

The Role of Independent Advocacy Groups in RFID Technology Use

**The Current Status of RFID Technology Adoption in
New Zealand**

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Declaration

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning."

Sign: _____

Date: ____/____/____

Jiayu Zhang

Abstract

Radio frequency identification, also known as RFID technology, has been commercially available since World War II. In recent years, interest has turned toward using RFID in supply chain management, such as monitoring and tracking business processes. There are many businesses that have already invested in an RFID supply chain management solution but little is known about the current state of diffusion of RFID technology and the role of advocacy groups in the diffusion process. This research investigated the current state of RFID diffusion in New Zealand according to diffusion of innovation and Moore's theory to provide insight into the role of innovation advocacy groups such as New Zealand RFID Pathfinder Group (referred as the NZ RFID Pathfinder Group). RFID in supply chain management terms is inter-organisational and much of the role of advocacy groups is in networking between players in the supply chain management context. Therefore, this research focused on industry group leaders. The research was conducted in two main parts, an online questionnaire survey and a follow up interview. The online questionnaire survey used a quantitative approach while the interview used a qualitative one. In summary, the result show that: 14% industries (seven out of 51) have already adopted RFID technology, the industries were from importer, research institute, manufacturing, and distribution; 36% have plans (16 out of 44) to adopt RFID technology in the near future, the industries were from importer, research institute, manufacturing, and distribution; and 64% industries (28 out of 44) did not any plan to adopt RFID. The strong recommendation was to standardise each aspect of the technology, making the products available to clients and creating competition between RFID technology service suppliers, thus bringing down the cost through market forces. Increasing the number of members of advocacy group could also encourage RFID adoption. One group of potential RFID adopters in the future will be local branches of international companies with a mandate to adopt RFID technology. The results suggest that the NZ RFID Pathfinder Group should set the direction of NZ RFID adoption; get involved in national pilots; and the activities of lobbying governments and associations and information sharing.

Chapter One

1. Overview

Radio frequency identification, also known as RFID technology, has been in use now for decades. It was mainly used for military purposes in the past. In recent years, the development of international identification number standards by EPC global, and MIT Auto ID lab has facilitated the wider diffusion of RFID applications. In Chapter Three, all of the advocacy groups and technologies will be explained in full detail.

According to the RFID Journal (n.d.), many countries, including the USA, China, UK, Japan, Korea, and Germany, have already started to use RFID technology for functions such as monitoring business processes and parts traceability. Using RFID for traceability can speed up the availability of product information as products move through the supply chain from the manufacturer to consumers. RFID systems can make important maintenance information available for businesses or consumers. In a review of Australian and New Zealand RFID use, Harrop (2006) stated that New Zealand has lead in some areas of RFID adoption; however, New Zealand needs to benchmark itself against best practice elsewhere and catch up in order to keep New Zealand businesses competitive with the rest of the world.

The advocate model has been used in this thesis to inform the researchers understanding of the role of RFID advocacy groups. The main purpose of advocates according to the advocate model (Markus & Benjamin, 1996) is to influence people's behaviour to serve the organisation's best interests. In this case, it is important to understand the industry groups' best interests with regard to RFID technology. The advocate model is discussed in more detail in Chapter Three.

The NZ RFID Pathfinder Group (PathfinderGroup, n.d), is dedicated to the competitive development of New Zealand businesses through the adoption of RFID and EPC (electronic product code) technologies. The goal of the NZ RFID Pathfinder Group is to provide a shared learning approach to RFID among New Zealand businesses. The NZ RFID Pathfinder Group is also actively participating in the EPC global community both nationally and internationally through membership in working groups. They encourage EPC adoption and knowledge acquisition among New Zealand businesses by providing

education and marketing support. The NZ RFID Pathfinder Group also includes GS1 and other standards, current and future RFID and EPC technologies.

In this research four research questions are put forward:

- 1) What are the RFID technology adoption levels at the industry level in New Zealand?
- 2) What are the intentions to use RFID technology in the future at the industry level?
- 3) What are the recommendations to the NZ RFID Pathfinder Group? and
- 4) What is the innovativeness of the respondents' industry?

These four research questions provide a framework for understanding and analysing the relationship between New Zealand RFID use and the advocacy groups that promote its use. First of all, it is critical to understand New Zealand industries by finding out what type of industries RFID has been used for in New Zealand already. Secondly, what their future plans are in regard to RFID technology adoption. Thirdly, what role could the NZ RFID Pathfinder Group play in the innovation process. Finally, the results from this research were used to gauge the innovativeness of the respondents using Moore's theory.

The research was conducted in two main parts. An online survey was undertaken first and was followed up by interviews. 51 industry group representatives responded to the online survey, and follow-up interviews were conducted with three prominent members of the RFID development community in New Zealand. The data have been collected at industry level. The results show that New Zealand has three main groups regarding RFID adoption: industries who had adopted RFID already; industries that planned to adopt RFID in the near future; and industries that did not intention to adopt RFID at all. There are only a small number of RFID adopters. Most industries who responded intended to adopt RFID soon; however, there were still a certain percentage of industries that did not have any intention to adopt RFID technology. The main adopters were manufacturers, import / export companies, and public sector bodies.

The body of the thesis, from Chapter Two to Chapter Eight, describes the research thesis in detail. Chapter Two provides the background and motivation of the research thesis and a small amount of information about RFID. Chapter Three provides a literature study of RFID technologies. Chapter Four discusses the innovation theories

related to the analysis of the research findings. Chapter Five outlines the methodology and relevant methods used in the research thesis. Chapter Six provides a detailed discussion of the results from the online survey as well as the data analysis. Chapter Seven details the findings from the interview data. Chapter Eight, it provides the final outcomes of the research thesis, outlines the possible limitations of the thesis and implications for both academia and industry.

Chapter Two

2. Motivation for the research

2.1. Current state of RFID around the world

Radio frequency identification technology is also known as RFID. The technology has been available for many decades. According to Microsoft.com (2006), “unit cost of tags and the overall cost of RFID implementation” has been one of the factors impeding RFID adoption by many businesses. Since RFID hardware has been developed specifically for application to supply chain management (SCM), the potential of the business applications have been re-focused globally. Maloni and DeWolf (2006) stated that RFID applications have been successfully used for the purpose of monitoring and tracking business processes.

Many countries have invested a fortune in RFID technology. For example in 2007, RFID technology in the East Asia market was US\$2.7 billion of US\$4.96 billion spent globally, with US\$1.9 billion of it in China alone (ReportBuyer.com, 2007); and the USA has invested even more than China in RFID development (Xiao, 2007). The US market of RFID technology for retail supply chains will rise from \$91.5 million US Dollars in 2003 to \$1.3 billion US Dollars in 2008 (PharmaceuticalInternational, n.d.).

However, some RFID development has occurred within organisations and is used for traceability of items as demonstrated in the examples of evidence traceability at the Dutch Forensic Institute in Europe and uniform management at Alvear Palace in South America. For example, the Dutch Forensic Institute has implemented an RFID track-and-trace system for 100,000 pieces of evidence, including guns, knives, cigarette butts and other items collected during the investigations. All of them have been labelled with EPC Gen 2 RFID¹ tags (Wessel, 2008). The Dutch Forensic Institute RFID system gives detectives absolute control over all of the evidence. All changes or movements are recorded and this information can be used to detect if evidence has been tampered with or moved without permission. The system at the Dutch Forensic Institute reduces the

¹ EPC Gen 2 stands for the Electronic Product Code Class-1 Generation-2 UHF RFID Protocol, the specification developed by EPCglobal for the second generation RFID air interface protocol and a passive RFID tag protocol. More information available at:
http://www.epcglobalinc.org/standards/uhfc1g2/uhfc1g2_1_2_0-standard-20080511.pdf

work load for office clerks and the incidence of lost articles of evidence by tracking every movement of evidence shared among the investigators and prosecutors.

O'Connor (2008) reported that Alvear Palace, a luxury hotel in Buenos Aires, Argentina, has implemented RFID system for managing their uniforms lifecycle. The uniforms are one of the very important perspectives for a hotel. Many of their staff uniforms are supplied from Europe, sometimes the staffs has to wear ill-fitting garments while waiting for the uniform replacements. The RFID system provides a small RFID tag for every uniform garment, therefore, all the garments can be monitored daily before shifts start and after shifts finish. If there are any problems with the uniforms, the manager could act immediately to solve the uniform issues. Winwatch is a Swiss company, which has been developing RFID application to prevent the counterfeit wristwatches and manage customer service. The CEO of Winwatch believed that RFID technology with EPC Gen 2 standard can be the most cost-effective and also best suited for the purpose of authentication. The RFID tags provide the unique feature for each wristwatch, therefore, the Customs and the Winwatch customer service team can easily obtain the genuine information about the watch, and then they can deter the illicit trade and provide customer service accordingly (Bacheldor, 2008).

Australia is also promoting RFID technology adoption for businesses and as an important next door neighbour to New Zealand, the experiences of Australian companies is important to the study of New Zealand RFID advocacy. The following section discusses the current state of RFID technology adoption across organisation in Australia.

2.2. Current state of RFID in Australia

Australia is close to New Zealand in many ways; they have a similar physical environment and similar historical and cultural backgrounds. Therefore, New Zealand could learn something about RFID adoption from the experience in Australia. According to Harrop (2006), Australia and New Zealand achieve a similar benchmark from a global point of view. Australia is a leader in some aspects of its adoption of RFID, but it is still not quite competitive globally. G2 Microsystems is an Australian RFID chip producer, which is recognised as the world's leading producer of a type of RFID called real time locating systems (RTLS).

Through the work of GS1 Australia, the main RFID advocacy group in Australia, there have been several projects that have dealt with RFID across organisations in the context of supply chain management.

GS1Australia (2007) reported that there were several significant RFID events undertaken over the last two years to show RFID technology cases. In 2007, a pilot named the National EPC Network Demonstrator Project Extension (or NDP Extension), was launched at the Smart 2007 Conference by consortium representatives CHEP (Commonwealth Handling Equipment Pool), MasterFoods and GS1Australia. At the conclusion of the NDP Extension, CHEP estimated that 28 percent of end-to-end processing time could be saved per pallet delivery journey, and EPC/RFID allowed total visibility of assets throughout the supply chain which enabled trading partners to immediately track pallet orders adding value through improved customer service. In the same year, the Australian Communications and Media Authority (ACMA) renewed GS1 Australia's four-watt scientific license for an additional 12 months, which allowed the Australian branch of GS1, an international standards-setting organisation, more time to test UHF EPC RFID systems (Bachelder, 2007). In section 6.4, a set of 2007 data published by GS1Australia is compared with the results gathered from a New Zealand survey data undertaken in this study.

The next section will outline the current state of RFID technology in New Zealand.

2.3. Current state of RFID in New Zealand

New Zealand is a leader in some aspects of global RFID technology adoption; however, in some respects it is still behind some other countries. According to Harrop (2006), New Zealand is well behind countries such as, Botswana, Uruguay and Canada. There are only a few cases of RFID adoption in New Zealand so far and these cases have been project implemented within organisations rather than in supply chains that reach across several organisations. According to Industry Search (IndustrySearch, 2006), Fonterra, the world's largest milk cooperative, has appointed system integrators for a major project using RFID for error prevention and record keeping in New Zealand. iStart (2005) reported that the Warehouse has been cooperated with IBM NZ to explore whether RFID could be used to improve the efficiency of its store management and stock availability since late 2004. Yakka Apparel, a clothing supplier to the New

Zealand Defence Forces, worked closely with Manufact Data Systems (MDS) to develop an innovative ordering solution using Radio Frequency Identification technology in 2005 (Elmes, 2005). They created a software program with an RFID wristband and all garments were identified with an RFID tag. Traditionally, sizes of soldiers were measured and recorded manually, but now they use the wristband to scan the soldiers, and the garments are scanned to identify sizes and numbers of garments. The managing director of MDS, Ian Parker (Elmes, 2005) indicated that RFID technology “had brought significant value to the suppliers as well as the customers by reducing the error rate and speeding up the working process”.

Scoop (2005) reported that Botany library was the first New Zealand public library to implement an RFID-based intelligent library system. Some 30,000 books tagged with RFID. Books were automatically scanned for loans and the library staff could use a handheld scanner to check whether books were out of sequence on shelves. The deployment of the RFID library system gave the Botany Library a 20 percent increase in process efficiency (Scoop, 2005). As noted by Dover (2005), despite RFID pilot projects by companies such as: the Warehouse, Tranz Rail, Progressive and Fonterra, most New Zealand companies were still in a watching and waiting mode. Soon (2007) stated that the RFID adoption rate in New Zealand is low; however, there is a lot of interest in RFID among New Zealand businesses and organisations. Soon and Gutierrez (2008) stated that the most frequently cited barriers in RFID articles are standards, cost, reliability, and privacy. According to Soon and Gutierrez (2008), there are a number of basic rules businesses need to follow in order to make RFID effective in their supply chain: understand and learning about how the technology fits in their supply chain; focus on competency and extend implementation across the supply chain; plan for enterprise wide implementation from the beginning to minimize costly reworking; decide on the type of information required and how it should be reported; beware of any likely shifts in their operations and have a process in place to mitigate the disruption; be knowledgeable about retailer-supplier relationships in order to position the strategies.

2.4. The New Zealand business environment

New Zealand is a relevantly small country. According to the Treasury.govt.nz (TheTreasury, 2008), economic recovery experienced in late 2006 and 2007 shows growth of 1.2% and 0.8% in March and June quarters respectively. There are many

small or medium businesses (SMEs) making up the New Zealand economy. The significance of the SME sector in New Zealand has been increasing over last a few years, driven by globalisation and technological development. The Ministry of Economic Development (MinistryOfEconomicDevelopment, 2007) provides a database of enterprise sizes in New Zealand in 2006. The database shows that 63.6% of enterprises have zero employees; enterprises with 500 or more employees make up only one tenth of a percent; 23.3% of enterprises have less than five employees; those which have less than 10 but more than five employees constitute around five percent of businesses; four percent of businesses have less than 20 but more than 10 employees; and enterprise with less than 500 but more than 20 employees make up only three percent of businesses. These figures represent the economy structure of New Zealand and show that there are far more SMEs than large companies.

2.5. Purpose of this thesis

The aim of this research was to gain an understanding of how the NZ RFID Pathfinder Group would facilitate the RFID technology adoption process in New Zealand and act as an advocate for RFID use in business. Moore's theory was used to provide insight. The study was also to investigate industry perceptions of technology advocacy groups such as the NZ RFID Pathfinder Group and seek to understand the perceptions of RFID technology within the New Zealand industry community.

2.6. Research questions

In order to achieve the aim of the thesis, two research propositions were formulated: the first “what is the perception of RFID technology within the New Zealand industry community?” The purpose of this proposition was to find out what the industry community thoughts about the RFID technology. Linked to the answer to the first proposition, the second was “what role should national independent technology advocacy groups (e.g. the NZ RFID Pathfinder Group) play in promoting technology use?” The purpose of this proposition was to help direct the advocacy groups’ next step in promoting RFID technology use. In order to answer the two propositions in detail, the material was broken down into the four questions stated in Chapter One: the RFID technology is used for what kind of industries in New Zealand; intentions of utilizing

RFID technology in the future; recommendations for the NZ RFID Pathfinder Group; and innovativeness of the respondents' industry.

2.7. Expected answer

The study used a survey and interviews to investigate the state of RFID adoption and perceptions toward an independent RFID advocacy group in New Zealand. The findings are of interest to both industry advocates and businesses interested in RFID technology, primarily in New Zealand but also in similar countries around the world as well as businesses and researchers interested in the adoption of similar technologies.

2.8. Summary

This chapter has discussed current state of RFID around the world and the New Zealand business environment. Purpose of this thesis, research questions and expected answers has also been outlined. The next chapter will provide RFID literature review, introducing advocacy groups, and a discussion of diffusion of innovation models.

Chapter Three

3. Literature review

Chapter Three will provide an overview of studies reported in the literature about RFID technology adoption including international research and studies specific to New Zealand. Following on from this, will be an explanation of why this research thesis should be undertaken. Innovation theory will be used later in this study to categorise the research data and draw a conclusion from the thesis. There are three advocacy models introduced in this chapter: traditional model; facilitator model; and advocate model. These are discussed in detail in the later sections of Chapter Three.

3.1. Perception of RFID

RFID (radio frequency identification) technology is well known in many countries, and many of them use the technology in supply chain management (SCM). RFID technology was invented during World War II; a system was designed to place on allied aircraft, so a friendly aircraft could be distinguished from the enemy aircraft. According to the RFID Journal (n.d.), the first RFID patent was in the U.S.A. for an active RFID tag with a rewritable memory on 23rd January, 1973 lodged by Mario W. Cardullo.

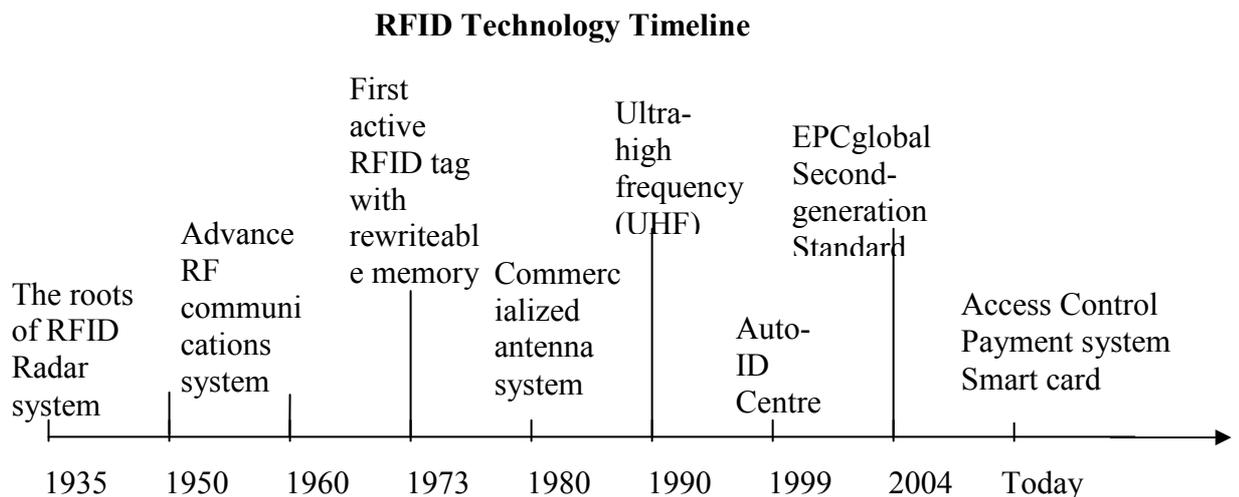


Figure 3.1: RFID technology timeline (RFID Journal, n.d.)

RFID technology has been well developed for business purposes over recent years, for example in just-in-time manufacturing. However, a just-in-time manufacturing tracking system is a closed loop and is not coordinated with customers, suppliers, logistics

providers or other outside organisations (Smith & Hawkins, 2004). The opportunity for RFID technology within an organisation using just-in-time is to enhance productivity throughout the entire production process and improve product availability to customers.

3.1.1. SCM and RFID

Supply chain management, also known as SCM is about the process of planning, implementing and controlling business operations across the supply chain. SCM has two main aspects, logistics and management (Myerson, 2007). The logistics part includes supplies being procured and transported from one point to another in the supply chain, for example: clothing supplies or aircraft supplies (Jay, 2004). The management part includes web services, handheld devices, smart shelves, and POS (point of sale) terminals (Jay, 2004).

