. In addition, the IT department also provided cover for the RFID leader while its database administrator liaised with the RFID vendor to manage the data collected by the system.

When the RFID system has been fully developed and installed, the staff will be given training. The most common training given was how to use the RFID system appropriately. For nurses and administrative staff, the training included guidance on how to handle the RFID tags. For librarians, the training included customer service training because after the installation, they were expected to assist patrons in finding the relevant materials in the library.

Although the RFID implementations represented only a small change to the organisations, it led to some minor resistance from staff. This was caused by the system's technical failures and the fear that the system would closely monitor every second of staff action. To overcome the resistance, the RFID project leaders had to personally talk to the affected staff. For the first cause of resistance, they had to convince the staff that the technical problems were temporary and that they would be rectified. For the second cause of resistance, they had to assure the staff that the system would not be used for monitoring their actions.

Because the RFID system was developed through a partnership of different parties such as the implementing organisations and their RFID vendor, strengthening the partnerships was crucial to the success of the implementation. To strengthen the partnership, the organisations chose to employ either encouragement or force. The organisations that employed encouragement tactics set up meetings between the different parties and encouraged them to consult with each other frequently. The organisations that employed force made the RFID vendors contractually responsible to deliver the RFID system and, therefore, also made them responsible for strengthening the RFID partnership.

During the refreezing stage, refining and extending the RFID system was found to be the key activities. Refining the RFID system consisted of sub-activities such as completing the setup of the postponed RFID application and securing the data collected by the system. Meanwhile, extending the RFID system included determining the future direction of the RFID system and developing more RFID-based applications.

The future direction of RFID has been determined internally and externally. The internal future direction of the technology can be seen in one organisation, which established a working committee to study the impact of RFID. The aim of the committee was to present a strategic way forward for RFID in the organisation. This kind of committee was found to be lacking in other organisations in this study. Also, the external future direction of the technology can be seen in one organisation that has been actively lobbying the book industry. The RFID project leader in this organisation lobbied the industry to insert RFID tags in the books supplied to the libraries.

In many organisations, the future direction of RFID is determined by the RFID project leaders. Because of the technology's positive impact, these project leaders have decided to add more RFID-based applications. Additions include the RFID-based smart shelves, stock management system, asset management, and call centre. This sub-activity also includes the rejection of certain RFID applications. One organisation rejected the employment of RFID-based sorting machines due to the high cost of purchase.

7.1.2 Contribution 2: Problem identification

A review of the literature on RFID implementation in chapter 2 has revealed two research problems. The first research problem pertains to the lack of literature on the RFID implementation in the public sector, especially the implementation process. This lack of literature has two implications. First, there is very little guidance to the existing and potential RFID managers in the UK public sector on how to best manage the technology's implementation. Second, the RFID managers have to base their implementation on the private sector's RFID implementation. This action may lead to implementation failure because both sectors have different IS characteristics.

The second research problem concerns the emphasis of the literature on the technical aspects of RFID implementation. The emphasis on the technical aspects can be attributed to the perception that RFID is merely an input device that can be easily installed and running. This 'plug and play' perception failed to realize that the success of any IS implementation, including RFID, is dependent upon many social and organizational factors, such as acceptance of the users and the support of the top management. Failure to consider the social and organizational factors may lead the RFID implementation to failure.

7.1.3 Contribution 3: Reconfirm the usefulness of the Lewin's change model

This study has confirmed the usefulness of the Lewin's change model in investigating IS implementation. The use of the model in chapter four, five and six has enabled this study to frame the implementation process into three stages. In addition, it disputes

the claims that the model is useful only in prescribing the methods of achieving change. Instead, the simplicity of the model has facilitated this study in identifying and framing the key activities in the implementation process

7.2 Limitations of the study

This study has several limitations. First, the organisations involved were limited to libraries and hospitals. Although these two domains represent the most active RFID implementers in the UK public sector, the various RFID implementers in the other public sector organisations such as local authorities were left out as access was not granted. This action was taken to allow in-depth investigation of the implementation process.

Second, there is an imbalance between the numbers of participating informants as there was significantly larger number of libraries compared to hospitals. Third, the data was not collected through direct observation of the RFID implementation process. Instead, the study's framework was developed through retrospective accounts of the RFID project leaders. Their accounts may contain biases, i.e. they may want to show only the positive aspects of the implementation. However, the potential biases cannot be verified without direct observation of the phenomenon (Woodside and Wilson, 2003). Furthermore, they may have missed out some important matters when discussing their experiences. To overcome the problem pertaining to the retrospective accounts of the informants a few measures were taken, which are discussed in the next section.

7.3 Enhancing the quality of the findings

To overcome the limitations stated above, several measures were taken to enhance the quality of the study's findings. The quality of the findings is measured by the validity, which comprises internal and external. Internal validity concerns the credibility of the inferences made from the data while external validity concerns the generalisability of the findings (Eisenhart and Howe, 1992; Kirk and Miller, 1986).

