

Implications of the Implementation of RFID in the Irish Retail Sector

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ABSTRACT

Radio Frequency Identification or RFID for short has been in use around us for quite a while now. It started off as a military application to identify friendly aircraft during the last world war. The technology relies on a small chip with an antenna called tag which can store a vast amount of data and transmit it to a receiver at high speed even out of visual range. Touted by many as “bar code on steroids,” the technology has garnered huge interest among many private organisations from varied fields of industry for its ability to track individual tags. They were very quick to apply it in increasing the efficiency of their supply chain. Retailers have more recently tried to use them to track individual items of a product for saving employee time on stock counts, reduce shrinkage and improve availability of stock thereby increasing customer satisfaction. But attaching tags on to individual items has drawn the wrath of consumer privacy groups as consumers can be tracked with the help of live tags in the products inside and out of the retail outlet.

This dissertation tries to explore the problems and issues faced by the retailers in the implementation of itemised RFID tagging. To investigate them in detail, a thorough study of the realm of privacy has been done and literature reviewed for explaining the ways in which the privacy of an individual can be breached by RFID tags. Primary data has then been collected for the reliability of the methods that can be used for protecting the privacy of the consumers while handling products with embedded RFID tags. The data regarding the importance given to the perceived benefits of itemised RFID tagging has also been collected through the use of survey method. The collated data from all the sources has then been analysed to produce a big picture regarding the concerns of itemised RFID tagging along with the significance given to the benefits received from it. Conclusions drawn at the end of this study try to highlight the main problems that the retailers might face when implementing itemised RFID tagging in Ireland and processes that they can put in place for getting a positive response on the first attempt.

1.0 INTRODUCTION

1.1 Research Background

We all use numerous new technologies developed in the past few decades to make our personal living easier and better in the fast moving world of today. GPS navigation systems, internet, mobile phones and credit cards to name a few are some of the newfound technologies which are finding increased usage in making our way through the daily grind. Radio frequency Identification or RFID for short is the latest technology which is making inroads into our personal life and is touted to make our daily routine faster, convenient and free from anxiety (Thomas, 2003).

RFID came into the limelight when in 2003 the world's largest retailer Wal-Mart and the world's largest buying organisation Department of Defence (US) ordered that all their suppliers should attach RFID tags to all pallets and cases en-route to their distribution centres. The DoD went a step further and stipulated that individual items delivered to the military should also carry an RFID tag (Juban and Wyld, 2004).

RFID technology has been used by supply chain organisations for the past few years for inventory tracking and control (Laczniak & Murphy, 2006). This has led to improvement in the efficiency and the decision making process thereby saving costs (Hingley et al, 2007). Previously the RFID tags had not been used in the individual items of products. Gillette was the first company to embed tags in the individual packs of its razors to prevent them from being stolen from a retail outlet. But the retail giant Tesco who was stocking those razors went a step further and created a system which took pictures of consumers picking up those packs from the shelves (Dodson, 2003).

This eventually created an outcry among the privacy activists who took this as an invasion of the privacy of the consumer and frowned at the lack of concern for protection of privacy by the use of RFID tag on an individual item. The reasons for their concern about privacy intrusion was that the tags could be used to track people outside the store as well if not killed after purchase and taking pictures of consumers without their knowledge was an evident breach of their privacy.

Marketers who are constantly hungry for information about buying preferences of consumers have welcomed RFID with open arms in their arsenal of tools. The tracking capability of the RFID tag is a boon for marketers as they can track the precise movements of the consumers in the store without their knowledge and target them with specific product advertisements depending on their preferences (Curran and Richards, 2004). As the benefits provided by RFID technology come to the forefront more retail organisations would not hesitate to employ the technology to gain advantage over their competitors.

There is at present very little evidence of work done to provide any theories towards the implications of the implementation of RFID itemised tagging in Ireland. Hence, this dissertation would try to explore consumer attitudes towards the technology. The measures to be adopted by retailers for the getting positive response from the consumers in light of the privacy concerns would also be highlighted in this study.

1.2 Research Questions

For the purposes of this study, the following research questions have been formulated.

- RQ1- What would be the consumer response in Ireland to the possible implementation of RFID tagging at product level along with procedures to safeguard the privacy?
- RQ2- What is the basis of such consumer response towards RFID tagging?
- RQ3- What can the retailers do to ensure maximum positive response towards RFID tagging at product level in Ireland based on the conclusions of this research?

1.3 Research Objectives

This basis of the research questions is to find out the consumer response towards implementation of RFID itemised tagging at product level in Ireland and underline the reasons for such an opinion. Furthermore measures to be undertaken by the retailers to ensure a positive opinion would be postulated in this study.