According to a publication from WowGAO Technology Solutions Team (WowGAOTechnologySolutionsTeam, 2007), SCM must consider a number of potential problems: distribution network configuration; distribution strategy; information; inventory; and cash flow. Distribution network configuration is to cover location, network missions of suppliers, production facilities, distribution centres, warehouses, cross-docks and customers. Distribution strategy includes mode of transportation, replenishment strategy and transportation control. Information means the integration of other processes throughout the supply chain to share valuable information about demand signals, forecasts, and potential collaborations. Inventory management is about raw materials, and finished goods. Cash flow is arranging the payment methods and terms for exchanging funds within the supply chain. Traditionally, capturing and entering data into a computer system in order to determine item status and its movements was done manually on paper and input into computer systems after the event. Initially a bar code system was used based on the use of bar code labels. The code was manually scanned, so each item could be identified as a product, an asset or a location. With RFID technology, RFID tags have been integrated into SCM data capture systems, which can store and retrieve data out of line of sight. RFID tags contain antennas which enable them to receive and respond to radio-frequency queries from an RFID transceiver. RFID technology can link objects to the Internet, so they can be monitored and tracked, and the companies can share data about them (RFID Journal, n.d.).

Recent RFID business applications can be of many different types for a variety of purposes, and businesses themselves can even develop their own RFID system, therefore, it is very important for businesses to choose the right type to cut costs and boost efficiency. The RFID tag is just one of the major pieces of an RFID application. RFID standards are even more critical for many RFID applications. The International Organisation for Standardisation (ISO) has created standards for RFID with tracking items (RFID Journal, n.d.). The existing RFID standards deal with the air interface protocol, data content and applications.

Jay (2004) states that integration of RFID technology into the SCM can provide efficiency and accuracy similar to bar code systems, with additional benefits, such as: label face readability; insensitivity to grease and contamination; integral capability with sensors; security; faster speed; and multi-label readability. Label face readability means that RFID supports not only read but also write operations with its real-time characteristic. Tags not sensitive to grease and contamination can be read unlike barcodes that might become smudged or wrinkled, in addition, RFID tags can be read through non-metallic materials. Integral capability with sensors and security of RFID means that RFID tags can be hidden and they are virtually impossible to counterfeit due to an unalterable permanent serial code. RFID tags are read at a faster speed than bar codes and multiple tags can be read at once. These positive features provide potential efficiency and accuracy gains for businesses that integrate RFID technology into their supply chain management system.

3.2. Advocacy groups

There are many advocacy groups involved with identification system development for organisations such as EPC Global, GS1 and the NZ RFID Pathfinder Group. These groups are not-for-profit organisations. The primary purpose of these groups is to provide training, consultancy, and mentoring to establish and emerge leaders and advocates. They normally introduce leading technology into the country to support the business communities. The following paragraphs will describe each of these groups. At the end of this discussion is a literature review of various models and frameworks that can be found in the literature that denote advocacy groups.

3.2.1. EPC Global

EPC global is a subscriber-driven organisation, which creates global standards for the EPCglobal Network. Subscriber-driven means made up of people who are interested in EPC global organisation and would like to be informed about news. Therefore, they pay and register with the organisation in return for regular updates, but they are not part of the organisation. EPCglobal (2004) stated that the EPCglobal Network is a method for using RFID technology in the global supply chain by using inexpensive RFID tags and readers to read an electronic product code number and then sharing a large amount of associated information with authorized users. The EPCglobal Network consists of five components: electronic product code (EPC); ID system; EPC Middleware; Discovery Services; and EPC Information Service (EPC IS). The electronic product code (EPC) is a unique number that identifies a specific object in motion within the supply chain. The ID system consists of EPC tags and EPC readers. EPC tags are RFID devices that contain a microchip and an antenna attached to a substrate. EPC tags communicate between the EPCs and the EPC readers using RFID technology. EPC Middleware manages real-time events and information, and manages the basic read information for communication with the EPC Information Services and any other existing information systems of a company. Discovery Services enable users to find data related to specific EPCs and to request access to those data. “EPC Information Services (EPC IS) enable users to exchange EPC-related data with trading partners via the EPCglobal Network” (EPCglobal, 2004). The organisation manages the development of industry-driven standards for the electronic product code (EPC) to support the use of RFID (radio frequency identification) technologies in order to enhance supply chain management processes and product identification.

The goal of EPCglobal is to enhance visibility and efficiency throughout the business supply chain and facilitate higher quality information flow between companies and their trading partners. EPCglobal provides a number of services: maintenance and registration of EPC Manager Numbers; participation in the development of EPCglobal standards; access to the EPCglobal standards, research and specifications; influence on the future direction of research by the Auto-ID labs; creation of pilots and test cases; and provision of training and education for implementing and using EPC technology and the EPCglobal network (EPCglobal, n.d.). Auto-ID labs are the leading global network of academic research laboratories in the networked RFID field (Auto-IDLabs, n.d.). The labs comprise seven of the world’s most renowned research universities

located on four different continents. These universities were chosen by the Auto-ID Centre to design the Internet of Things together with EPCglobal (Auto-IDLabs, n.d.). EPCglobal is the commercial successor of the Auto-ID Centre, a global business initiative and academic research programme with its roots at MIT. The focus of the Auto-ID Centre is on simple, and thus inexpensive, RFID tags to enhance supply chain and store management processes in a fast moving consumer goods industry (Auto-IDLabs, n.d.).

According to EPCglobal (n.d.), “the EPC is built around a basic hierarchical idea that can be used to accommodate many identification systems, including global trade identification number (GTIN), serial shipping container code (SSCC), global location number (GLN), global returnable asset identifier (GRAI)”. EPCglobal is leading the development of industry-driven standards for electronic product code. RFID is one kind of identification system, which needs to be supported by EPC standards in order to fit in with the fast moving, information rich, trading networks (EPCglobal, n.d.).

3.2.2. GS 1

GS1 New Zealand is a not-for-profit organisation. It develops global standards for the identification of systems and goods. These supply chain system standards have been well used all around the world. GS1 New Zealand represents the interest of New Zealand in the development of the global language of business. GS1 is also a membership driven organisation; it gives exclusive rights to the members to a globally unique company prefix, and is an essential component to creating industry-compliant bar codes. The members may also receive industry education opportunities, toll-free help, and access to the full range of services and standards (GS1NewZealand, n.d.). Membership driven means that the members play a part of the organisation activities, not just receive information or updates from GS1, which is still different from the subscriber-driven organisation. The aim of GS1 New Zealand is to improve business supply chain efficiency by providing relevant implementation and support services.

Both GS1 and EPCglobal have international branches; GS1 New Zealand and EPCglobal New Zealand represent participants from New Zealand. The NZ RFID Pathfinder Group is a local New Zealand organisation; however, it collaborates with GS1 and EPCglobal very closely. EPCglobal is a venture of GS1 International. After

EPC technology was developed in an academic setting, GS1 was chosen to assist EPC technology to be commercially implemented globally. GS1 is a not-for-profit organisation; it supports the Electronic Product Code Network as the global standard in the supply chain of any company and any industry. The objective of GS1 is to drive GS1 global standards adoption for by all New Zealand organisations (GS1NewZealand, n.d.).

3.2.3. The New Zealand RFID Pathfinder Group

The NZ RFID Pathfinder Group became an Incorporated Society on 11th May, 2006. The group campaigns for the competitive development of New Zealand businesses through the adoption of RFID and electronic product code (EPC) technologies. EPC is a series of coding schemes. One of its best known products is the bar code, which was created as a low-cost method of tracking goods by using RFID technology (EPCglobal, n.d.). The goal of the NZ RFID Pathfinder Group is to provide a shared learning approach to RFID technologies and EPC for businesses in New Zealand and to accelerate the revolutionary vs. the evolutionary change management process. The NZ RFID Pathfinder Group grows rapidly every year, since its inception in 2006, the NZ RFID Pathfinder Group membership in New Zealand has grown by about 100 members each year. The NZ RFID Pathfinder Group is also actively participating in the EPC global network national, international community and working groups. They encourage EPC adoption by and education of New Zealand businesses by providing education and marketing activities. The NZ RFID Pathfinder Group is also integrating other GS1 standards, RFID and EPC technologies now and in the future (PathfinderGroup, n.d.).

In terms of RFID technology development, the most important role of national advocacy groups is to educate and influence the New Zealand businesses' decision makers. Advocacy groups need to keep updating businesses with new information available nationally and internationally.

3.3. Advocates

There are studies of the management of technology in general, such as Banwet, Momaya and Shee (2003) and Kim, Beldona and Contractor (2007). The idea of technology management is to provide a fast, efficient, reliable supply chain for

businesses. RFID technology is one of the most innovative solutions for enhancing the visibility of supply chain management. Markus and Benjamin (1996) stated that new information technology is an organisational intervention, it requires IS (Information System) specialists and businesses to do their parts effectively in IT change management, and thereby then the IS specialists can improve their organisational credibility and businesses can have the most suitable systems for their businesses. There are three models mentioned for IT change management: the traditional IS model; the facilitator model; and the advocate model.

3.3.1. Traditional model

The traditional IS model is that the change agent attempts to satisfy the goals of their clients. Information Systems (IS) specialists do not hold themselves responsible for achieving change or improvements in organisational performance. In the traditional IS model, IS specialists are more passive towards technology change. IS specialists act as agents of change by serving the others' objectives. This traditional model has low IS credibility and creates IS resistance to role change.

In the traditional model, IS specialists are the sole-source provider of services; clients have only limited technical and sourcing options. IS are normally used for expert/functional performance rather than business performance. In the traditional model, there is often strong IS budget pressure and clients have limited sourcing options. The information system is normally decentralised and the system is either outsourced or purchased. The new technologies demand different implementation activities.

According to Markus and Benjamin (1996), the traditional IS model can have three negative consequences: IT failures; IS inhibiting change; and reduced IS credibility. IT failures are not usually a technical problem but an implementation problem. In many cases, the building of the systems and the training of end users have been carried out separately. IS specialists have the responsibility to build the system well, but they do not believe that training the end users should be part of their brief. The training is normally done by outsourced agents or the human resources department. The IS specialists take care of the technical problems only. Any other problems have to be resolved by a third party. Therefore, it is vital to implement the new system successfully rather simply build a successful system. The second negative consequence is IS

inhibiting change, as IS specialists do not have the same goals or interests for organisational development as the clients. The IS specialists normally have higher expectations of organisational development than the clients, because they think they should always be ahead of the clients in understanding new technologies. The IS specialists really need to have some change management skills on top of their technical expertise in order to give better assistance to their clients. The third negative consequence is reduced IS credibility, if IS specialists do not create their role properly within the change management, they will reduce their credibility. Traditionally, IS specialists are often considered as the expert role, because they rate themselves so high, when the IS specialists cannot deliver the solution to the client's satisfaction, their credibility is reduced. Overall, the traditional model focuses on building technology without consideration for achieving business results.

3.3.2. Facilitator model

In the facilitator model, the change agent attempts to help clients realise their goals. The change agents in the facilitator model believe that the people or the clients are capable of creating change and the role of the change agents is to facilitate the change for the clients. As suggested by Markus and Benjamin (1996), there are three main defining points with the facilitator model: first of all, the change agents do not believe they should create the change for organisational development in first place. Secondly, change agents within the facilitator model focus on the process from the perspective of behavioural or group process rather than business process. Their functions during change management are solving the conflicts in the team but not establishing the business's direction, such as determining which software is more suitable for the clients. Thirdly, the change agents do not adopt the role of expert, giving technical advice to their clients, because they believe that when there is conflict between the interests of the change agents and their clients, the interests of the clients could be better than the experts' (the change agents').

As argued by Banwet et al. (2003), the facilitator model is not perfect, because the change agents believe that they only facilitate organisational change, and the change agents do not consider technical components during facilitation. On the other hand, the facilitator model has some advantages over the traditional model. First of all, IS specialists can provide valid information about the new system including the pros and

cons; and they are also able to express their own ideas while accepting different views from the others. Secondly, IS units, rather than a third party, will take responsibility for providing training and education and other implementation activities to their clients. Finally, IS specialists not only provide valuable service within their technical expertise but also within other areas where they could help the clients. Overall, Markus and Benjamin (1996) concludes that the facilitator model is better for resolving friction between IS specialists, clients, and users to provide better systems and IT management.

3.3.3. Advocate model

The advocate model has a distinguishing feature from the previous two models, which is to influence people's behaviour in particular directions as the change agent desires whether or not the change "targets" themselves hold similar views, and adopting and internalise the change agent's views about what is needed to serve the organisation's best interests (Markus & Benjamin, 1996).

In this model, IS specialists (Markus & Benjamin, 1996) believe that the changes are made by many people and parties not just themselves, they break down all the IT change management processes into pieces so all the necessary parties can participate from within their own roles. The progress of change management can only move forward when all parties agree with the outcomes. IS specialists focus on communication between all parties to achieve the best system performance for all parties.

According to Kim et al. (2007), there are three advantages to using the advocate model: firstly, IS specialists are able to add business value into the change management process by advocating end user training; secondly, IS specialists can improve their credibility by providing good communication with clients, because effective and constant communication can make the clients' goal more visible; finally, the advocate role may hold better results for IT infrastructure issues such as funding, because IT infrastructure issues can be solved more effectively by the organisations themselves.

Banwet et al. (2003), examines the role of technology in assets, processes, performance framework with 100 firm-level data from the software industry in India. The study was measuring the role of technology and its significant contribution to the business

outcomes. In the study, the researchers stated that the technological competitiveness and logistics capability were the main factors impacting international competitiveness and growth. The technological competitiveness included technology selection, technology acquisition, and technology commercialisation. Technology selection was considered as the most significant part for the technological competitiveness. The researchers also mentioned in the study that continuous innovation, technological innovation and diffusion, technology selection strategy making up the technological competitiveness as well. The advocate model was used in the study to determine the technological competitiveness among the Indian software firms.

Kim et al. (2007) focused on the chemical-pharmaceutical industry. The study investigated how the technology learning occurred in networks. In the study, the researchers stated that social and inter-organisational factors should all be taken into account rather than just emphasises either technical factors (i.e. knowledge overlap) or social factors (i.e. relational characteristics).

In the past RFID technology has been marketed as a replacement for barcodes and suffered from having its benefits over sold. Therefore, RFID technology can benefit from an advocate approach to help to portray the benefits and capabilities of the technology more accurately. The studies above show that the advocate model has been used in pharmaceuticals and software development/user training industry. There is no specific scholarly research that applies any of the advocacy models to RFID technology adoption and diffusion.

3.4. Summary

This chapter provided literature review for RFID technology, introduced advocacy groups, and discussed different advocate models. RFID is not a new technology; however, from a business perspective it is a new method of supply chain management. There are many advocacy groups around the world promoting the deployment of RFID technology into SCM.

GS1, EPCglobal, and the NZ RFID Pathfinder Group have significant roles in RFID technology development. GS1 has been administering industry-driven standards for many years. EPCglobal is an organisation that collaborates with GS1 to commercialise

EPC technology. EPCglobal is trying to use RFID technology to enhance today's fast moving, information sharing, and trading networks. The NZ RFID Pathfinder Group is another not-for-profit organisation. The objectives of the NZ RFID Pathfinder Group are to coordinate and support organisations and individuals involved in the field of RFID and electronic product code (EPC). These three organisations have a common goal in RFID development, and all of them are playing very important roles in the improvement process.

IS change management is undertaken by IS specialists as well as business decision makers. Both of them have to understand the innovation technologies and suitability for businesses and then change management can be fast and efficient. The role of advocates is to use the correct model, assisting innovation deployment for businesses. In this case, the advocate model more efficiently deals with RFID technology in change management, because the advocate model influences people's behaviour in a positive direction when businesses have less successful examples around them. Change management processes involve not only the IS specialists but also the clients. The clients often do not fully understand what they really need, that is why IS specialists have such a very important role. Therefore, the success of change management relies on how the IS specialists perform during the process. The role of the advocate is to provide good communications between different parties, including the clients, to ensure the clients achieve what they really need from change management. The advocate role shares credit for the outcome with all the parties involved in the change process. Consequently, there is a need to measure the innovativeness of the industries in this study. The following chapter introduces innovation theory, which has been applied to this research thesis.

Chapter Four

4. Innovation theory

This chapter introduces innovation theory in detail. Innovation theory is used to categorise the respondent industries in the survey. First, diffusion of innovations is discussed and then the discussion turns to study the innovation itself.

4.1. Diffusion of innovations broad view

Rogers, Takegami and Yin (2001) define “diffusion is the process which an innovation is communicated among the members of a social system through certain channels over time”. Rogers (1995) also stated that the first original diffusion research was done as early as 1903 by the French sociologist Gabriel Tarde who plotted the S-shaped diffusion curve; in the 1940’s, two sociologists, Bryce Ryan and Neal Gross renewing interest in the diffusion of innovation S-curve, stated that the rate of adoption of agricultural innovation followed an S-shaped normal curve when plotted on a cumulative basis over time.

According to Rogers (1995), innovation, communication, social system and time are the four main elements to the diffusion of innovations. Innovation is an idea, practices, thoughts or objects that are viewed to be new by an individual or other unit of adoption. Communication means the new idea, practice thought or object is shared from one individual to another. Social system means the group of individuals get together to solve problems in order to complete a common goal of adoption. Time is an important consideration as the diffusion of innovations occurs over a period rather than at any particular point in time. Each group or individual of the social system has their own innovation-decision process (Figure 4.1): knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1995). Knowledge means people start to be aware of an innovation idea or objects and how they work. Persuasion means how the people react toward the innovation idea or objects. A decision is taken when people analyse the innovation idea or object and make a choice to either adopt or reject. Implementation occurs when the people deploy the innovation are evaluated. Confirmation is to evaluate the results of implementing the innovation already made.

According to diffusion of innovations theory, researchers can expect that the diffusion of RFID technology into supply chains will go through certain stages before becoming accepted as the status quo. The development of RFID technology for supply chains is the expected starting point. Once the RFID hardware customised to RFID is established, the interested groups can share their experiences as they discover the technology. If their results are successful, then RFID hardware and software applications for SCM can be put into practice. Of course, this process takes place over a period of time unique to the interested groups and individuals involved. The whole adoption process has five stages mentioned previously (Rogers, 1995). Diffusion of innovations theory forecasts that businesses have to be aware of the innovation and they have to have some kind of information about it. And then, if they are interested in the technology, they will form an attitude to the innovation. A trial version of the technology will be tested by the interested groups. At some point in the process, the decision will be taken to either accept or reject the innovation. Once the innovation is accepted, the implementation of the innovation will follow. Finally, confirmation of adoption is the last step. According to innovation theory, this adoption process is true for all kinds of innovation adoption processes.

Diffusion of innovation theory is used help researchers understand why and how new technologies spread through industries and at what rate (Rogers et al., 2001). The theory applies to not only technology but also new ideas.

Conceptual Model

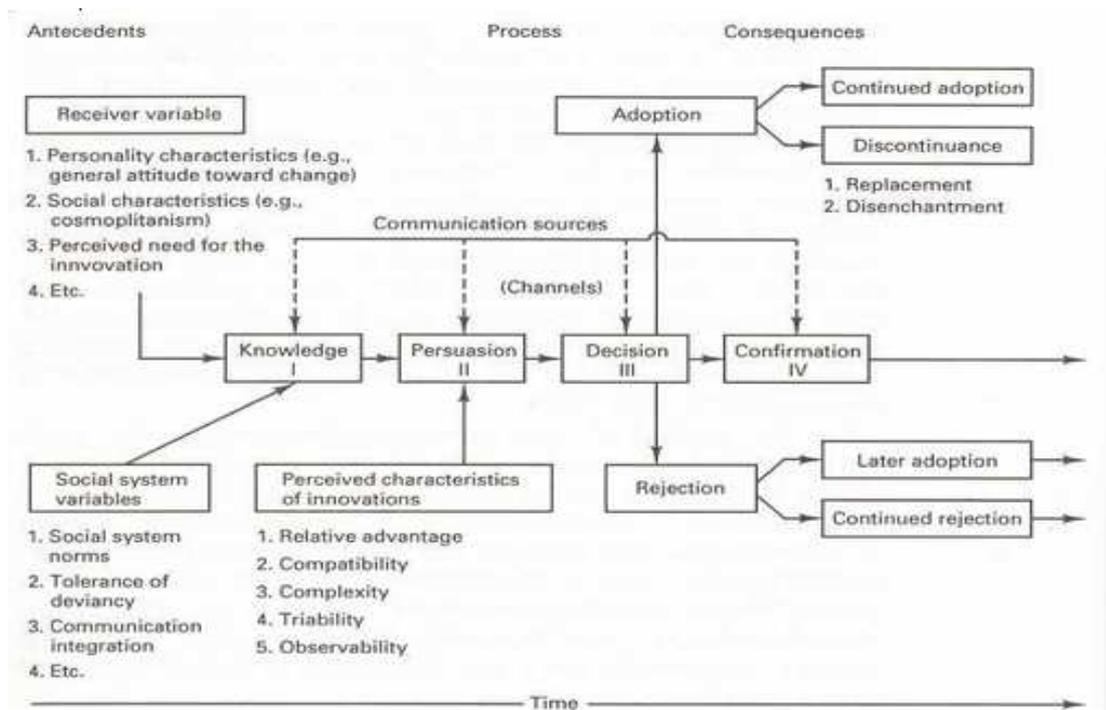


Figure 4.1: Diffusion of innovation model (Rogers, 1995).