To achieve internal validity, this study adopted certain measures. The first measure was feeding back the transcripts and findings to the informants (Easterby-Smith et al, 1991) (examples of the feedback can be found in Appendix 1). This measure served two purposes. First, it enabled the informants to check the accuracy of the transcripts, thus, enhancing the descriptive validity of the study (Maxwell, 1992), i.e. the accounts of the informants are factually correct. Second, it presented an opportunity for the informants to provide feedback to the study's interpretation of their RFID implementation process. The feedback has enhanced the study's interpretive validity (Maxwell, 1992). The second measure was to include the relevant quotations from the informants (Healy and Perry, 2000) in the research report. The quotations allow the readers of the research report to evaluate the basis of the researcher's interpretations. The third measure was to match the findings of the study with conflicting findings from other studies in the same area of research (Eisenhart, 1989). This measure ensured that the study's findings were comparable with previous studies on RFID and IS implementation.

Generalisability is a crucial secondary issue for qualitative case studies (Eisenhart and Howe, 1992, Maxwell, 1994). Although generalisability is a crucial secondary issue for qualitative case studies, it is inaccurate to assume that they lack generalisability. A single case study can be generalised by framing it as a supplement or alternative to other methods (Flybverg, 2006). In addition, the purpose of qualitative research is to generalise the findings analytically in which the researcher is striving to generalise a particular set of results to some broader theory (Healy and Perry, 2000). This was achieved by comparing the findings with similar findings from previous studies on IS and RFID implementations (Eisenhart, 1989, Lee, 1989).

One of the significant threats to validity in qualitative case studies is reactivity, a researcher's influence on the organisations or individual studies. Although it is possible to control the influence of the researcher in quantitative studies, achieving the same feat in qualitative studies is almost impossible. Furthermore, controlling the influence of the researcher could be counter-productive as qualitative studies require in-depth understanding of the phenomenon under investigation (Kirk and Miller, 1986). In this process, it is possible that the researcher's personality could affect the research site and, thus, distort the data collected from the site. In addition, there is a possibility of interview bias where the interviewer imposes their own reference frame on the interviewees, both when the questions are asked and when the answers are interpreted (Easterby-Smith et al., 1991). However, there are methods available to reduce the threat of reactivity. In this study, the informants were allowed as much freedom as possible to tell their experience in managing the RFID implementation. This involved minimising the number of questions in the interview guide and probing

the informants only when necessary (i.e. when the informants deviated from the topic or when they ran out of things to say).

7.4 The implications of the study

The study adds to the state-of-the-art knowledge on RFID implementation. Whereas the existing literature on RFID focuses mostly on the technical aspects of the implementation, this study raises the organisational aspects of the technology implementation. In addition, whereas the issues concerning RFID implementation, such as users training and the tagging process, are found separately in earlier RFID literature, the issues are merged to form a normative framework of the technology's implementation process in this study.

This study also reaffirms and adds some factors to the state-of-the-art knowledge on IS and DSS implementation. Variables that were identified in previous studies of IS and DSS implementation, such as top management support, user resistance and system's quality (Alavi & Joachimsthaler, 1992; Sabherwal et al., 2006) have been found to be equally crucial in RFID implementation. In addition, some factors such as the formation and strengthening of the RFID partnership have emerged in this study. Hence, knowledge on IS and DSS implementation is highly valuable in guiding the implementation of RFID technology.

The findings in this study also suggest that RFID implementation is not just a technical implementation. Although the technology is often treated as an input device to an information system (Stair and Reynolds, 2008), the technology offers its greatest

value when it is developed as an information system (Doerr et al, 2006). Therefore, RFID implementation must be treated as an IS implementation. Consequently, a number of organisational factors play important roles in the success of the technology's implementation. Among them are setting the implementation objectives, championing the RFID project and strengthening the RFID partnership.

This study has important implications to the implementation of RFID in public sector organisations, especially in the UK. First, the objective of the implementation should be focussed towards enhancing the services given to the public. Second, the focus on services enhancement must be followed by a strong justification for the inclusion of the technology. This justification should include a cost-benefit analysis and comparison with competing technologies. Third, although users' involvement in the design and installation of the RFID system is small, their feelings gave some indications of the new system's health. The users feel frustrated when the RFID system is not working properly and this frustration could be translated in the form of resistance towards the new system.

The normative framework offers two important factors to the management of RFID implementation. First, RFID managers have to give different emphasis to different stages of the implementation. During the initial stage of the implementation, emphasis should be given to creating a climate that is conducive to the introduction of RFID. In the middle of the implementation, emphasis should be given to developing the RFID system and assisting the users in employing the system. Towards the end of the implementation, emphasis should be given to stabilising and maintaining the system. Second, creativity is equally important in the successful implementation of

RFID. Some key activities in the normative framework, for example, justifying the RFID project to the senior management, can be approached in different ways. RFID managers must use their judgement and creativity to adopt the most suitable approach in each activity to ensure that the RFID project will run successfully.