4.2. Innovation theory introduction

Rogers (1976) stated that “innovation is an idea, thought, process or object that is new to a certain area and reviewed by an individual or other unit of adoption”. According to the Rogers et al. (2001), there are five adopter categories: innovators, early adopters, early majority, late majority, and laggards. The innovators have the ability to understand and apply complex technical knowledge, and to cope with a high degree of uncertainty about an innovation. Early adopters are an integrated part of the local social system, and serve as role models for other members of society, and are respected by their peers. The early majority normally interacts frequently with peers, and deliberates before adopting a new idea. The late majority normally adopts innovations due to pressure from peers or economic necessity and is cautious in doing so. The laggards are normally isolated, suspicious of innovation, and have limited resources.

According to Rogers (1976), “most business plans are based on the technology adoption life cycle, which includes: innovators, early adopters, early majority, late majority, and

finally laggards” (refer to Figure 4.2). The technology adoption lifecycle and each of the innovation adopter types are discussed in the next section.

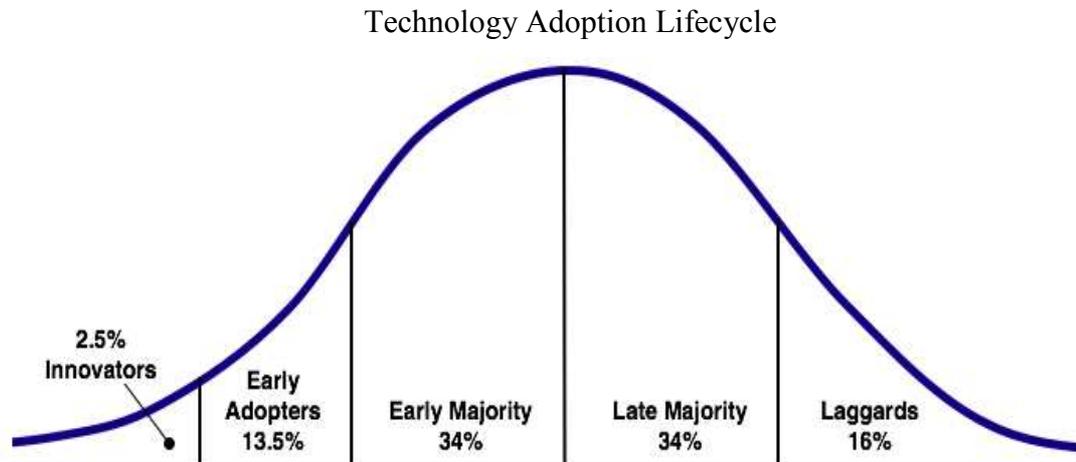


Figure 4.2: The technology adoption lifecycle (Rogers, 1976).

4.3. Innovation theory segments

In this section, each of the five segments of innovation will be described to provide detailed background information for innovation theory with insights from the work of Moore (2002).

First of all are the innovators. The innovators have the ability to understand and apply complex technical knowledge, and to cope with a high degree of uncertainty about an innovation. This group is willing to take risks with new technologies, which have a high degree of uncertainty. They have the ability to understand complex technical knowledge and apply that knowledge in real life practice (Rogers et al., 2001).

Early adopters are an integral part of the local social system, and serve as role model for other members of society, and are respected by their peers (Rogers et al., 2001). Early adopters are “the visionaries, who drive the high-tech industry, because they can see the potential return on investment and willingly take high risks to pursue the goals” (Moore, 2002). The visionaries are easy to sell to but very hard to please, because they want high technology to make their high-level expectations come true. Once the visionaries are satisfied with a high-tech product, a good reputation for the technology will spread.

However, the early adopters do not make the most profit from the innovation.

According to Moore (2002), this group has the greatest degree of opinion leadership in

most new technology systems. They respect their peers and also are respected by the others. In most cases, they are quite successful in their field.

The early majorities normally interact frequently with peers, and deliberate before adopting a new idea. The early majority are “pragmatists, who communicate more with other, similar businesses and the early adopters” (Rogers et al., 2001). The early adopters open up the market for new technology (Moore, 2002). Between each of the innovative group there is a gap, the largest gap is normally considered a chasm, and is between early adopters and the early majority. The chasm can be the critical point that decides whether the high-tech adoption will succeed or a fail (Moore, 2002). References and relationships are also very important to make the early majority believe in the product. On the other hand, once the market has opened, the product will have the loyal customers and also the advertising costs will be reduced, because sales will to some extent be based on reputation. This segment looks at many more aspects of the product, such as: interfaces, reliability of service, and the infrastructure of supporting products. This group of adopters is the largest category out of all the different adopters. However, as argued by Mytelka and Smith (2001), the group of adopters does not often hold a position of leadership within their industry.

According to Rogers et al. (2001), the late majority normally adopts innovations due to pressure from peers or economic necessity and is cautious to do so. This group is normally quite behind in adopting a new technology, they usually adopt a new technology simply because of economic necessity. They do not have positions of leadership, are much less innovative and are very cautious.

The laggards are normally isolated, suspicious of innovations, and have limited resources. This group has no leadership at all. According to Rogers et al. (2001) they normally do not communicate with their peers or with other, similar industries. Their innovation decision process usually takes a very long time.

There have been many studies carried out by using the innovation theory to explain the phenomenon under investigation. The following section discusses some of the studies that have used innovation theory to explain innovation in organisations.

4.4. Research using innovation theory

This section outlines several studies that have already used innovation theory to understand the results reported in their projects.

The research of Zona Latina (Soong, 2000) describes a survey of 2,003 people between the ages of 12 and 64 living in the Santiago area. They tried to determine the innovativeness of the population. They categorised socio-economic status into groups such as A, B, C1, C2, C3 and D applied these categories against Moore's innovation theory to identify the innovators and early adopters. This study focused on both private and business usage of new technologies (i.e. Internet, email, fax, telephone, photocopiers and so on) and asked respondents to report their attitudes towards these new technologies. A points system was then used to establish the innovativeness in the Gran Santiago area.

In the research conducted by Diederer, Meijl, Wolters and Bijak (2003), Moore's innovation theory was used to analyse the categories of a farmer as an innovator, an early adopter or a laggard in the adoption of innovations available on the market. The survey and interview gathered data from 1075 farms participating in the Dutch Farm Accountancy Data Network (FADN), maintained at the Agricultural Economics Research Institute. In the survey, farms were asked to self report innovations that they had adopted and to place that innovation on the diffusion curve. Because the farmers could easily overstate the level of innovation on their own projects, the results were checked carefully by experts from the Agricultural Economics Research Institute who worked closely with the farmers. The survey found that innovators and early adopters differed from laggards at a lower level of aggregation with regard to structural characteristics like size, market position, age and solvency. The study also found that innovators made more use of external sources of information and they were more involved in the actual development of innovations.

In this research, innovation theory has also been used to understand the phenomenon of technology adoption. The detail regarding who the theory is used will be discussed in later chapters.

4.5. Summary

This chapter explores innovation theory in detail. It has discussed the relevant literature including a detailed discussion of the five segments of innovation theory with relevant examples: innovators, early adopters, early majority, late majority, and finally laggards. The following chapter will outline the methodology used in this thesis.

Chapter Five

5. Methodology

This thesis used a quantitative approach which was followed by interviews. A quantitative approach was used on an online questionnaire survey, and the interview was carried out using a qualitative approach. In order to answer the research proposition proposed in this study, it was necessary to firstly survey the New Zealand industry group representatives about the current state of RFID use and plans for use, plans for future RFID use and attitudes toward a technology advocacy group such as the NZ RFID Pathfinder Group. A survey method was chosen as being the most suitable for collecting information from a large number of participants (Kuter & Yilmaz, 2001). The questionnaire method was chosen because it is inexpensive to administer, easy to compare and analyse, and can be administered to many participants (Cohen, Manion & Morrison, 2000). A questionnaire was used to gather information about the current state of RFID use in New Zealand and the perceptions of the role of the technology advocacy group and was developed with the input of the NZ RFID Pathfinder Group. The perceptions of RFID and attitudes toward the role of the NZ RFID Pathfinder Group were collected through three interviews with leading members of the technology advocacy group and industry leaders. The participants were from the management level in the IT field of each industry.

5.1. Quantitative survey method

Quantitative research method is a research method that relies less on observation, small numbers of questionnaires, focus groups, subjective reports and case studies but is much more focused on the collection and analysis of numerical data and statistics (Walsham, 1995). The quantitative research method is often used for scientific research, including the generation of models, theories and hypotheses; the development of instruments and methods for measurement; collection of data; modelling and analysis of data; and evaluation of results. The following sections will outline the deployment of the quantitative survey method according to the layout recommended by Creswell (2002).

5.1.1. Email vs. paper survey method

A self-administered survey can be deployed either in hard copy or as an electronic document. A hard copy is normally posted to the participants by mail or delivered face-to-face at the end of a workshop. An electronic survey is presented to the participants either by email or via a website. Traditionally, surveys have been distributed in hard copy. Hard copy surveys do not require any computer software or hardware and the researchers and the participants do not need any computing knowledge to use them. The only resources required are paper, pencil, postage and envelopes. It only takes a few days in the post for the questionnaire to reach the participants.

According to Dillman, Tortora and Bowker (1999), the advantages of an electronic survey are cost efficiency, elimination of mail processes (i.e. envelope stuffing), faster transmission, less likelihood of being ignored as junk mail, and environmental friendliness. The electronic survey can also facilitate access to individuals in distant locations and participants who are difficult to contact (Tse, 1998). Creating and conducting a good electronic survey is a time-consuming task requiring familiarity with web authoring programs, HTML code, and scripting programs (Markus, 1994). However, the development of survey authoring software packages and online survey services have made the electronic survey less difficult for the researchers and participants to use, especially when the participants are from the IT industry (Andrews, Nonnecke & Preece, 2003).

The degree to which survey data can be relied upon depends chiefly upon the response rate achieved. Another point of focus is related to efficiency gains from the survey method and last but not least, coverage of the survey method is also an important consideration. According to Couper, Blair and Triplett (1999), the electronic survey method has a much higher response rate than the mail method. It is thought that email is more able to be personalised and therefore it generates a higher response. As the cost of the computer hardware and software continues to decrease, and the popularity of the Internet increases, more categories of society are choosing the Internet for communication and information exchange (Nie, Hillygus & Erbring, 2002). While the mail could be misplaced or misused, generally the email can only be accessed by the specific users. If the email is lost, the researcher can resend a link or an email attachment. If the researcher wants to follow up with the participants, the follow up enquiries can be added as a link or an attachment to the email (Andrews et al., 2003).

According to Thomas (2004), response rates for paper-based questionnaires were typically in the 39.6% range, and web-based questionnaires found an average response rate of 55%. Therefore, the Internet and email surveys are becoming more accepted. The electronic survey method will allow the participants to receive the questionnaire any time, any where. Although electronic surveys are self-administrated, rules can be set in place in the software to ensure that all questions are complete, therefore minimizing non-response and its related bias. Clicking and submitting reduces mail processes for both the researcher and the participants. Electronic surveys avoid the cost of printing and postage as well as duplicated follow-up mailing. According to Schaefer and Dillman (1998), the electronic survey method has a low human error rate. If the email is lost, the researcher can resend a link or an email attachment. If the researcher wants to follow up with the participants, the follow up enquiries can be added as a link or an attachment to the email (Andrews et al., 2003). However, one disadvantage of the email method is that it can be fiddly to answer if the participants have to save something to hard drive or if the formatting is upset by text, html or different operating systems.

Online surveys have many of the same benefits as email surveys. Surveymony.com is a good example of an electronic survey software package (SurveyMoney.com, 2007), because it provides necessary functions to set up the online questionnaire, an easy navigation system, good data storage capacity, and is easy to build and so on. There are other online questionnaire building software available, and a more detailed comparison of them is provided in the following table (see Table 5.1). Overall, the electronic survey method and the hard copy survey method are suitable for different research fields and participants. If the participants have few computing skills, the hard copy survey method will be more effective for the process of the research. Otherwise, the electronic survey method is better suited to technically savvy users. An Internet-based self-administrated questionnaire will be the choice for this research thesis.

There is a wide variety of software available to create a self-administered questionnaire, these are four online survey tools have been chosen to compare as examples:

<http://www.websurveyor.com/>

<http://www.survey-online.com/>

<http://info.zoomerang.com/>

<http://www.freesurveyonline.com/>

Table 5.1: Online survey software feature comparison

| Desirable Features | www.websurveyor.com | www.freesurveyonline.com | Info.zoomerang.com | www.survey-online.com |
|-----------------------|---------------------|--------------------------|--------------------|-----------------------|
| Usability | | | | |
| Counter | ✓ | ✓ | ✓ | ✓ |
| Easy to update | ✓ | ✓ | ✓ | ✓ |
| Mandatory notice | ✓ | ✓ | ✓ | |
| Good navigation | ✓ | ✓ | | ✓ |
| Individual URL | ✓ | ✓ | ✓ | ✓ |
| Returning message | | ✓ | ✓ | ✓ |
| Self managing process | ✓ | ✓ | ✓ | ✓ |
| Building wizard | ✓ | ✓ | | |
| Easy to response to | ✓ | ✓ | ✓ | ✓ |
| Set input format | | ✓ | ✓ | |
| Media format support | ✓ | ✓ | ✓ | ✓ |
| Accessibility | | | | |
| Access control | ✓ | ✓ | | |
| Reporting | ✓ | ✓ | ✓ | |
| Available add-ons | | ✓ | | ✓ |
| Stable data storage | | ✓ | ✓ | |
| Low error rate | ✓ | ✓ | ✓ | ✓ |
| Post support | ✓ | ✓ | ✓ | ✓ |
| Technology friendly | | ✓ | | |
| World-wide access | ✓ | ✓ | ✓ | ✓ |
| Low cost | | ✓ | | |

* Desirable features adopted from the Online Survey Design Guide (2002).

Table 5.1 presents an evaluation of all features from four software products against the desirable features for this thesis. According to online survey design guide (2002), the goal of online survey is to provide easy access for the participants and accurate data for the researcher. The online survey of this thesis will also comply with other design standards, including usability and accessibility. According to the evaluation, the online survey software should be able to offer all desirable features and standards to complete a survey satisfactorily. Usability and accessibility will be discussed separately in the following paragraphs.

Usability can be assessed by a number of criteria, such as “counter”, “easy to update”, “mandatory notice”, “good navigation”, “individual URL”, “returning message”, “self managing process”, “building wizard”, “easy to response”, “set input format”, and “media format support”. The term “counter” means that the software is able to count the number of responses. “Easy to update” concerns how easy the software can be updated on a daily basis. “Mandatory notice” means the software can provide mandatory question options. “Good navigation” indicates how easy the software can be navigated by the users. “Individual URL” is about the ability to provide an individual URL for each questionnaire survey when the survey is published on the Internet. “Returning message” means the software has the ability to return a message to the researcher as the survey is undertaken. “Self-managing process” assesses the way the software can manage the responses from the participants into a self-managed record for future reference (SurveyMoney.com, 2007). A “building wizard” provides an easy step-by-step method for the creator to set up the online survey. “Ease of response” means how easily the participants can use the online software to respond to the survey. The term “set input format” means the software is able to pre set the responses data format before the data are stored into the system. “Media format support” is about the ability to replay an ability to replay a variety of media responses after participation, such as video, clip, or voice.

Accessibility is to ensure the survey web page function well when the participants are using it. Accessibility includes “access control”, “reporting”, “available add-on”, “stable data storage”, “low error rate”, “post support”, “technology friendly”, “world-wide access”, and “cost less”. These features are also to ensure the researcher can easily maintain the survey web page and have enough technical support from the software provider. The term “access control” means the researcher can have control of the start

and end of the survey, and the researcher can also control the respondent data.

“Reporting” means the software has the ability present organized data reports for the researcher as required in a certain format. “Available add-on” assesses whether the software can install more functions as they are available from the server in order to improve the performance of the software. “Stable data storage” means the software must provide reliable data storage and data security. “Low error rate” means the software has few errors when it is operating. “Post support” is about the technical support still available after purchase is made by the researcher. “Technology friendly” means how easy the software can be used by others. “World-wide access” means the users are able to have access when they have Internet access. The term “low cost” means the cost of the software or cost for using the software.

Due to the fact that some of the features could not be tested, unless a purchase was made, some evaluations were made on the basis of self-reported documentation provided by the software vendor. Therefore, Table 5.1 could only support the final decision. According to the comparison, most standard features were included by every software provider and the point of difference point was the price. Therefore, freesurveyonline.com was chosen as the online survey software provider.

Online questionnaire logic

First of all, it is very important to know the current status of RFID user in New Zealand, because it is the base where the research could build on. Appendix A shows the logic of the online questionnaire branching. The reason for the branching was to distinguish the RFID adopters and non-RFID users to ensure that participants were only asked questions that they could reasonably be expected to respond to.

Questionnaire design

The first question of the survey “Does your company use RFID” has the possible answers of “Yes” or “No”. The answer of this question is a branching point. If the participant chooses “Yes”, then the set of questions relating to adoption will be answered by the RFID adopters. Otherwise, the other set of questions will be answered by the non-RFID adopters.

Industries who had adopted RFID already

Finding out “What is the value of using RFID?” questions

The respondents who had adopted RFID answered two sets of questions. The first set of questions included questions about motivation, limitation, challenges, and benefits of adopting RFID.

Innovative theory practice questions

The second set of questions was very specific, targeting the attitude of New Zealand businesses towards RFID and new technology. According to the responses and innovation theory, the participants could be rated for different scores and the means of the scores indicated their innovation level. The data could also give a better idea to the NZ RFID Pathfinder Group on how to further direct new technology development.

Industries that planned to adopt RFID

What is the plan?

This set of questions was only answered by the participants who had not adopted RFID yet, but had RFID adoption plans for the future. The respondents showed their timeframe for adopting the RFID. After that, they went on to complete the demographic questions.

Demographic questions

Demographic data collection set of questions

This page contained a set of questions answered by all respondents. Their data asked for relevant background of the participants, such as position title; age; years with the company; industry type; years of the company had been established. Note that the respondents typically were from industry boards or governing bodies and so this demographic information could be used to establish credibility of the respondent background.

Innovative theory practice questions

The questionnaire consisted of 28 questions. It was presented on a website; therefore, participants could get easy access from anywhere, anytime (<http://FreeOnlineSurveys.com/rendersurvey.asp?sid=10vwbzvtv83a6996304643>).

5.2. Questionnaire development

In order to ensure the reliability and validity of the survey data, the questionnaire development underwent a number of different assurance stages.

According to Silverman (2004), reliability and validity are very important, because they represent objectivity and credibility of such research. This research can also produce descriptions of the innovation theory reflected RFID users in New Zealand, the descriptions that in some controllable way correspond to the sample data that is being described.

Reliability

Reliability refers to the degree of consistency with which instances are assigned to the same category by different observers or by the same observer on different occasions (Silverman, 2004). General guidelines were used for online questionnaire development (Kuter & Yilmaz, 2001). Kuter and Yilmaz (2001) recommend that the questionnaire needs to be tested by more than one party and the parties should be from different backgrounds.

This part of the survey instrument was based on that of the GS1 questionnaire from EPC Advisory Group in Australia, which was undertaken in November, 2006, and number of other questionnaires. All these instruments were combined into one questionnaire (Appendix C). The questionnaire was administered to the committee members of the NZ RFID Pathfinder Group as a pre-test. Minor changes to the wording of the questionnaire and instructions given were made as a result of the pre-test.

Validity

Validity represents truth (Adams, Khan, Raeside & White, 2007). There are many ways to ensure the validity of the data, such as the refutability principle; the constant

comparative method; comprehensive data treatment; deviant-case analysis; and using appropriate tabulations. According to Walsham (1995), validity is concerned with the study's success at measuring what the researchers try to measure. In this study the use of branching to ensure that only respondents who can be reasonably expected to be able to answer certain questions provided answers.

5.3. Innovativeness instrument development

As outlined in Chapter Four this study draws on innovation theory. A set of questions were developed to classify the survey participants into the five categories of innovation theory: innovators; early adopters; early majorities; late majorities; and laggards. The actual questions and coding for those questions are provided in Appendix B. More detailed discussions are provided in the later sections.

5.3.1. Questions

In innovation theory, there are six focused areas used to classify innovativeness adopters: number of competitors; leadership; the main driver of deployment; regarding new ideas; acknowledgement by peers; interactive level with peers (Moore, 2002). Therefore, there were six questions developed to classify the adopters. These were:

What will be the main driver for this RFID deployment?

Has your company got many competitors?

Is your company quite often rated among the top companies in the industry?

How often do you interact with the other companies?

How do you think similar companies in the industry regard your company?

Is your company always highly regarding new technologies or new ideas?

Some of the questions were initially put forward by the NZ RFID Pathfinder Group and other questions were developed according to the basic principals of innovation theory. After the final development stage for the questions, they were administered to the NZ RFID Pathfinder Group as pre-test and minor changes to wording and instructions were made as a result.

5.3.2. Measurement

Parametric-free method

According to Han, Lakshmanan and Pei (2001), parametric-free methods or distribution-free methods are more appropriate when the data set is small. Parametric-free methods do not rely on the estimation of parameters (such as the mean or the standard deviation) describing the distribution of the variable of interest in the population. Parametric-free methods were developed to be used in cases where the researcher knows nothing about the parameters of the variables of interest in the population. Since the data set is small (less than 100), parametric-free methods of measurement were considered more appropriate for the analysis of the survey data.

Levels of measurement variables

There are four levels of measurement: nominal, ordinal, interval, and ratio (Han & Kamber, 2000). Nominal variables allow for only qualitative classification. Ordinal variables allow items to be rank ordered for measurement in terms of which has less and which has more of the quality represented by the variable, but it does not say how much more (Berry & Linoff, 2000). Interval variables allow not only items to be rank ordered, but also to quantify and compare the size of differences between them. Ratio variables are very similar to interval variables; in addition they also allow for statements such as x is two times more than y (Witten & Frank, 2000).

Measurement method for this survey

In this particular survey, the measurement method was parametric-free for nominal and ordinal data. Every participant was from different industry bodies with their unique background; therefore, it is not possible to compare them. They can only be measured in terms of whether they belong to the categories or not.

For each of the questions, the answers were coded from one to five (Appendix B). The five numbers were low to high weighted. The innovativeness of each participant was calculated by taking the mean frequency across the scale.

5.4. Qualitative interview method

The qualitative research method is much more reliant upon interviews and case studies and generally deals with much smaller numbers of participants (Silverman, 2004). Qualitative research methods are designed to help the researcher understand social and cultural contexts. In this case, a qualitative interview method was used to help the researcher check the results of the survey as recommended by Bogdan and Biklen (1998).

According to Rubin and Rubin (1995), the purpose of a follow-up interview is to fully understand the users' impressions or experiences or learn more about responses to the questionnaires. The interview was also designed to re-confirm the findings from the online questionnaire survey. The interviews were recorded and transcribed. Interview data were analysed using an open coding technique. Walsham (1995) stated that the advantages of the interview method are that the researcher can get a full range and depth of information about the participants, and the researcher can also develop relationships with the participants. In this case, the participants will not feel they are just experimental elements for research. The researcher could also have more accurate information about RFID technology in use. However, the interview method can be time consuming and might be costly, because the researcher has to set up a certain time and place just for the interview. Therefore, the researcher will have to deal with the relevant issues. The following sections will detail how the qualitative interview method for this thesis was employed.

5.4.1. Interview data analysis process

According to Trochim (2006), there are three stages involved in the data analysis process: identifying a research problem; developing and implementing a sampling plan; measurement testing; and developing a structure.

Identifying a research problem

According to the highlights from the online survey findings, the interview focused on the areas that answered the research questions. Therefore, the problems identified in the interview were: current status of RFID users in New Zealand; issues of RFID replacement; promoting the use of RFID; future trends in RFID adoption; and

innovativeness of New Zealand businesses. These questions were the backbone of the interview.

Develop and implement a sampling plan

Deliberate sampling was used to select the interview participants from the survey participants. The interviewees were chosen, according to their background, thus giving different views on the innovativeness of RFID in New Zealand, making the results more representative of the population under study.

Structure development

The interview was constructed based on the online questionnaire survey and followed the focus of the research questions. Three interviews were conducted. The consent form and information sheet have also been filled and signed. Three interviews were conducted individually in person with the researcher. The average interview time was 25 – 30 minutes. The structure of the interview was categorized into five main areas, including: current status of RFID users in New Zealand; issues of RFID replacement; promoting the use of RFID; future trends in RFID adoption; innovativeness of New Zealand businesses. Five questions were developed for each category. All of these questions were designed to explore the survey findings. The questions were deeper and more focused than the online questionnaire. A copy of the interview protocol is included in Appendix D.

The following sections will discuss the data analysis process for both the online survey and the interview. Both the online survey and the interview parts will be detailed respectively.

5.5. Data analysis process

The data analysis process includes: pre-coding of survey questions; descriptive statistics and the open coding technique. According to (Huberman & Miles, 2002), pre-coding of survey questions normally involves checking or logging the data into storage; ensuring the accuracy of the data; transforming the data and documenting a database structure integrating the measures. The descriptive statistics stage is to describe the data in the study. In this stage, it should have some kind of summary about the data themselves and

the measures. It also includes the relevant graphic or diagram analysis based on the data. The main purpose of this stage is to describe what the data are and what the data show. The descriptive statistics stage has the most useful outcomes or analysis. It is more like information rather than the data in the previous stages. This stage includes investigating questions, models, or hypotheses.

This research was like other research studies in that the data analysis process involved three phases of analysis as described by Bogdan and Biklen (1998). Firstly, it described how the data were prepared to meet the requirements of the research. Secondly, the data as a whole is described as a big picture. Finally, all the raw data is organised and transformed into useful information. The next sections follow this layout.

5.5.1. Pre-coding of survey questions

The “Statistical Package for the Social Sciences”, also known as SPSS, was used for the purpose of statistical description (SPSS, n.d.). Specifically, SPSS was used to code and split the data set for preparation and analysis. All the data and relevant questions were coded (refer to Appendix E) into a created SPSS model by numeric symbols, and the missing values coded for the convenience of the final data display. When all the variables had been coded, the data were organised very easily into diagrams or graphs. There were 10 criteria for the SPSS pre-coding model: name, type, width, decimal, label, values, missing, columns, align, and measure. Name was to provide a code for each question and each sub question. Type was to define the data type, such as string, and numeric. Width was about size of the input data. Decimal provided space for decimal data. Label was the description of each given code. Value was to give a code for each possible answer. Missing provided a specific code for when answers were not given. Columns were about where the questions located on the SPSS model. Alignment was specifying the alignment of the text. Measure was about how the data was measured by, such as nominal and scale. The final data presentation could be exported from SPSS to meet the requirements of the researcher.

5.5.2. Descriptive statistics

Online survey data

Online survey data analysis was based on the online questionnaire, which consisted of 28 questions. The analysis of the survey data has been organised into five main parts: demographics; general results; New Zealand vs. Australia RFID future adopters; specific Pathfinder results; and innovativeness.

Interview data

The purpose of the interview was to address the issues found in the online survey, and provided information to support the survey data analysis. This sub section will explain how the interview data were processed. Interview data were recorded by voice recorder. Hand written notes were taken during each of the three interviews. Then the voice data were transcribed into word document by the researcher. A summary was produced based on the three interviewees' comments and was also recorded in a word document.

There were several issues re-addressed in the interview related to the research questions, such as: current status of RFID users in New Zealand; issues of RFID replacement; promoting the use of RFID; future trends in RFID adoption; and the innovativeness of New Zealand businesses. As mentioned in the previous sections, the interviewees were the members of the RFID Pathfinder national committee; therefore, their comments regarding RFID technology adoption in New Zealand had credibility. The three interviews were undertaken in different locations and at different times. The interview data were summarized in pure text.

The following section will explain how the data analyse approach.

5.5.3. Open coding technique

This section will discuss the transformation of the interview data from the interviews into usable information.

The open coding technique was used for the process of analysing the interview data. This approach allowed the researcher to keep an open mind in all directions until

discovering the core variables that reoccur consistently throughout in the interview data. The open coding technique is best at describing what is happening in the data to explain possible relationships between and across incidents. According to Goulding (2002), open coding is the process of breaking down the data into distinct units, which contain different meanings. The process normally starts with a full transcription of an interview and the text is then analysed line by line, where all identifiable key words or phrases can be investigated. The open coding process involves verification, correction and the opportunity for saturation. Line-by-line analysis normally goes along with the open coding technique (Pauleen & Yoong, 2004). Line-by-line analysis is undertaken to search for key words or phrases which give some insight into the behaviour of the participants regarding the research (Ryan & Bernard, 2005). Coding data is just like highlighting the main points of a book. The code words are like flags or signposts that point to things in the data (Holstein & Gubrium, 2003). The role of code words is to help the researcher collect points that can be subjected to further analysis (Smith, 2003).

In the case of this thesis, the three interviews were recorded and transcribed on a digital device. Line-by-line analysis was used to look for key words or phrases from the participant in order to study their attitudes towards RFID adoption among industries and businesses in New Zealand. The responses from the five areas of the interview were accordingly subjected to the open coding technique (see Appendix F for codes).

5.6. Summary

This chapter described the data analysis process for the whole research thesis. It gave details about the online survey data and interview data, and how they have been processed in the different stages of the data analysis process. The next chapter reports the results of the data analysis from the questionnaire data. Results from the analysis of the interview data is reported in Chapter Seven.

Chapter Six

6. Survey results

This chapter presents the analysis of the data collected by using the online survey. There were 51 industry group representatives responded to the survey. The survey shows that the majority of New Zealand industries have not adopted RFID technology. Only 14% of industries have already used RFID technology. There were 10 responds out of total 51 participants conducted the innovativeness measurement, the result shows that 10% were “innovators”; 40% of the adopters were “early adopters”; 30% were “early majorities”; and 20% of them were “late majorities”. First, the aim and objectives of the study will be revisited in order to provide a focus for the chapter.

6.1. Aim and objectives

The aim of the survey was to find out the current status of radio frequency identification (RFID) technology adoption in New Zealand and to investigate perceptions about technology advocacy groups such as the NZ RFID Pathfinder Group. To achieve these aims, the survey sought to determine:

- 1) RFID technology adoption levels at the industry level in New Zealand
- 2) Intentions to use RFID technology in the future at the industry level
- 3) Recommendations for the NZ RFID Pathfinder Group
- 4) Innovativeness of the respondents' industry

These aims form the basis of the survey instrument.

The objectives of this research are to gain an understanding of how the NZ RFID Pathfinder Group could facilitate RFID adoption and act as an advocate for RFID use in industries. Radio frequency identification rapidly increases the ability of the organisation to capture data about the location and properties of any entity that can be physically labelled and scanned within a certain distance. RFID can be applied to a variety of industries and contexts, such as internal operations, marketing, and after-sale services. The focus of this thesis is the use of RFID technology for enhancing supply chain management.

6.2. Demographics

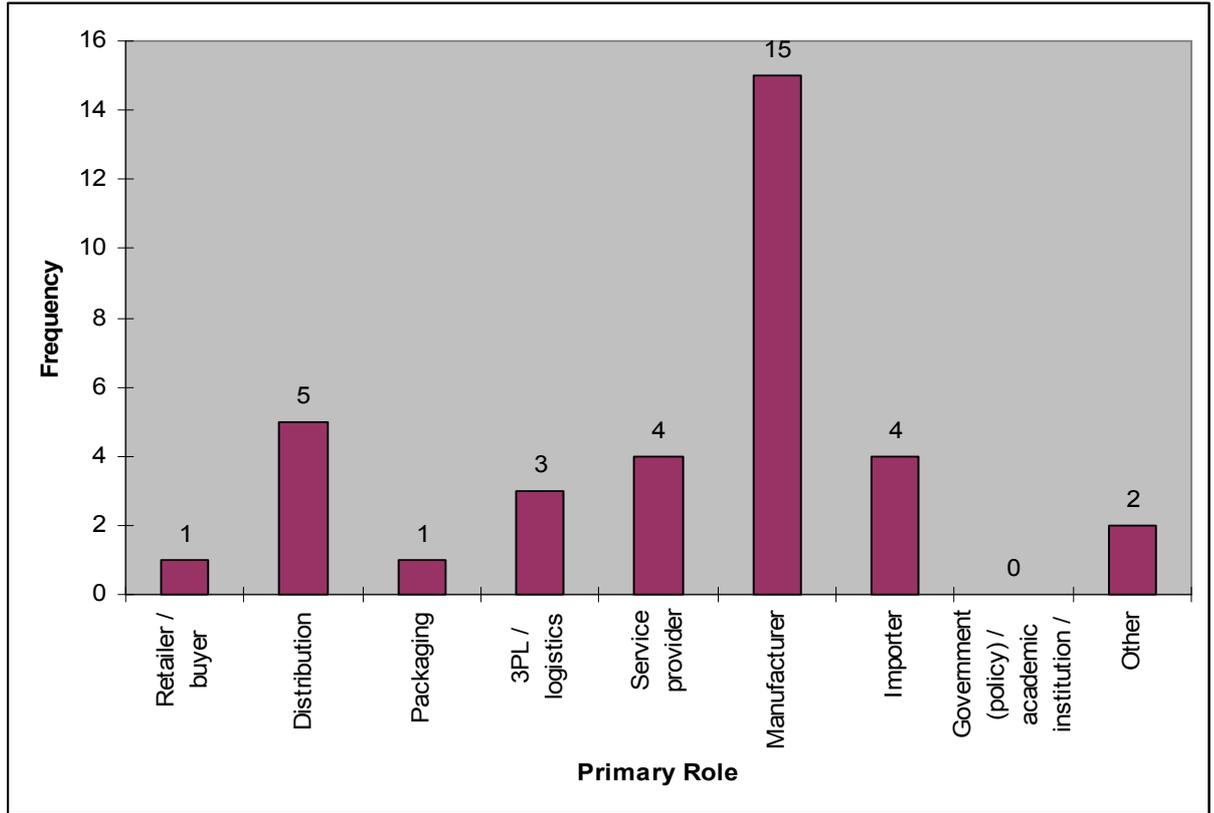
There were two methods to combat non-response bias in this study, mail invitations and a follow up email. The invitations were specifically for either CEOs or the person in charge of the IT department. To combine the advantages of mail and email, therefore, both methods have been used to ensure a better response rate. There were 57 mail invitations sent out throughout New Zealand according to a list of participants, which was a list of New Zealand industries from New Zealand business demography statistics (StatisticsNewZealand, 2008), such as government, manufacturers, and import/export companies. After two weeks, there was another follow up email sent to the participants.

After period of a month, 51 responses were received from a variety of industry organisations, which was an 89% response rate. The participants' list was a list of New Zealand industries retrieved from New Zealand business demography statistics (StatisticsNewZealand, 2008). Therefore, the response rate was reasonably high and was combined with the intensive follow-up invitations to the participants. However, due to the branching design of the questionnaire, the response to individual sets of questions was sometimes low, because only respondents who were qualified to answer certain set of questions did so. This is acknowledged and dealt with in the data analysis sections.

6.2.1. Who responded

An overview of all the respondents is provided in this section. The first details presented refers to the industries primary role in the supply chain (refer to Figure 6.1). This question received 35 responses out of the total 51 participants because the question was not compulsory to allow for a greater level of anonymity for the respondents if desired. The highest response was from manufacturing group of industries, which was 43%. There was no response from the group of government (policy)/academic institution/association. The distribution group of industries represented 14%; service provider and importer groups were 11%. Retailer/buyer and packaging groups both represented three percent. The 3PL/logistics group represented nine percent. The others group represented six percent and included research institutes and adventure tourism operators. This result shows that there is a bias towards the manufacturing industry in this data set.

What is your industries primary role in the supply chain?



N=35

Figure 6.1: Industries primary role in the supply chain

6.2.2. General background of the participants

This section provides an overview of the background of the survey participants. Most of them sometimes interact with the other companies, and they have sometimes been rated among top companies in their industry. Fifty percent of them had been involved in RFID projects previously.

Perceptions of NZ RFID Pathfinder role

Sixty-seven percent of the survey respondents thought that RFID education and training should be based on introductory and RFID awareness. Most respondents thought that the most important activities of the NZ RFID Pathfinder Group should be to promote the direction for New Zealand adoption, lobby governments and associations, information sharing, seminars/conferences, field trips, and networking functions. Most of them believe that they have been using leading edge technologies compared with their peers.

Fifty percent of them intended to use RFID in the supply chain within organisations.

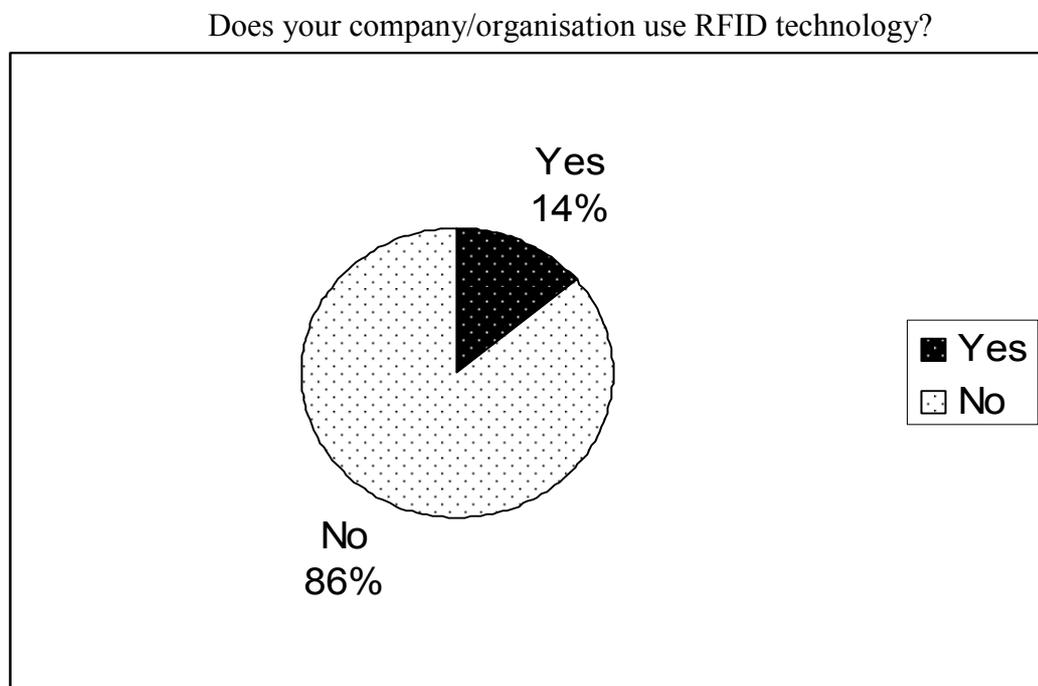
The majority of respondents were interested in the NZ RFID Pathfinder Group membership. Seventy percent of respondents thought they would use the advantages of RFID to support the industries future direction. Forty percent the participants had discussions with their customers regarding the use of RFID. Thirty-three percent of respondents had discussed the matter with RFID suppliers. Only seven percent of respondents had not had any discussion with partners regarding the usage of RFID.