7.5 Future research directions

Promising avenues for future studies on RFID implementation are hereby proposed. First, future studies may want to replicate this study's framework in different settings. The settings may include other public sector organisations or a public sector in a different country. Second, future studies may want to include more organisations that have implemented RFID in the study of their implementation process. This may strengthen the normative framework and increase the generalisability of the findings. Third, rather than relying on retrospective accounts of RFID project managers, future studies may want to directly observe the RFID implementation process. Direct observation should overcome the problems that come with the use of the retrospective account method. Fourth, because a significant number of public sector organisations have not embraced RFID technology, future studies may want to investigate the reasons for the technology's non-adoption. Studies on the non-adoption of RFID could enable the barriers to RFID adoption to be identified and possibly remedied.

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Appendices

Appendix 1: Examples of acceptance e-mails from the case study sites

1a. Acceptance from Mr Alan Brine, De Montfort University Library

Dear Shamshul

We have indeed implemented RFID and are still rolling it out to our
other libraries. If you would like to talk about it I would be delighted
to speak to you.

Best wishes,
Alan Brine

-----Original Message-----
From: Shamshul Zakaria [mailto:Shamshul.Zakaria@brunel.ac.uk]
Sent: 30 July 2007 17:58
To: Alan Brine
Subject: RFID in De Montfort University's Library

Dear Mr Alan Brine,

I am a research student in the School of Information Systems, Computing,
and Mathematics, Brunel University, West London. I am doing a research
on the implementation of Radio Frequency Identification (RFID) and I
read that the De Montfort University's library has used the technology.
May I know whether that is correct? If it was true, may I know who I can
talk to in order to know more on how the library implement RFID? Thank
you very much.

Kind regards,

Shamshul Bahri Zakaria
School of Information Systems, Computing, and Mathematics
Brunel University
Uxbridge, Middlesex
UB8 3PH
United Kingdom
Phone: 07835927366

1b. Acceptance e-mail from Ms Jo Aitkins, University of Leicester Library

Dear Shamshul

Thank you for your letter of the 20 June to Christine Fyfe, the
University Librarian.

She has passed it to me, as I am responsible for the implementation of
RFID here at Leicester.
So I am the person you need to contact (My details are below)

I look forward to hearing from you.

Regards,

Jo Aitkins

Ms Jo Aitkins
Head of Public Services
University Library
University of Leicester
PO Box 248
University Road
Leicester. LE1 9QD

Telephone +44(0)116 252 5180
Fax +44(0) 116 252 2066
Email jua1@le.ac.uk

Appendix 2: Feedback from informants on their RFID implementation process framework

2a. Feedback from Ms Sharon Cure, Sainsbury Library, Oxford University

Hello Shamshul,

It looks fine to me. I've passed it on to Fiona Richarson, the
Information Services Manager, in case she has any comments.

With best wishes,

Sharon

_____

From: Shamshul Zakaria [mailto:Shamshul.Zakaria@brunel.ac.uk]
Sent: Mon 4/14/2008 21:48
To: sharon.cure@said-business-school.oxford.ac.uk
Subject: RFID Implementation at the Sainsbury Library, Said Business
School

Dear Ms Sharon Cure,

Thank you for talking to me sometime last year about the RFID
implementation process in your library. For your information, I have put
them in writing. Would it be possible for you to have a look at what
I've written and perhaps point out the things that I might have
misinterpreted from the interview? It will ensure the accuracy and
validity of my findings. Thank you very much for your time and help.

Regards,

Shamshul B Zakaria
Research Student
School of Information Systems, Computing and Mathematics
Brunel University, West London

2b. Feedback from Mr Mike Berrington, Nottingham Trent University Library

Dear Shamshul,

Thank you again for the opportunity to comment on your work. I have made a few comments regarding factual matters or areas where I think the emphasis is slightly wrong. I hope the remarks are helpful, but I would be more than happy to look over it again if you would like me to after you have made revisions.

One final query, I am assuming from your copy that the University and its supplier will be named in your final copy, rather than be anonymised? If I am right in thinking that, would you mind if I looked at again at the references to Intellident, just make sure that there is nothing attributed to me that they would be unhappy about? I am not requesting you remove any of the content in relation to them, but some of the quotes could perhaps be reworded in a less critical way! I hope you don't mind my asking this, please let me know if it would be a problem.

Best wishes and good luck with completing it.

Regards,

Mike.

_____

From: Shamshul Zakaria [mailto:Shamshul.Zakaria@brunel.ac.uk]
Sent: Mon 14/04/2008 21:56
To: Berrington, Mike
Subject: RFID implementation at the Nottingham Trent University's library

Dear Mr Mike Berrington,

Thank you for talking to me sometime last year about the RFID implementation process in your library. For your information, I have put them in writing. Would it be possible for you to have a look at what I've written and perhaps point out the things that I might have misinterpreted from the interview? It will ensure the accuracy and validity of my findings. Thank you very much for your time and help.

Regards,

Shamshul B Zakaria
Research Student
School of Information Systems, Computing and Mathematics
Brunel University, West London