6.3. General results

There were three main groups of participants: industries who had adopted RFID already (seven); industries that planned to adopt RFID (16); and industries that did not intend to adopt RFID (28). The next sections report results for each of the sections in turn beginning with those that had adopted RFID.

6.3.1. Industries who had adopted RFID already

According to the survey analysis (see Figure 6.2), 14% (seven industry groups) industries surveyed had adopted RFID technology. The industries were from importer, research institute, manufacturing, and distribution industries.



N=51

Figure 6.2: The percentage of RFID adoption so far among the industry groups.

Challenges

The analysis highlights several challenges currently impeding RFID technology adoption (refer to Table 6.3). 25 out of the total 51 participants responded to this question (this question was not compulsory as shown in Appendix A). The consideration of the cost of infrastructure-hardware, software and tags accounted for 15% of responses in total. The challenge of process change required accounted for another 15% of responses. The other challenges supported by the survey included relative priority vs. other business initiatives; executive ownership vs. senior executive sponsorship; required RFID skills and radio frequency regulations; and RFID standards.

Limitation and issues

According to the analysis of the questions relating to challenges (refer to Table 6.3), the most cited issues limiting RFID adoption were the cost of the hardware infrastructure and the cost of tags. These findings are collaborated by other studies, which have always been a concern for the RFID adopters (Shoewu & Badejo, 2006). The second most cited issue is the cost of the software infrastructure, reliability of tags and readers and process change required. The tags are placed on each of the product, the more products the businesses have, the more tags will be consumed. The tags are not reusable. Therefore, the tags are considered as part of the base cost for an RFID application. Reliability directly affects the productivity of a business, if the tag or the scanner is not stable, it could give incorrect information about the product. Reliability is a technical consideration. Since some of the types of RFID technology are still in a process of maturation, the NZ RFID Pathfinder Group has the opportunity to lobby hardware manufacturers and standards bodies to improve the performance of the RFID to encourage further adoption.

Table 6.3: Challenges may impede the organisation in implementing an RFID application

What challenges do you believe may impede your organisation in implementing an RFID application?

| Challenges | Responses |
|--|-----------|
| Cost of infrastructure - hardware | 1 |
| Cost of infrastructure - software | 2 |
| Cost of tags | 1 |
| Reliability of tags and readers | 0 |
| No executive ownership | 0 |
| Proving the business case / ROI | 0 |
| Raising awareness of RFID | 0 |
| System integration | 1 |
| RFID standards | 2 |
| Radio frequency regulations | 2 |
| Privacy consumer groups / issues | 1 |
| Required RFID skills | 2 |
| Participating vs. deployment | 1 |
| Executive ownership vs. senior executive sponsorship | 3 |
| Process change required | 4 |
| Relative priority vs. other business initiatives | 3 |
| Other | 4 |

N=27

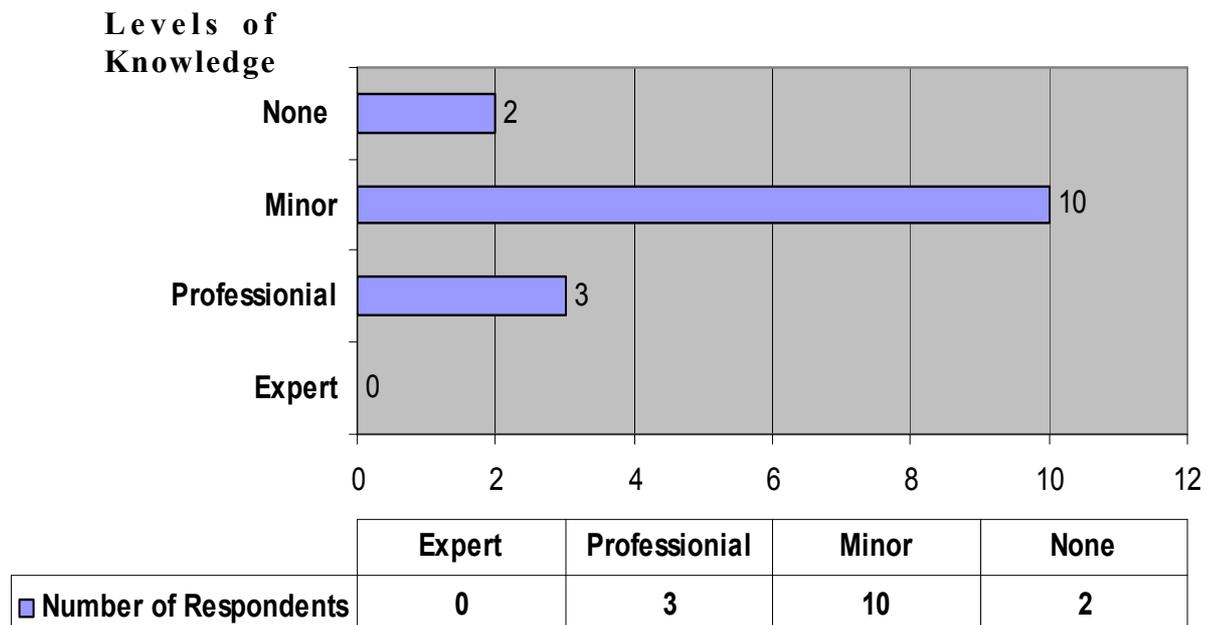
6.3.2. Industries that planned to adopt RFID

Out of all the respondents who have not adopted RFID technology, 36% intend to deploy RFID in their operation /supply chain (16 out of 44 participants). These industries were packaging, adventure tourism, service provider, and 3PL/Logistics. For the participants who intended to deploy RFID in the future, 19% (three out of 16 respondents who have a plan) intend to deploy RFID in a production/logistics environment within one year; 38% (six out of 16 respondents who have a plan) intend to deploy RFID within one to two years; 31% (five out of 16 respondents who have a plan) intend to deploy RFID within two to four years; and 13% (two out of 16 respondents who have a plan) intend to deploy RFID four years later. According to the survey, 16 respondents intended to adopt RFID technology in the future, while 57% of them would adopt the technology within two years. This result shows that there is a trend of adopting RFID in the near future.

Level of knowledge

This question was answered by 15 respondents. The survey (refer to Figure 6.3) shows that the majority of the participants, who answered this question, had minor knowledge of RFID (67%). None of them rated themselves as expert in RFID. Three respondents considered their knowledge as professional while two respondents didn't have much knowledge about RFID at all. This result suggests that many industries do not possess deep knowledge regarding RFID. This provides another opportunity for the NZ RFID Pathfinder Group to develop in a near future. According to the survey, there are very few experts in the area of RFID technology in New Zealand. The majority of industries have only minor knowledge. The NZ RFID Pathfinder Group could change this by providing more presentations, courses, or conferences to address this lack of RFID knowledge. The result shown in Figure 6.3 could also indicate the innovative level of New Zealand industries regarding leading-edge technologies, but more data collection would be needed.

What would you rate your company's knowledge of RFID?



N=15

Figure 6.3: Industry groups knowledge levels of RFID

6.3.3. Industries that did not intend to adopt RFID

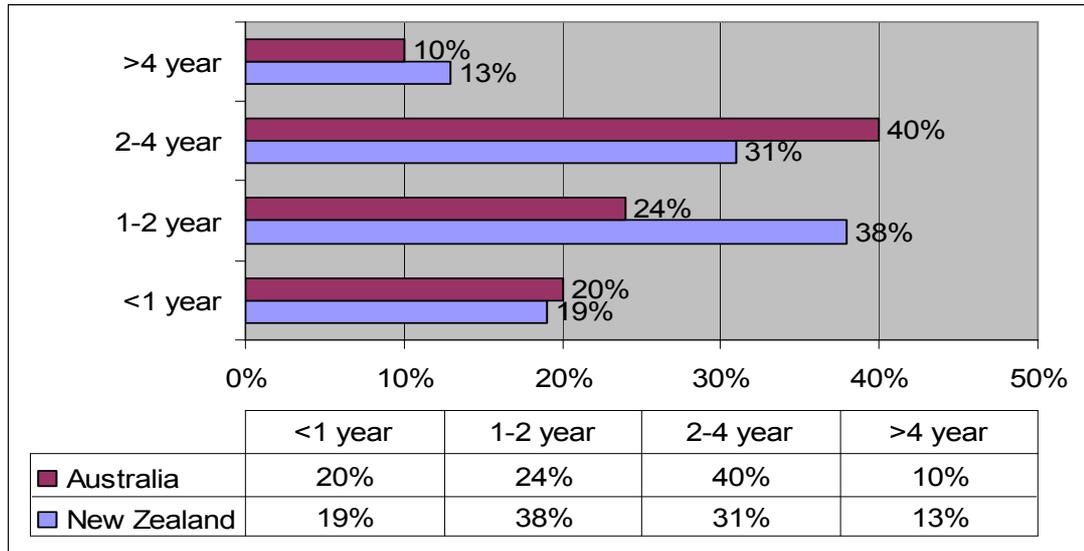
According to the survey results, 64% of the respondents (28 out of 44 respondents) have no plan to use RFID. There could be many reasons for this result. Some of them might

not have realised the benefit of adopting RFID while the others might not need RFID technology. For those non-RFID adopters, the NZ RFID Pathfinder Group could analyse the limitations. However, RFID might not be appropriate in all situations, which can be a reason some of the industries not adopting it and the NZ RFID Pathfinder Group must remain cognisant of that.

6.4. New Zealand vs. Australia RFID future adopters

GS1Australia completed a survey regarding RFID adoption in Australia asking the same questions that were adapted for this study. Their survey result has been published online. As mentioned in Chapter Two, New Zealand and Australia have many things in common, such as economy structure, businesses structure, geography, and beliefs. Australia is much bigger than New Zealand and therefore the number of respondents to the Australian study is much higher. However, the percentage of respondents' answers in each survey can be compared. The set of data result about Australia data retrieved from GS1Australia (2007) to compare with the New Zealand result from this survey. According to the results of GS1 Australia (refer to Figure 6.4), Australia had 20% of the participants intended to adopt RFID less than one year; 24% participants planned to adopt RFID between one and two years; 40% participants intended to adopt RFID between two and four years; and 10% of them planned to adopt RFID after four years time. In New Zealand, 19% of the participants intended to adopt RFID less than one year which was very similar to Australian study; more participants intended to adopt RFID between one and two years than in the Australian study; less participants planned to adopt RFID between two and four years than in the Australian study; and 13% participants planned to adopt RFID after four years time in New Zealand. From the diagram, it seems that the majority industries would adopt RFID within four years time in New Zealand, and the early majority adopters complete the adoption process less than two years even faster than in the Australian study.

What do you see is a realistic time frame for your organisation to deploy RFID in a production/logistics environment?



N=16

Figure 6.4: New Zealand vs. Australia (Australia data in Figure 6.4 was retrieved from GS1Australia (2007))

6.5. Specific Pathfinder results

From the survey results to the specific questions relating to Pathfinder activities (refer to Figure 6.5), 24% responded that the most important activity of the NZ RFID Pathfinder Group was to set the direction for NZ RFID adoption. The second highest rated activity was getting involved in national pilots (21%). Lobbying governments and associations and information sharing were equally rated (17%) activities that the NZ RFID Pathfinder Group should be doing.

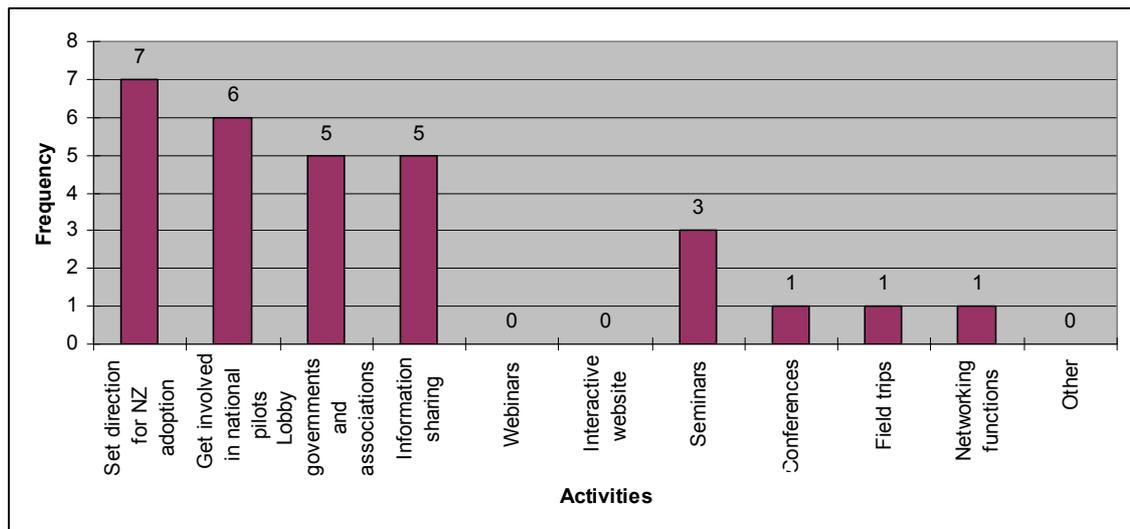
6.5.1. Providing seminars

Providing seminars was another important activity the NZ RFID Pathfinder Group might undertake (10%). The other activities responded: conferences, field trips, and networking functions were also rated three percent individually, which the NZ RFID Pathfinder Group might undertake. Having an interactive website was not selected by any of the respondents as being an important activity that the group should undertake.

6.5.2. Introductory/awareness

There was a question asking about the type of training the industries expected from the NZ RFID Pathfinder Group. Introductory/awareness means introduction or basic training of RFID technology. Introductory/awareness has the highest rate, which was 47% out of the responses. Business case/ROI development and RFID technology training were equally rated for 18%. Advanced certificate course was rated 12%. The education of standards was the least rated one for six percent. That shows that the majority of using RFID is still on the introductory stage in New Zealand. Forty percent of the participants were the member of the NZ RFID Pathfinder Group as well as 40% of them was committee member. Twenty percent of the participants responded that their involvement with the NZ RFID Pathfinder Group might be co-option because of expertise.

What do you think the most important activities of the NZ RFID Pathfinder Group should promote?



N=29

Figure 6.5: Activities the NZ RFID Pathfinder Group should do to promote RFID adoption

6.5.3. The NZ RFID Pathfinder Group membership

Under the question of “Are you aware of the NZ RFID Pathfinder Group?”, according to the result (Figure 6.6), 70% of the respondents answered that they were not aware of the NZ RFID Pathfinder Group, 39% of them were interested to join the membership while 31% of them had no intention to join. On the other hand, 30% of all the respondents were aware of the NZ RFID Pathfinder Group, but 22% of them were not a

member; only eight percent of them were aware of the NZ RFID Pathfinder Group and also having the membership. This question was in the demographic data collection page at the end and was for all the participants to response to. However, there were only 36 responses out of the total 51 participants as the question was not compulsory.

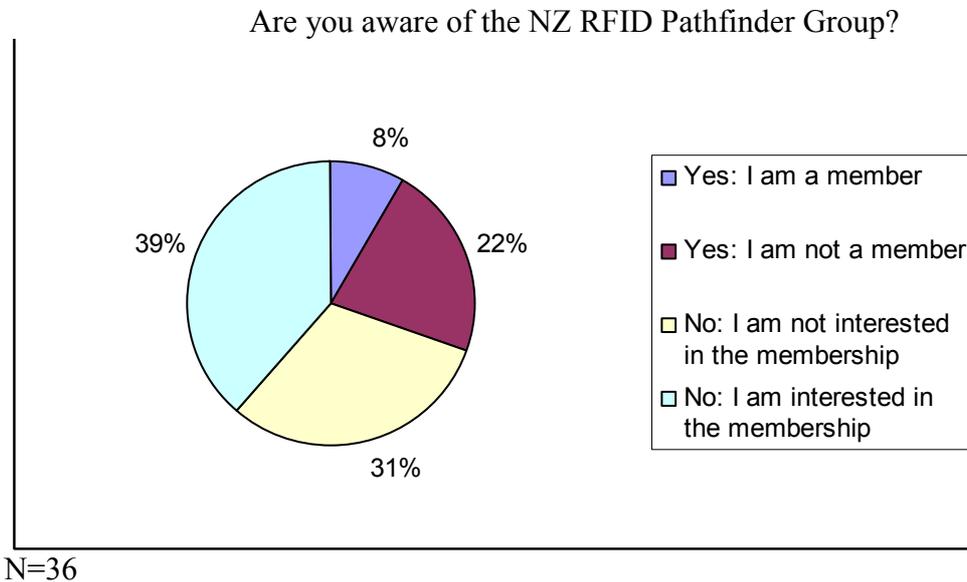


Figure 6.6: Awareness of the New Zealand RFID Pathfinder Group

6.6. Innovativeness

According to the responses for each participant, all the responses were given a score and the means of the scores indicated the innovativeness of the participant (Appendix B). The participants were classified as innovator, early adopter, early majority, late majority, and laggard. Five different adopter classifications have been allocated according to the mean of each participant: innovator between 4.1 and five; early adopter between 3.1 and four; early majority between 2.1 and three; late majority between 1.1 and two; laggard was up to one (see Table 6.6). According to Table 6.6 and the innovativeness calculations, 10 responds for the innovativeness measurement, 10% were innovators; 40% of respondents were early adopters; 30% were early majorities; and 20% were late majorities. All the participants who have experienced or adopted RFID technology have responded to all the innovation questions. The questions are available in Appendix C. The small data set for this question means that interpretations of this data must be very conservative; however, this measure would appear to show some value and should be considered for a more complete study.

Table 6.6: Innovativeness indicator frequency

| Innovativeness indicator frequency | | |
|------------------------------------|-------|-----------|
| | Scale | Frequency |
| Innovator | 4.1-5 | 1 (10%) |
| Early adopter | 3.1-4 | 4 (40%) |
| Early majority | 2.1-3 | 3 (30%) |
| Late majority | 1.1-2 | 2 (20%) |
| laggard | 0-1 | 0 |

N=10

6.7. Summary

The online survey results suggest that only a small number of New Zealand industries (seven out of 51) have already adopted RFID (14%). The participants were from many different industries, for instance, manufacturers, importer/exporter, logistics, and service provider. Many of them found that the cost of implementing RFID technology was a big issue. For the industries that had not adopted RFID (44 out of 51), there were 36% (16 out of 44) participants planned to adopt RFID in the near future, and most of them intended to adopt RFID within two years time (57%). According to the survey, not many participants rated themselves as professionals or experts in RFID. The suggestion from the participants to the NZ RFID Pathfinder Group was to provide more seminars and introductory/awareness approach. The innovativeness measure suggests that most New Zealand industries are in the early adopter, early majority bracket and therefore, Moore's "chasm" may come into play here.

Chapter Seven will discuss the interview results. There were five focused areas involved in the interview: "current status of RFID users in New Zealand"; "issues of RFID replacement"; "promote the use of RFID"; "future trend of RFID adoption"; and "innovativeness of New Zealand businesses". These five areas of interest match those of the survey and are intended to corroborate the findings of the survey. It is expected that the analysis of the interview data re-confirm the findings from the online survey, and also provide a depth of understanding about the innovativeness of New Zealand businesses and what the NZ RFID Pathfinder Group need to do for the RFID future adoption not available from the survey data.

Chapter Seven

7. Interview findings

This chapter presents the results of the analysis of the interview data. There were three interviewees chosen. The analysis was based on the interview data over the three interviews. The purpose of the interview was to corroborate the findings from the survey data.

According to the survey data, there were few industries to have adopted RFID technology, and the majority New Zealand industries did not have enough knowledge about RFID. The limitations for development of RFID technology were the costs of hardware and software, costs of the tags, process change required, and the reliability of the readers and tags. The majority of participants expected the RFID educator could run more conferences, presentations, training, or courses available for businesses in order to promote the use of RFID in the future. The objective of the interviews was to try to corroborate the survey findings and to flesh out some of the issues. Therefore, the following question themes were developed for the interviews.

7.1. Themes for the interview

The interview questions were focused around five main themes that compliment the questions on the survey. Remember that the five main themes introduced in Section 5.3.2 are:

- What do you think the current status of RFID users in New Zealand is?
- What do you think the limitations for future development of RFID technology are?
- What would you do to promote the use of RFID?
- What do you think about the future trend of RFID adoption will be? and
- What do you think about innovativeness of New Zealand businesses?

There were a total of 20 questions (refer to Appendix D) developed in order to investigate the five themes identified.

7.2. Interviewee personnel

Interviewee A profile:

Interviewee A is a general manager for GS1 in New Zealand. His responsibility is for sector development. Specifically, in two priority areas, first is RFID within the content of EPC global technologies. The second is GS1 in EPC standard for health care specifically.

Interviewee B profile:

Interviewee B is the managing director of a small RFID hardware development company. His company is specialised in handheld and mobile RFID readers. The product is designed for the workforce, for example truck drivers. His company is also specialises in RFID consultancy services in New Zealand providing strategic planning services for RFID within business as opposed to within supply chains.

Interviewee C profile:

Interviewee C is a researcher in one of the universities in New Zealand. Her role is doing research on leading-edge technologies, and understanding the current status of RFID technology. She is also a member of Pathfinder committee. She specializes in web development, requirements analysis, and reporting related to RFID enabled projects.

7.3. Interview analysis

7.3.1. Current adoption of RFID in New Zealand

All three interviewees agreed that the RFID implementation in New Zealand was very minor. There were not many adopters. Interviewee A stated that “New Zealand is still at the watching and learning stage”. “The most businesses are still holding back their decisions on adopting RFID”. “They are looking at what is happening overseas to determinate whether it fits their businesses processes”. Interviewee B also mentioned that “New Zealand is the innovation and early adoption phase; it hasn’t yet moved to mass level adoption”.

All of the interviewees stated that RFID technology can be used in any kind of organisation; it was only matter of how they used the technology. Interviewee B said

that RFID was a horizontal technology. The Interviewee gave the example that some businesses might use RFID in a lower level while the others might use it in a higher level application. For example: email can be used as a daily communication tool, and it can also be used as data transfer or data storage tool. Interviewee B also thought that there was a certain type of industry involved with RFID more than the others, such as stock control, supply chain, process tracking, quality insurance, and management.

When the interviewees talked about the size of the adopters, one of them thought the size was a factor while the others disagreed. They thought this because the costs of adopting RFID, which can mean that adopting RFID is outside the realm of small company adopters. From their point of view, the small companies might not be able to invest the big capital for the technology. However, interviewee A thought that the “the most important thing was the return on investment. If a small company can work out the initial investment and the return, there should not be any problem for a small company to adopt RFID”. Overall the interviewees felt that adoption was about how much the adopter could afford to invest and how much return the company could gain from RFID technology.

7.3.2. Limitations for future development

The interviewees agreed that RFID was more expensive than existing identification systems for most the business applications. The interviewees also agreed that RFID was much more suitable for critical business processes because these processes have much more influence of the overall profit margin of the organisation.

Interviewee A said that “RFID type solution is more expensive initially in terms of investment than would the bar coding solution be, in another cases that is the other way around”. That is, the costs of the bar coding solution is less, but some of the stock are lost within the supply chain. RFID can increase supply chain visibility and therefore minimise shrinkage of stock. Therefore, overall, the system gains more profitability through less stock shrinkage to cover the higher cost of implementation.

Interviewee B also stated that “RFID opens up opportunity for driving new efficiency and new business processes”. To identify these business processes within a company is critical for adoption. Competition is the way to drive the costs of RFID infrastructure

down, as interviewee A mentioned that “the way to reduce the infrastructure costs is standardisation. Once you start to standardise a technology, making product available to the clients, then you have competition between RFID technology service suppliers”.

7.3.3. Promote the use of RFID

As the application of RFID technology in the supply chain is still new to New Zealand businesses, awareness can be a concern. The interviewees were invited to comment about this issue. GS1 in New Zealand, EPC global, and the NZ RFID Pathfinder Group are the main information source for RFID technology related information and advice. Recall that the NZ RFID Pathfinder Group is a not-for-profit organisation, it is membership driven. Pathfinder aims to educate the market on the standard automatic identification in the product for supply chain, whether it would be bar code and RFID, as stated by interviewee A. All three interviewees mentioned that the most common ways to raise RFID awareness were at conferences, presentations, classes, and demonstrations. These are not only held nationally, but also internationally. The NZ RFID Pathfinder Group also has a website with a lot of information regarding RFID technology for the use of the public members. There were regular RFID related conferences and presentations held nationally and internationally. All interviewees indicated that the main participants were from the primary sector, people from transport organisation, vendors, solution providers; company involved all sectors in the supply chain. According to the result, increasing the number of members for the advocacy groups is one way to accelerate RFID adoption speed in New Zealand. The three interviewees had different ideas about the number of participants suited to each conference or presentation; the numbers have been given from 50 to 120 and some times it could be up to 250.

7.3.4. Future trend of RFID adoption

To predict the future is always a hard thing. It is the same for RFID adoption in New Zealand. Two interviewees stated that the mainstream RFID application adoption could happen within one or two years, such as mobile technology. However, interviewee A said that “there is never going to be a boom year for RFID adoption anywhere in the world, the adoption process will happen slowly step by step. Businesses need an appointed RFID champion within their organisation to do research and get familiar with

the technology, so they can brief their executive about how RFID can make profit for the organisation”.

According to interviewee B, the most important aspect for future deployment is that, the companies need to understand return on investment, and payback period, or application in the industry.

All of the interviewees agreed that New Zealand was behind the global RFID levels of adoption by about one or two years. New Zealand has lack of businesses case studies on which to make business decision on adopting RFID technology. However, in the next few years, it is expected that there will be a number of New Zealand retailers forced to adopt RFID due to global trading partnerships. For example, international franchise retailers located in New Zealand may have not option but to adopt RFID technology if their head office mandates a RFID SCM approach. There will be a need to provide local support for such franchisee owners. Interviewee A said “in the early stage, it is more about education and communication and follow the research.” interviewee B stated that “demonstrate and helping businesses understand visual example of more realistic RFID application first”. Therefore, for the immediate future, the NZ Pathfinder Group may find it really useful to observe international companies that have a presence in New Zealand and their RFID projects. As suggested by the interview results there may be New Zealand offices forced to adopt RFID and who need or would benefit from local support.

7.3.5. Innovativeness of New Zealand businesses

The interviewees emphasised that the adoption rate of RFID was very low in New Zealand; it was about 10%. They observed that many businesses in New Zealand were interested in leading-edge technologies, but fewer businesses were actually adopting them. Comparing New Zealand and Australia, two interviewees said that New Zealand and Australia had made similar progress, while interviewee B stated that “New Zealand and Australia is collaborative link, New Zealand is learning from Australia. Australia is ahead of New Zealand, it has large companies and economy. New Zealand is about 2 years behind Australia.” All three interviewees agreed that there are increasing numbers of businesses interested in RFID technology and the change had been quite rapid over the twelve months prior to the interview. Interviewee B also said that “a lot of people

interested, small number of people passionate about it but with less action adopting RFID at moment.” Interviewee A stated that “the innovativeness of New Zealand is poor, because there are many companies in New Zealand haven’t done the fundamental research.” Interviewee B said that “New Zealand is one of most innovative countries” Interviewee C said that “from my knowledge New Zealand is a little bit behind.”

Therefore the interview responses corroborate the findings of the survey (refer to Section 6.6) that New Zealand is in the early majority adoption phased according to the innovation curve.

7.4. Discussion

As stated in the previous chapters, many studies showed that the RFID adoption rate in New Zealand is quite low (Soon, 2007; Harrop, 2006). Standards, cost, reliability, and privacy are the limitations for RFID adoption according to Soon and Gutierrez (2008). The result of this research shows that the RFID adoption percentage in New Zealand is still very low. However, the result also shows that there are industries intending to adopt RFID within the next couple of years. Many common limitations still exist, for example RFID infrastructure; costs of tags; and reliability.

According to the analysis of the interview data, the issue of the costs might not be a problem if businesses could understand the return on investment. It is more suitable for businesses that can use RFID technology to improve their supply chain management. If businesses could have proof of how much they could save by adopting RFID technology into their supply chain, they would be keener to implement.

7.4.1. Awareness real life examples, not just presentation

The interviewees all made reference to the many RFID presentations or conferences have been held regularly around the world in order to promote RFID technology. However, they argued that such presentations were very artificial to the real businesses decision makers. They felt that real life examples of RFID technology would have more impact. The reasons given were that the majority of business decision makers were no longer at the stage where they have no idea about what RFID was. The majority of

business decision makers were up to the point where they would like to know how RFID could help their business or a similar business in real life.

One interviewee noted that the private sector and in particular small businesses were normally late adopters of new technology. Therefore, they reason, that the RFID vendors might want to start with the public sectors. The reason being is that the public sector is more likely to provide free application or low price application for trials through budgeted research and development spending. There are two supporting points. Firstly, the public sector can afford to budget more money for research and development and therefore can support trial applications; secondly, the public sector can have better reputation and ability to distribute the findings of the trials, thereby increasing and spreading the rate of diffusion of the innovation. The respondent suggested that a workshop was a good way for vendors to begin a conversation on this topic with the public sectors.

7.4.2. Expanding network

According to the interviewees, the media is a very important way to spread the news of the diffusion of innovations. However, they also said that reputation and “word of mouth” were also very good mediums for the diffusion of an innovation. RFID educators should also consider these methods in order to extend the diffusion of RFID technology innovation in New Zealand. The interviewees also suggested that increasing the number of the members in the NZ RFID Pathfinder Group was one of the most efficient ways to expand the existing professional network. The more people included in the network the greater the chance that RFID technology will be considered. The NZ RFID Pathfinder Group has increased more than 70 members since the establishment.

7.4.3. Standardisation

All the interviewees agreed that, there are currently still many limitations for adopting RFID technology, such as costs. Standardisation is one of the most effective solutions for all of these problems. According to interviewee C, he said that “...the way to reduce the costs is standardisation, and competition drives the prices down as well...”

Standardisation means to standardise the current RFID applications, so that RFID applications can work on specifications for both scanners and the tags of individual

parts, kits, unit packs and assemblies. RFID applications will struggle in the future without standards.

Standardisation can cut costs, because firstly it can make RFID applications and tags more robust; and secondly, there will be more competitors for providing RFID products. Competition can drive prices down. The vendors will reduce the price to win the market, through reductions in labour costs, material costs and so on. Overall, standardisation can not be ignored RFID development in order to have more adopters in the future.

7.4.4. Investment and return

RFID technology has been used for decades; however, it was mainly used by the US military. In recent years, RFID has been developed for commercial use. Business relies on profit to survive. A successful business means to have better returns than the initial investment. Therefore, in order to increase the chance of adopting RFID applications, profit is the biggest factor that businesses will consider.

Interviewee A said that "...to implement RFID as infrastructure out the company is quite high, generally above the affordability of a medium enterprise..." Interviewee B also stated that "...RFID expensive at this stage, so it is easier for large company to adopt..." So far, a lot of businesses are holding back due to the expensive initial investment. However, interviewee C mentioned that "...in some cases, appointing a RFID type solution is more expensive initially in terms of investment than the bar coding solution...in other cases that is the other way around...RFID has actually been seen cheaper to implement than a bar coding solution..." Therefore, the business decision makers must understand the future benefits and figure amount of the profit as a percentage of initial investment in order to choose the suitable products for their supply chain management.

In conclusion, the interviews were able to corroborate and explore the survey findings. The main points that came out of the interviews were firstly, the need for realistic demonstrations; secondly, the importance of networking, particularly with a technology that clearly has an inter-organisational focus, the need for a clear investment return; and

finally, linked in with all of this, the need for standardisation which will in turn allow competition and market cost adjustment.

7.5. Summary

This chapter outlined the analysis process of the interview data. It described how the interview data were transformed into information to support the survey findings. The interview focused on five main areas, which were developed from the online survey questionnaire. Three interviewees commented on the five main areas in order to corroborate the survey findings. The following chapter will provide the conclusions for the thesis and the answers for the research questions.

Chapter Eight

8. Conclusion

This is the final chapter of the thesis. The chapter summarise all the findings and discussions from the survey and the interview to address the research propositions. It also provides insights of the thesis, limitations, and implications for both academia and industry.

The objective of this research was to find out the current status of RFID adoption in New Zealand. There were two research propositions formulated: the first “what is the perception of RFID technology within the New Zealand industry community?” The second proposition was “what role should national independent technology advocacy groups (e.g. the NZ RFID Pathfinder Group) play in promoting technology use?” The two propositions were broken down into four questions: the RFID technology is used for what kind of industries in New Zealand; intentions of utilizing RFID technology in the future; recommendations for the NZ RFID Pathfinder Group; and innovativeness of the respondents’ industry. The research was conducted in two main parts, an online survey, and follow-up interviews. The interview was conducted with three individual interviewees.

In summary, the survey results showed that New Zealand had three main groups regarding RFID adoption: industries that had adopted RFID already; industries that planned to adopt RFID; and industries that did not intend to adopt RFID. As stated in Chapter Six, 14% industries (seven out of 51) had already adopted RFID technology for their supply chain and 36% had plans (16 out of 44) to adopt RFID technology in the near future. However, there were still 64% industries (28 out of 44) that did not plan to adopt RFID at all. The main adopters were importers, research institutes, manufacturing, and distribution. As discussed in Section 6.6, the participants have been measured for innovativeness, 10% were innovators; 40% were early adopters; 30% were early majorities; and 20% were late majorities.

The survey results suggest that the challenges for industries adopting RFID technology are lack of RFID knowledge, expensive hardware and software, lack of technical support, lack of businesses case studies, and lack of RFID businesses environment. In the next couple of years, there are more industries intending to adopt RFID. Only few of

the industries rated themselves as RFID experts. There are only a small percentage of industries who are experienced with RFID technology. Most industries have concerns about the initial investment, which is high when compared with traditional identification methods such as bar codes. Bar code technology has been around for many years and has been used extensively both nationally and internationally to solve business tracking problems. Unless there is an overwhelming business case to upgrade to RFID, bar code systems are likely to prevail for some time yet.

Analysis of the interview data backs up the survey results on several fronts. Overall the interviewees felt that adoption was about how much the adopter could afford to invest and how much return the company could gain from RFID technology. The interviewees generally agreed with the limitations of RFID technology including the expense, however, their strong recommendation was to standardise each aspect of the technology, making the products available to clients and creating competition between RFID technology service suppliers, thus bringing down the cost through market forces. Another suggestion from the interviewees to try to encourage RFID adoption was to increase the number of members of the advocacy group. The interviewees also pointed out that one group of potential RFID adopters needing assistance in the near future will be local branches of international companies with a mandate to adopt RFID technology. Overall, the interview responses do corroborate the findings of the survey that New Zealand is in the early majority adoption phase according to the innovation curve.

The research shows that RFID technology in New Zealand is still new for most industries. New Zealand has more small businesses rather than bigger companies and they can not afford too much on switching their businesses tool, because whenever businesses switch their tools, it costs their investment dollars through relevant infrastructure costs, and switching cost. Businesses have to make investment for the hardware, software, tags, and also maintenance costs for the long run.

Overall, New Zealand is innovative in terms of information knowledge. However, it has less RFID related activities on, because there are not many industries that would like to make the investment to try the new technology. There are many issues involved. The most important issue is the cost of switching products. The size of investment is always the key point for businesses decision making. Therefore, most New Zealand industries are still at the watching and learning stage. According to the analysis of the interview

data as discussed in Section 7.4, the issue of the costs might not be a problem if businesses could understand the return on investment. It is more suitable for businesses that can use RFID technology to improve their supply chain management. If businesses could have proof of how much they could save by adopting RFID technology into their supply chain, they would be keener to implement.

The following section will specifically address the answers to the research questions that can be derived from this study.

8.1. Research propositions and answers

The first proposition was “what is the perception of RFID technology within the New Zealand industry community?” To answer this proposition, the survey asked questions about the RFID technology used for what kind of industries in New Zealand and the intentions of respondents of utilizing RFID technology in the future. The participants were from many different industry backgrounds, such as manufacturers, importer/exporter, logistics, and service provider.

There were only very few industries (14%) have adopted RFID technology, the industries were from importer, research institute, manufacturing, and distribution. For those industries have not adopted RFID so far, some of them (36%) planned to adopt RFID in a near future but most them intended to adopt RFID within the next two years. These industries were from packaging, adventure tourism, service provider, and 3PL/Logistics. The majority New Zealand industries did not have enough knowledge about RFID technology. The interview followed up by asking about the current status of RFID users in New Zealand and the limitations for future development of RFID technology and future trend of RFID adoption. The interviewees brought to the researchers attention that New Zealand based industries with a strong global link may be faced with a mandate to implement RFID technology in the future and therefore this may start to influence RFID adoption patterns in New Zealand in the near future. In summary, the answer to the first research proposition is that the New Zealand industries that have already adopted RFID are importer, research institute, manufacturing, and distribution. The industries that intend to adopt in the near future are packaging, adventure tourism, service provider, and 3PL/Logistics. It is likely the RFID

adoption patterns will be affected by New Zealand industries with a mandate to implement RFID from an international parent or cooperative company.

The second proposition was “what role should national independent technology advocacy groups (e.g. the NZ RFID Pathfinder Group) play in promoting technology use?” To answer this proposition the survey asked respondents about recommendations for the NZ RFID Pathfinder Group; and innovativeness of the respondents’ industry. The survey results showed that 24% responded that the NZ RFID Pathfinder Group should set direction of NZ RFID adoption; 21% of them suggested to get involved in national pilots; and the activities of lobbying governments and associations and information sharing were equally rated 17% that the NZ RFID Pathfinder Group should be doing. The participants also suggested the national independent technology advocacy groups to continually providing RFID classes, presentations, and seminars to attract new member and refresh the knowledge of the existing members. There were 10 responds out of total 51 participants for innovativeness measurement, the innovativeness of the respondents was: 10% innovators; 40% early adopters; 30% early majorities; and 20% late majorities. The interview followed up by asking interviewees what they would do to promote the use of RFID and what they thought the current state of innovativeness of New Zealand businesses was. The result of this was that the most common ways to distribute RFID awareness were at conferences, presentations, classes and demonstrations. The GS1, EPC global, and the NZ RFID Pathfinder Groups are the main information source. In order to promote the use of RFID, they should not only deploy those common ways nationally but also internationally. In addition, expanding RFID membership network could be another way to accelerate RFID adoption speed in New Zealand and successful business examples will give more motivations for the potential RFID adopters. The interviewees emphasised that the adoption rate of RFID is very low in New Zealand; it is about 10%. They observed that many businesses in New Zealand were interested in leading-edge technologies, but fewer businesses were actually adopting them. New Zealand is in the early majority adoption phased according to the innovation curve.

8.2. Limitations

There are several limitations of the study that must be acknowledged.

8.2.1. Sample size

Due to the leading edge technology content, only a small proportion of industry representatives were qualified to answer questions related to the adoption of RFID technology. Therefore, conclusions from the data analysis must be made cautiously. The conclusions from this study will need further testing before findings can be stated with confidence. However, the contribution of this thesis is to address the research questions which can be corroborated by future work.

8.2.2. Limited national expertise

There are only small number of New Zealand based professional and academics qualified to comment on RFID technology development. Therefore, future studies might investigate the state of RFID adoption in similar countries to corroborate the findings of this study.

8.2.3. Time limit

This research thesis was one year long and as such was just very small portion of the RFID development path. It can only capture a “snapshot” of New Zealand RFID adoption. In order to monitor the process of RFID technology improvement in New Zealand, future research is required to update the results. In the future research, businesses not adopting RFID technology will be the focus group for further investigation. Therefore, future updates to this study are important and researchers may take a longitudinal approach to this research problem in the future.

8.3. Implications for academia

The result from both online survey and interviews show that the innovation theory logically assisted the researcher to explore the research proposition in this thesis. Moore’s theory played a role in the analysis.

8.4. Implications for industry

The RFID advocacy group can take several pointers in growing their membership. They know from this survey that the majority of adopters in New Zealand are from the importer, research institute, manufacturing, and distribution industries. They also know that the packaging, adventure tourism, service provider, and 3PL/Logistics industries will likely be the next group of adopters. They should also take into account any international RFID mandates that might impact on New Zealand based subsidiaries or collaborators of the project.

8.5. Future research

It is suggested that future studies might like to focus on two important aspects of research. Firstly, due to the focus on New Zealand industry level RFID diffusion of innovation, this study has a small data set for the innovativeness measure. Even so, preliminary analysis shows that this may be an interesting avenue of investigation to test with a much larger sample size. Secondly, this study has used the industry as the unit of analysis. Due to the potential of RFID to be used across supply chains and between groups of large organisations, it may be interesting to do a similar type of study using the industry as the unit of analysis in a global context where there will be a larger number of responses.

8.6. Summary

This chapter summarised all the findings, the results and the answers to the research propositions. It also outlined limitations of this research and implications for both academia and industry. It described how the survey results and interview results corroborated to provide the insights of this research. The limitations gave more focuses for future RFID research. The implications indicated the significance in academia and industry. This is the final chapter of this thesis.

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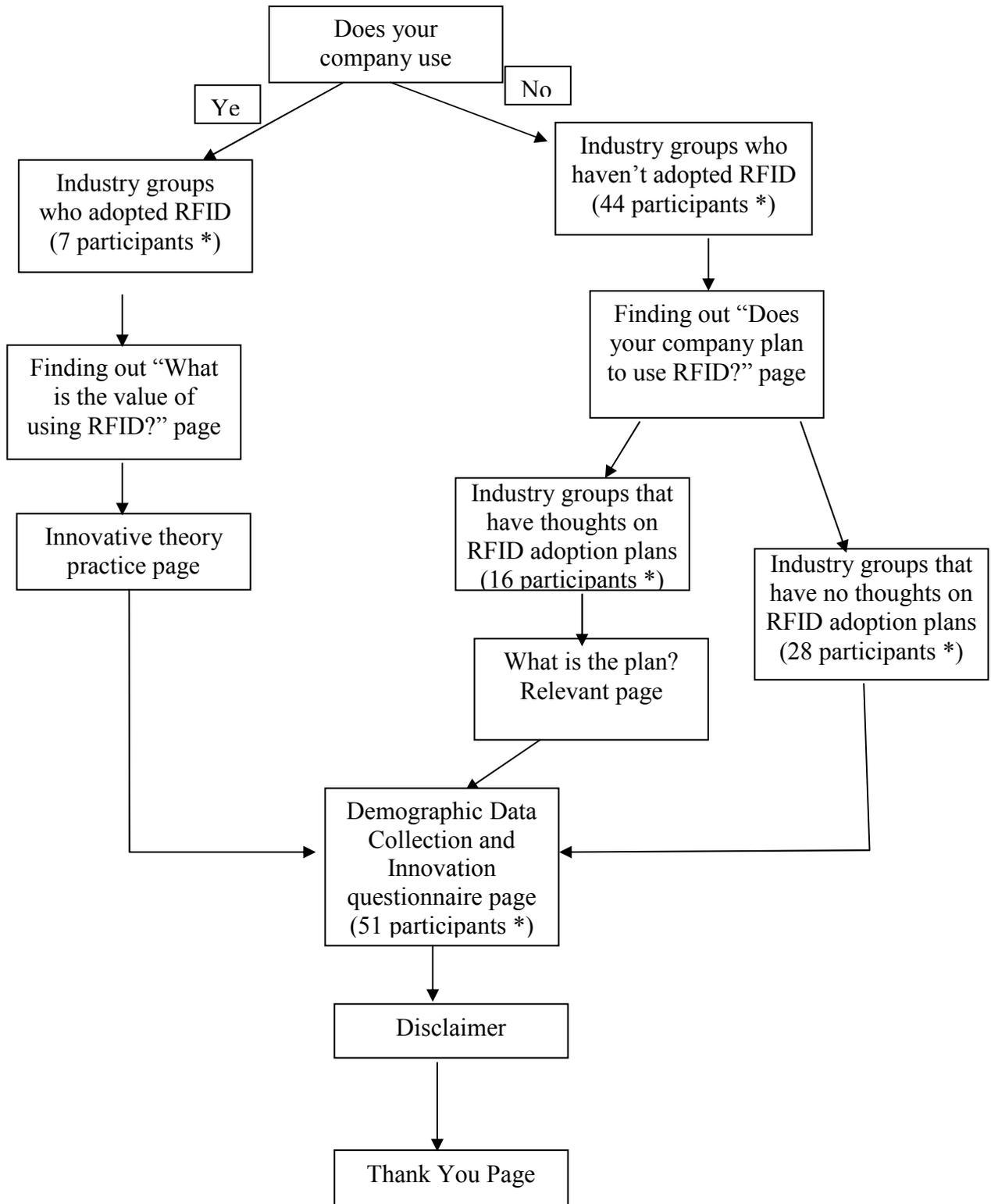
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Appendix

Appendix A Survey logic diagram



*The number of participants demonstrates the accessibility for the participants; however, the number of responses might not be the same as the participants' number due to the questions are not all compulsory.

Appendix B Innovativeness data codes

| Question | Answer | Code |
|--|--------------------------|------|
| Has your company got many competitors? | No | 5 |
| | A few | 4 |
| | Some | 3 |
| | A lot | 2 |
| | Quite a lot | 1 |
| Is your company quite often rated among top companies in the industry? | always, Regular | 5 |
| | Often | 4 |
| | Sometimes | 3 |
| | Seldom | 2 |
| | Never | 1 |
| What will be the main driver for this RFID deployment? | Leading-edge | 5 |
| | Successful business case | 4 |
| | Trading partner mandate | 3 |
| | Global rollout | 2 |
| | None | 1 |
| Is your company always highly regarding or taking on new technologies or new ideas? | Always, Regularly | 5 |
| | Often | 4 |
| | Sometimes | 3 |
| | Seldom | 2 |
| | Never | 1 |
| What is the attitude of the other similar companies in the industry towards to your company? | Role model | 5 |
| | Respect | 4 |
| | Admit | 3 |
| | Not sure | 2 |
| | None | 1 |
| How often do you interact with the other companies? | Always, Regularly | 5 |
| | Often | 4 |
| | Sometimes | 3 |
| | Seldom | 2 |
| | Never | 1 |

The Current Status of RFID Technology Adoption In New Zealand

| Does your company/organisation use RFID technology? | Has your company got many competitors? | Is your company quite often rated among top companies in the industry? | What will be the main driver for this RFID deployment? | Is your company always highly regarding or taking on new technologies or new ideas? | What is the attitude of the other similar companies in the industry towards to your company? | How often do you interact with the other companies? | Score | Mean (Score /6) |
|---|--|--|--|---|--|---|-------|-----------------|
| Yes | a few 4 | regularly 5 | Business case 4 | regular 5 | Role model 5 | sometimes 3 | 26 | 4.3 |
| Yes | some 3 | sometimes 3 | NZ legislation 3 | often 4 | Not sure 2 | sometimes 3 | 18 | 3 |
| Yes | a lot 2 | often 4 | Cattle tagging 2 | often 4 | Respect 4 | sometimes 3 | 19 | 3.2 |
| Yes | a few 4 | sometimes 3 | Business case 4 | often 4 | Not sure 2 | sometimes 3 | 20 | 3.3 |
| Yes | a lot 2 | regularly 5 | Business case 4 | regular 5 | Respect 4 | often 4 | 24 | 4 |
| No | a few 4 | sometimes 3 | | sometimes 3 | Admit 3 | seldom 2 | 15 | 2.5 |
| No | a few 4 | seldom 2 | | sometimes 3 | Not sure 2 | never 1 | 12 | 2 |
| No | none 5 | never 1 | | sometimes 3 | None 1 | seldom 2 | 12 | 2 |
| No | a few 4 | often 4 | | often 4 | Role Model 5 | often 4 | 21 | 3.5 |
| No | a lot 2 | never 1 | | sometimes 3 | Admit 3 | often 4 | 13 | 2.2 |
| | | | | | | | | |
| | Scale | Frequency | | | | | | |
| | Innovator | 4.1-5 | 1 (10%) | | | | | |
| | Early adopter | 3.1-4 | 4 (40%) | | | | | |
| | Early majority | 2.1-3 | 3 (30%) | | | | | |
| | Late majority | 1.1-2 | 2 (20%) | | | | | |
| | laggard | 0-1 | 0 | | | | | |
| | No responses | | 41 | | | | | |
| | | | 51 | | | | | |

Appendix C Questionnaire

- 1. Does your company/organisation use RFID technology??(Select one)**
 - Yes
 - No

- 2. Which business partners have you had discussions with regarding the use of RFID??(Select as many as you apply to your situation)**
 - Customers
 - Suppliers
 - 3rd party logistics (warehousing and distribution)
 - IT infrastructure (hardware and software)
 - None
 - Don't know
 - Other (Please Specify):

- 3. Has an active RFID champion been appointed? (Select one option)**
 - Yes
 - No
 - Don't know

- 4. What do you think the most important activities of the NZ RFID Pathfinder Group should promote??(Select as many as apply)**
 - Set direction for NZ adoption
 - Get involved in national pilots
 - Lobby governments and associations
 - Information sharing
 - Webinars
 - Interactive website
 - Seminars
 - Conferences
 - Field trips
 - Networking functions
 - Other (Please Specify):

- 5. What are the future plans for information technology within the company?**

- 6. What involvement could your organisation have within the NZ RFID Pathfinder Group??(Select one please)**
 - Member
 - Committee member
 - Co-option because of expertise

- 7. Is their background from:**
 - Senior management
 - Business development
 - Supply chain
 - IT
 - Others

8. Does your business intend to use / deploy RFID in its operation / supply chain?

- Yes
- No

9. What do you see is a realistic timeframe for your organisation to deploy RFID in a production / logistics environment?

- < 1 year
- 1 - 2 yrs
- 2 - 4 yrs
- > 4 yrs

**10. Company Name
Position Title**

11. Age:

- 18-25
- 25-30
- 30-40
- 40-50
- >50

12. Years with the company

13. Years in the position

- 1-3
- 3-5
- 5-10
- 10-15
- >15

14. What would you rate your company's knowledge of RFID?

- None
- Minor
- Professional
- Expert

15. What would you like to see in the way of RFID education and training??(Select as many as apply)

- Introductory / awareness**
- Advanced certificate courses
- Business case / ROI development
- RFID technology
- Standards
- Other (Please Specify):

16. What is your industries primary role in the supply chain??(Select one please)

- Retailer / buyer**
- Distribution
- Packaging
- 3PL / logistics

Service provider
Manufacturer
Importer
Government (policy) / academic institution / association
Other (please specify):

17. How many full-time equivalent employees are in your company?

<100
100-300
300-500
>500

18. Which year was the company established?

Pre-1970
1970-1980
1980-1990
1990-2000
2000-recent

19. What challenges do you believe may impede your organisation in implementing an RFID application??(Select as many as you apply to your situation)

Cost of infrastructure - hardware
Cost of infrastructure - software
Cost of tags
Reliability of tags and readers
No executive ownership
Proving the business case / ROI
Raising awareness of RFID
System integration
RFID standards
Radio frequency regulations
Privacy consumer groups / issues
Required RFID skills
Participating vs. deployment
Executive ownership vs. senior executive sponsorship
Process change required
Relative priority vs. other business initiatives
Other (Please Specify):

20. Are you aware of the NZ RFID Pathfinder Group??(Select one please)

yes: I am a member
yes: I am not a member
no: I am not interested in the membership
no: I am interested in the membership

21. Have you been involved in any RFID projects??(select one please)

yes: overseas
yes: locally
yes: overseas and locally
Never

- 22. If you are interested in receiving a summary report of the findings, please leave your Email address in the text box below.**

Innovation Questions

- 23. Has your company got many competitors??(Select one please)**

none
a few
some
a lot
quite a lot

- 24. Is your company quite often rated among top companies in the industry??(Select one please)**

never
seldom
sometimes
often
regularly
always

- 25. What will be the main driver for this RFID deployment??(Select one)**

Business case
Trading partner mandate
Global rollout
Other (Please Specify):

- 26. Is your company always highly regarding or taking on new technologies or new ideas??(Select one please)**

never
seldom
sometimes
often
regular
always

- 27. What is the attitude of the other similar companies in the industry towards to your company?**

- 28. How often do you interact with the other companies??(Select one please)**

never
seldom
sometimes
often
regularly
always

Appendix D Interview protocol

Interview Protocol

Q1 Current status of RFID users in New Zealand

1. Tell me a little bit about your role in your company and your understanding of the current status of RFID?
2. Tell me a little bit about your role in the New Zealand RFID Pathfinder Group?
3. What kind of organisation is more suitable to use RFID technology?
4. Is there a certain type of industry only to adopt RFID so far?
5. What size of company would you recommend to adopt RFID? What type?

Q2 Limitations for future development of RFID technology

6. How much more would cost a company if they use RFID to replace the current identification system?
7. What do you have to distribute RFID awareness to businesses in New Zealand?
8. Is there a new way to reduce the costs of hardware and software?

Q3 Promote the use of RFID

9. What is the feedback from your members?
10. Do you hold conference or presentation regularly? Who are the main participants?
11. How many people attend when you have a RFID conference or presentation?

Q4 Future trend of RFID adoption

12. When do you predict the early majority RFID adopters will come?
13. What preparation has the NZ RFID Pathfinder Group done for the early majorities?
14. Are you members requiring technical support quite often after they purchased RFID application?
15. How do you think to keep New Zealand RFID technology development progress competitive compare with the rest of the world?

Q5 Innovativeness of New Zealand businesses

16. How much does the number of RFID adopter increase annually?
17. How many RFID adopters do you think we have in New Zealand?
18. How close you think RFID development process compare with Australia? What about the rest of the world?
19. How many businesses are interested in RFID?
20. What would you rate New Zealand businesses innovativeness?

Appendix E SPSS coding database (survey data)

| | Name | Type | Width | Decimal | Label | Values | Missing | Columns | Align | Measur |
|----|------|--------|-------|---------|-----------------------------|--------|---------|---------|-------|---------|
| 1 | q1 | String | 25 | 0 | Use RFID | None | None | 8 | Left | Nominal |
| 2 | q2a | String | 25 | 0 | Challenge - Hardware | None | None | 22 | Left | Nominal |
| 3 | q2b | String | 25 | 0 | Challenge - Software | None | None | 8 | Left | Nominal |
| 4 | q2c | String | 25 | 0 | Challenge - tags | None | None | 9 | Left | Nominal |
| 5 | q2d | String | 25 | 0 | Challenge - reliability | None | None | 7 | Left | Nominal |
| 6 | q2e | String | 25 | 0 | Challenge - ownership | None | None | 8 | Left | Nominal |
| 7 | q2f | String | 25 | 0 | Challenge - ROI | None | None | 8 | Left | Nominal |
| 8 | q2g | String | 25 | 0 | Challenge - awareness | None | None | 8 | Left | Nominal |
| 9 | q2h | String | 25 | 0 | Challenge - integration | None | None | 8 | Left | Nominal |
| 10 | q2i | String | 25 | 0 | Challenge - standards | None | None | 8 | Left | Nominal |
| 11 | q2j | String | 25 | 0 | Challenge - regulations | None | None | 8 | Left | Nominal |
| 12 | q2k | String | 25 | 0 | Challenge - privacy | None | None | 8 | Left | Nominal |
| 13 | q2l | String | 25 | 0 | Challenge - skills | None | None | 8 | Left | Nominal |
| 14 | q2m | String | 25 | 0 | Challenge - deployment | None | None | 8 | Left | Nominal |
| 15 | q2n | String | 25 | 0 | Challenge - sponsorship | None | None | 8 | Left | Nominal |
| 16 | q2o | String | 25 | 0 | Challenge - change required | None | None | 8 | Left | Nominal |
| 17 | q2p | String | 25 | 0 | Challenge - priority | None | None | 8 | Left | Nominal |
| 18 | q2q | String | 25 | 0 | Challenge - other | None | None | 8 | Left | Nominal |
| 19 | q3a | String | 25 | 0 | Discussion - Customers | None | None | 8 | Left | Nominal |
| 20 | q3b | String | 25 | 0 | Discussion - Suppliers | None | None | 8 | Left | Nominal |
| 21 | q3c | String | 25 | 0 | Discussion - 3rd Party | None | None | 8 | Left | Nominal |
| 22 | q3d | String | 25 | 0 | Discussion - Infrastructure | None | None | 8 | Left | Nominal |
| 23 | q3e | String | 25 | 0 | Discussion - None | None | None | 8 | Left | Nominal |
| 24 | q3f | String | 25 | 0 | Discussion - Don't know | None | None | 8 | Left | Nominal |
| 25 | q3g | String | 25 | 0 | Discussion - Other | None | None | 8 | Left | Nominal |
| 26 | q4 | String | 25 | 0 | Champion Appointed | None | None | 8 | Left | Nominal |
| 27 | q5a | String | 25 | 0 | Promote - Direction | None | None | 8 | Left | Nominal |
| 28 | q5b | String | 25 | 0 | Promote - Pilots | None | None | 8 | Left | Nominal |
| 29 | q5c | String | 25 | 0 | Promote - Lobby | None | None | 16 | Left | Nominal |
| 30 | q5d | String | 25 | 0 | Promote - Info | None | None | 8 | Left | Nominal |
| 31 | q5e | String | 25 | 0 | Promote - Webinars | None | None | 8 | Left | Nominal |
| 32 | q5f | String | 25 | 0 | Promote - Website | None | None | 8 | Left | Nominal |
| 33 | q5g | String | 25 | 0 | Promote - Seminars | None | None | 8 | Left | Nominal |
| 34 | q5h | String | 25 | 0 | Promote - Conference | None | None | 8 | Left | Nominal |
| 35 | q5i | String | 25 | 0 | Promote - Field trip | None | None | 8 | Left | Nominal |
| 36 | q5j | String | 25 | 0 | Promote - Networking | None | None | 8 | Left | Nominal |
| 37 | q5k | String | 25 | 0 | Promote - Other | None | None | 8 | Left | Nominal |
| 38 | q6a | String | 25 | 0 | Train - Intro | None | None | 23 | Left | Nominal |
| 39 | q6b | String | 25 | 0 | Train - Cert | None | None | 8 | Left | Nominal |
| 40 | q6c | String | 25 | 0 | Train - Bus Case | None | None | 8 | Left | Nominal |
| 41 | q6d | String | 25 | 0 | Train - RFID | None | None | 8 | Left | Nominal |

| | Name | Type | Width | Decimals | Label | Values | Missing | Columns | Align | Measure |
|----|----------|--------|-------|----------|---|---|---------|---------|-------|---------|
| 42 | q6e | String | 25 | 0 | Train - standards | None | None | 8 | Left | Nominal |
| 43 | q6f | String | 25 | 0 | Train - other | None | None | 8 | Left | Nominal |
| 44 | q7 | String | 25 | 0 | Driver to deploy | None | None | 8 | Left | Nominal |
| 45 | q8 | String | 25 | 0 | Involvement | None | None | 8 | Left | Nominal |
| 46 | q9 | String | 25 | 0 | time frame for adoption | None | None | 8 | Left | Nominal |
| 47 | q10 | String | 25 | 0 | Intend to deploy | None | None | 8 | Left | Nominal |
| 48 | q11 | String | 25 | 0 | Knowledge rated | None | None | 8 | Left | Nominal |
| 49 | q12 | String | 25 | 0 | Timeframe | None | None | 8 | Left | Nominal |
| 50 | q13a | String | 25 | 0 | Company Name | None | None | 28 | Left | Nominal |
| 51 | q14 | String | 25 | 0 | age | None | None | 8 | Left | Nominal |
| 52 | q15 | String | 25 | 0 | Years with company | None | None | 8 | Left | Nominal |
| 53 | q16 | String | 25 | 0 | Years in position | None | None | 8 | Left | Nominal |
| 54 | q17 | String | 25 | 0 | SCM Role | None | None | 28 | Left | Nominal |
| 55 | q18 | String | 25 | 0 | Num Employees | None | None | 48 | Left | Nominal |
| 56 | q19 | String | 25 | 0 | Established | None | None | 8 | Left | Nominal |
| 57 | q20 | String | 25 | 0 | Aware of Pathfinder | None | None | 8 | Left | Nominal |
| 58 | q21 | String | 25 | 0 | Involved in Projects | None | None | 8 | Left | Nominal |
| 59 | q22 | String | 25 | 0 | Summary Report | None | None | 8 | Left | Nominal |
| 60 | q23 | String | 25 | 0 | Competitors | None | None | 22 | Left | Nominal |
| 61 | q24 | String | 25 | 0 | Rated | None | None | 22 | Left | Nominal |
| 62 | q25 | String | 25 | 0 | Interact | None | None | 8 | Left | Nominal |
| 63 | q26 | String | 25 | 0 | Future Plans | None | None | 8 | Left | Nominal |
| 64 | q27 | String | 25 | 0 | Regard | None | None | 8 | Left | Nominal |
| 65 | q28 | String | 25 | 0 | New Idea | None | None | 8 | Left | Nominal |
| 66 | userid | Num | 8 | 0 | Use RFID | {0, No}... | 8 | 8 | Right | Nominal |
| 67 | challeng | Num | 8 | 0 | Challenge Hardware | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 68 | challe_a | Num | 8 | 0 | Challenge Software | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 69 | challe_b | Num | 8 | 0 | Cost of Tags | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 70 | challe_c | Num | 8 | 0 | Reliability of Tags and Readers | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 71 | challe_d | Num | 8 | 0 | No executive ownership | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 72 | challe_e | Num | 8 | 0 | Proving the business case/ROI | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 73 | challe_f | Num | 8 | 0 | Raising the Awareness of RFID | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 74 | challe_g | Num | 8 | 0 | System Integration | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 75 | challe_h | Num | 8 | 0 | RFID Standards | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 76 | challe_i | Num | 8 | 0 | Radio frequency regulations | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 77 | challe_j | Num | 8 | 0 | Privacy Consumer Groups/Issues | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 78 | challe_k | Num | 8 | 0 | Required RFID Skills | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 79 | challe_l | Num | 8 | 0 | Participating vs Deployment | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 80 | challe_m | Num | 8 | 0 | Executive Ownership vs Senior Executive Sponsorship | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 81 | challe_n | Num | 8 | 0 | Process Change Required | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 82 | challe_o | Num | 8 | 0 | Relative priority vs other business initiatives | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |

| | Name | Type | Width | Decimals | Label | Values | Missing | Columns | Align | Measure |
|-----|------------|--------|-------|----------|--|---|---------|---------|-------|---------|
| 83 | challe_p | Nume | 8 | 0 | Other - Cattle Tagging | {1, Cost of infrastructure - hardware}... | 8 | 8 | Right | Nominal |
| 84 | discussi | Nume | 8 | 0 | Customers | {1, Customers}... | 8 | 8 | Right | Nominal |
| 85 | discus_a | Nume | 8 | 0 | Suppliers | {1, Suppliers}... | 8 | 8 | Right | Nominal |
| 86 | discus_b | Nume | 8 | 0 | 3rd Party Logistics(Warehousing & Distribution) | {1, 3rd Party Logistics (Warehousing & | 8 | 8 | Right | Nominal |
| 87 | discus_c | Nume | 8 | 0 | IT Infrastructure | {1, IT Infrastructure}... | 8 | 8 | Right | Nominal |
| 88 | discus_d | Nume | 8 | 0 | None | {1, None}... | 8 | 8 | Right | Nominal |
| 89 | discus_e | Nume | 8 | 0 | Don't Know | {1, Don't Know}... | 8 | 8 | Right | Nominal |
| 90 | discus_f | Nume | 8 | 0 | NAIT | {1, NAIT}... | 8 | 8 | Right | Nominal |
| 91 | champion | Nume | 8 | 0 | Champion Appointed | {0, No}... | 8 | 8 | Right | Nominal |
| 92 | promoted | Nume | 8 | 0 | Set direction for NZ adoption | {1, Set direction for NZ adoption}... | 8 | 8 | Right | Nominal |
| 93 | promotep | Nume | 8 | 0 | Get involved in national pilots | {1, Get involved in national pilots}... | 8 | 8 | Right | Nominal |
| 94 | promotel | Nume | 8 | 0 | Lobby Governments and Associations | {1, Lobby Governments and Association | 8 | 8 | Right | Nominal |
| 95 | promotei | Nume | 8 | 0 | Information sharing | {1, Information sharing}... | 8 | 8 | Right | Nominal |
| 96 | promotew | Nume | 8 | 0 | Webinars | {1, Webinars}... | 8 | 8 | Right | Nominal |
| 97 | promot_a | Nume | 8 | 0 | Interactive Web | {1, Interactive Web}... | 8 | 8 | Right | Nominal |
| 98 | promotes | Nume | 8 | 0 | Seminars | {1, Seminars}... | 8 | 8 | Right | Nominal |
| 99 | promotec | Nume | 8 | 0 | Conferences | {1, Conferences}... | 8 | 8 | Right | Nominal |
| 100 | promotef | Nume | 8 | 0 | Field Trips | {1, Field Trips}... | 8 | 8 | Right | Nominal |
| 101 | promoten | Nume | 8 | 0 | Networking functions | {1, Networking functions}... | 8 | 8 | Right | Nominal |
| 102 | promoteo | Nume | 8 | 0 | Other | {1, Other}... | 8 | 8 | Right | Nominal |
| 103 | trainint | Nume | 8 | 0 | Introductory / awareness | {1, Introductory / awareness}... | 8 | 8 | Right | Nominal |
| 104 | trainer | Nume | 8 | 0 | Advanced Certificate Courses | {1, Advanced Certificate Courses}... | 8 | 8 | Right | Nominal |
| 105 | trainroi | Nume | 8 | 0 | Business case / ROI development | {1, Business case / ROI development}... | 8 | 8 | Right | Nominal |
| 106 | trainrfi | Nume | 8 | 0 | RFID Technology | {1, RFID Technology}... | 8 | 8 | Right | Nominal |
| 107 | trainsta | Nume | 8 | 0 | Standards | {1, Standards}... | 8 | 8 | Right | Nominal |
| 108 | trainoth | Nume | 8 | 0 | Other | {1, Other}... | 8 | 8 | Right | Nominal |
| 109 | drivedep | Nume | 8 | 0 | Driver to Deploy | {1, Business case}... | 8 | 8 | Right | Nominal |
| 110 | involvem | Nume | 8 | 0 | Involvement | {1, Member}... | 8 | 8 | Right | Nominal |
| 111 | intendde | Nume | 8 | 0 | Intend to deploy | {0, No}... | 8 | 8 | Right | Nominal |
| 112 | knowledg | Nume | 8 | 0 | Company's Knowledge of RFID | {1, None}... | 8 | 8 | Right | Nominal |
| 113 | timefram | Nume | 8 | 0 | Timeframe | {1, < 1 year}... | 8 | 8 | Right | Nominal |
| 114 | jobtitle | Nume | 8 | 0 | Respondent Job Title | {1, Logistics Analyst}... | 20 | 8 | Right | Nominal |
| 115 | q13b | String | 25 | 0 | Title | None | None | 24 | Left | Nominal |
| 116 | age | Nume | 8 | 0 | Respondent Age | {1, 18-25}... | 8 | 8 | Right | Nominal |
| 117 | indutype | Nume | 8 | 0 | TypeOfIndustries | {1, 3PL / logistics}... | 8 | 8 | Right | Nominal |
| 118 | noempee | Nume | 8 | 0 | NumberOfEmployees | {1, 100-300}... | 8 | 8 | Right | Nominal |
| 119 | establis | Nume | 8 | 0 | EstablishTime | {1, pre-1970}... | 8 | 8 | Right | Nominal |
| 120 | membership | Nume | 8 | 0 | AreYouAMember? | {1, yes: I am not a member}... | 8 | 8 | Right | Nominal |
| 121 | experins | Nume | 8 | 0 | ExperincesWithRFID | {1, never}... | 8 | 8 | Right | Nominal |
| 122 | competor | Nume | 8 | 0 | NumberOfCompetitorsForYourCompany | {1, none}... | 88 | 8 | Right | Scale |
| 123 | rating | Nume | 8 | 0 | HowOftenYourCompanyBeenRatedAsTopCompany | {1, never}... | 88 | 8 | Right | Scale |
| 124 | interact | Nume | 8 | 0 | HowOftenDoesYourCompanyInteractWithTheOtherCompany | {1, never}... | 88 | 8 | Right | Scale |
| 125 | futplan | Nume | 8 | 0 | What are the future plans for information technology within the company? | {1, Product Identification}... | 88 | 8 | Right | Scale |
| 126 | newtech | Nume | 8 | 0 | Is your company always highly regarding or taking on new technologies or new ideas | {1, Sometimes}... | 88 | 8 | Right | Scale |

Appendix F Summary of interview data analysis

| Interview Components | Responses | | |
|---|--|--|---|
| Q1 Current status of RFID users in New Zealand | Interviewee A data analysis | Interviewee B data analysis | Interviewee C data analysis |
| <ul style="list-style-type: none"> ➤ understanding of the current status of RFID ➤ Kind of organisation is more suitable to use RFID technology ➤ Type of industry only to adopt RFID ➤ Size of company would you recommend to adopt RFID? What type? | <p>“New Zealand is the innovation and early adopter phase of RFID, it hasn’t yet moved to mass levels adoption”</p> <p>“Some of them have higher level of adoptions while the others have a lower level of adoptions”</p> <p>“The technology is horizontal technology, cuts cross every market sector”</p> <p>“...Yes, it does matter at this stage, because it is not mature technology, so the capital outline are required to implement RFID as infrastructure out the company is quite high, generally above the affordability of a medium enterprise. That is changing.... Most companies adopting are looking for competitive age, and prepare to invest on</p> | <p>“...it is actually improving a lot recently...”</p> <p>“...Any organisation interested in RFID and count RFID into their supply chain...”</p> <p>“...Manufactory, retail, all kind of industry. Service industry. Hospitality. Count things. Wider than bar code, almost all the industry use bar code...”</p> <p>“...RFID expensive at this stage, so it is easier for large company to adopt...”</p> | <p>“...New Zealand still continuing to keen on watch and learn approach to RFID...amount of activity in New Zealand by organisations around implementing RFID is very minor...It is really a watching and learning approach. ...I think disappointingly, from my speaking New Zealand is a little bit behind...”</p> <p>“...we current engaging with company looking at RFID fresh fruit produce, live stock, tracking and return the assets within a utility environment, we talking with organisation wants to track baggage for the travelling public, so really I think it is broad down to it. RFID has not suited to any one industry at all...”</p> <p>“...In New Zealand, I always thought the early adopters would be the main state of our economy which is primary project, live stock, meat, chess, fruit and vegetables...I call actionable visibility, that is having complete understanding the product, be able to monitor that, and then using that information to make robust decision.</p> <p>“...I don’t think in this particular case the size is matter actually...we engage with large government department, also organisation small one or two men organisation...”</p> |

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| | that. So you find generally the case small companies are attempting to follow, because they haven't got the pocket..." | | |
| Q2 Limitations for future development of RFID technology | | | |
| <ul style="list-style-type: none"> ➤ Cost to a company if they use RFID to replace the current identification system ➤ Distribute RFID awareness to businesses in New Zealand ➤ New way to reduce the costs of hardware and software | <p>"RFID opens up opportunity for driving new efficiency and new business processes. To identify these business processes within a company that is critical for success. ...company just simply wants to swap with the bar code; the pay back becomes very critical one often around tag pricing. Where the company that are adopting RFID would they can perform some new business processes..."</p> <p>"Pathfinder organisation is the form of the industry initiative to raise the level of the awareness in New Zealand. There are a number of RFID vendors. A number of international activity conferences are generally raising the noise of the awareness level. Specifically, in New Zealand been one or two case studies happened last few years reasonably large size companies, such as Fonterra, and the warehouse tried the technology a few years ago. And word on mouth essentially. So the media has bit of affect on that..."</p> <p>"When you do a case of adopt RFID, you have to look at the cost and benefit. There are number of businesses, yes there are the cost of tags, it occurs tags, there is non recoverable engineering charges, which is the business process engineering, then it is the infrastructure cost. If you only look at the cost, you never make up payback occasion. So what you have to look at on other side of the benefit, the most them measured increase assets, reduce other stock, improve the feasibility on capital</p> | <p>"...twice expensive than what they expected..."</p> <p>"...Through networking who interested in RFID, website, committee itself. Pathfinder conference, overseas conference..."</p> <p>"...it is coming down, development RFID hardware in overseas will reduce labours and the other costs..."</p> | <p>"...Some situation, costs and bar code, In some cases, appointing a RFID type solution is more expensive initially in terms of investment than would the bar coding solution be, in another cases that is the other way around. RFID have actually been seen cheaper to implement than a bar coding solution..."</p> <p>"...GS1, EPC global mandate...our main charter is to educate the market on the standard automatic identification the product for supply chain, whether it would be bar code, and RFID. We hold seminar, a lot of courses, annual conference, obviously we have website setup with a lot of information. We can lead the horse to the water, but you can't make it drink. RFID master classes, one day seminar, RFID principle and technology, that is continue..."</p> <p>"...The way to reduce the costs is standardisation...competition drives the prices down..."</p> |

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| | assets, reduce labour costs, reduce time taking from some business processes... Improve sales, reduce risk, traceability, do the calculation..." | | |
| Q3 Promote the use of RFID | | | |
| ➤ Feedback from your members | "...more members joining..." | "...many members are doing voluntary work for developing RFID awareness in New Zealand...they are looking forward the growing of RFID in New Zealand..." | "...every member is very passionate about RFID and its future...there is always new member interested to join..." |
| ➤ Conference or presentation regularly? The main participants | "Every year conference, RFID conferences, every two conferences in Australia...30 conferences worldwide... so one or 2 every month world wide" | "...one of the kinds every two or three months..." | "...Industry sectors, people from primary sector, people from transport organisation, we have vendors, solution providers, and company involved all sectors in the supply chain..." |
| ➤ How many people attend when you have a RFID conference or presentation? | "...Normally 70 to 120, sometimes 100 to 250..." | "...used to be about 50, now probably around 100..." | "...majority of existing members and some new members, over all about 70 members every time averagely..." |
| Q4 Future trend of RFID adoption | | | |
| ➤ Prediction of the early majority RFID adopters | "...the mainstream within two years...New Zealand is about one or two years behind from the other countries..." | "...2009, 2010, one or two years..." | "...There is never going to be a boom year for RFID adoption anywhere in the world, suddenly everyone on it. So it is just going to broad down to return on the investment to be identified with business then they will move..." |
| ➤ Preparation has the NZ RFID Pathfinder Group done for the early majorities | "...consumers have to increase, the standards the level of tractability, this is well on the track... Competitive offering, expertise. The most important, helping the companies need to understand return on the investment, and payback period, or application in the industry..." | "...A lot more members. A lot thing they haven't done yet by Pathfinder. Pathfinder is only one year old, very young..." | "...Changing of the mind set... This technology is distractive, it challenge current business processes, and challenge people to think about their businesses differently. It requires them to invest time and money and it is not easy. So with all of the complications..." |
| ➤ Technical support | "...offering technical consultancy..." | "...we provide advice rather than support; we are educator kind of | "...RFID been around for a long time, technology is about 50, 60 years |

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| <p>➤ Keep New Zealand RFID technology competitive</p> | <p>“...In the early stage, a lot about education, and communication. In terms of innovation, most people looking at New Zealand at externally...follow the research...”</p> | <p>organisation...”</p> <p>“...Demonstrate, helping businesses understand visual example. Labs, more realistic RFID application. People interact with it. Gathering intelligent data to do better business...”</p> | <p>old...Using some thing at different way that been there for long. We could give industries suggestions for technical support...”</p> <p>“... the company and organisation in NZ is going to be required via retailer mandate to RFID to able their product...identifying what tag with what readers, what readers works with what tags, what standards are, and all of that sorts things...I think NZ runs the risk of been told to RFID in labelling supply chain for retailer mandate rather than working out...”</p> |
| <p>Q5 Innovativeness of New Zealand businesses</p> | | | |
| <p>➤ Increase the number of RFID adopter</p> <p>➤ Number of RFID adopters in New Zealand</p> <p>➤ RFID development process compare with Australia</p> <p>➤ Businesses are interested in RFID</p> | <p>“...in terms of business processes organisation, it is very low, probably less than 10%...”</p> <p>“...I couldn’t tell you, many companies using RFID without known. Quite a lot people using RFID on daily basis, but they just don’t know they are using it...”</p> <p>“...About the same, maybe Australia slightly advance...Australia has more advantage...”</p> <p>“...The interests level remain high 7-15 percent, but actual commitment into invest remain relatively low probably close to 5%...change quite rapidly, probably double in last twelve months...”</p> | <p>“...certainly increase, but can’t tell the figure...”</p> <p>“...More adopters, more than 13 percent, around 20 percent....”</p> <p>“...Collaborative link, learning from Australia. Australia is ahead NZ, large companies, economic. New Zealand is about 2 years behind Australia. Way behind US, ahead the other developer country. Japan very innovative...”</p> <p>“...A lot people interested, small people passionate about it...Less action...”</p> | <p>“...We haven’t been responsible for any NZ business adopted RFID. Our influence is to educate provide guide and consult for company seriously to do it. We provide 3, 4 the company with cases studies...”</p> <p>“...it is about 10%, maybe slightly more than that...”</p> <p>“...I think Pretty much the same...”</p> <p>“...Increasing more so, the number of engagement, certainly increase last six months, some of the company showing us what they are doing with RFID. Revolution identity. So about 70 to 80 people. Creating networking</p> |

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| <p>➤ Rating of New Zealand businesses innovativeness</p> | <p>“...Poor, more research have been in Australia...Poor, because there many companies in New Zealand haven’t got the desperate to research, fundamental research. New Zealand is more like a follower rather than an innovator...”</p> | <p>“...NZ is one of most innovativeness countries. In top 10 maybe...”</p> | <p>type of thing for people who are interested in RFID can chat, exchange talk about problems...”</p> <p>“...from my speaking New Zealand is a little bit behind...”</p> |
|--|---|--|--|