Firstly, literatures available on the topic would be reviewed for gaining an insight into the technology itself, its advantages, drawbacks and current uses. Secondly, the notion of privacy would be explained followed by a review of theories postulating consumer behaviour towards RFID in light of breach of privacy. Lastly, this study would touch upon the measures and processes available to safeguard the privacy of the consumer while receiving the benefits from RFID technology.

1.4 Research Methods

For achieving the desired research objectives, secondary data would be collected and analysed from journal articles, business magazines, newspapers, case studies and websites. This would give an overview of the RFID technology and its features. The reviewed literature would also help in drafting a questionnaire to be administered in the survey for getting the primary data needed to quantify the consumer response towards itemised RFID tagging as well as gauge the effectiveness of measures to protect privacy.

1.5 Research Outline

The dissertation is divided into six chapters

Chapter 2 reviews the literature available on Radio Frequency Identification in the form of journal articles, books, websites and other relevant material. This chapter also tries to gain insight into realm of privacy and the behaviour of the consumer towards hypothetical scenarios of RFID use.

Chapter 3 elaborates on the research design used for conducting this research.

Chapter 4 provides the findings gained from the survey.

Chapter 5 analyses the data from the survey to answer the research questions.

Chapter 6 outlines the achievements of the research as well as its limitations and future work which could be done in this area.

2.0 LITERATURE REVIEW

2.1 Introduction

This dissertation outlines the problems faced by retail organisations in implementing RFID tagging at product level and suggests ways and means to create a positive outlook towards the technology. This literature review gives a brief description of RFID, its advantages and drawbacks. It also discusses the issues surrounding the technology and solutions available to tackle them. This part concludes with a thorough understanding on the forces at play in affecting the mind set of the consumer towards buying items tagged with RFID tags.

2.2 The Technology

RFID is a generic name for technologies that use radio waves to automatically identify individual items (Jones & Hill et al, 2004). RFID evolved from the IFF (Identification Friend or Foe) system used since the Second World War on allied aircraft by the Royal Air Force to recognise friendly aircraft (Dodson, 2003). An RFID system comprises of three primary components- tags, transceivers and a system to process the information (Markelevich & Bell, 2006).

2.2.1 Tags

An RFID tag is a semiconductor chip with an antenna. The antenna is a thin mesh of copper coil around the chip. There are two types of tags. Passive RFID tags have no power of their own. They use the radiated electromagnetic waves from the transceivers and through the help of induction change it into electrical energy to power the emission of the data stored in the chip. An active RFID chip on the other hand uses an internal battery to transmit signals on a continual basis that can be read from far away than the passive RFID tags (Romano, 2007). Passive RFID tags are therefore less expensive than the active RFID tags and have an unlimited lifespan due to non requirement of a power source. The chips in both types of tags can be read-write or read only. The information on a read-write tag can be updated and reused which makes them more expensive than the read only tag that can be only used on one product for which it was destined (Angeles, 2005 cited in Hingley et al,

2007). Normally RFID chips can carry 94 characters of information which makes it possible to store a wealth of information on the tag itself.

2.2.2 Transceiver

A transceiver comprise of a reader with an antenna that emit electromagnetic waves of a specific wavelength to power the passive tags and read the information off them. The information stored on an active tag which is powered by its own source is read by the transceiver when it comes within its range. The information received is then forwarded on to a computer for processing. As the communication between the transceiver and the tags is through electromagnetic waves, they do not have to be in the clear line of sight. A reader can read an RFID tag from as far as 30 feet away and up to fifty RFID tags can be read in one second (Kelly and Erickson, 2005).

2.2.3 Processing System

The data gathered from the tags through transceivers is collected in a computer which is then processed, interpreted and stored for future use. (Attaran, 2007)

Before the evolution of RFID, barcodes were used to store information about the products. The bar code stored the unique product code (UPC) relative to the product category. The barcode was scanned by an optical reader at the till which brought up the corresponding price stored within the database in the till. This helped the retailers cut the time spent by the staff in pricing individual items. The introduction of the barcodes based on UPC streamlined the whole supply chain. Although the technology saved time spent by the customers at the checkouts, fears were raised about the retailers fleecing customers at the checkouts as the items did not carry an individual price tag (Vogel, 2004).

Preceding the use of RFID tags in logistics and asset management, barcodes were the norm and are still used in majority all over the world. The advantages of RFID over barcode is stated in the chart below-

Bar Codes	RFID Tags
Bar Codes require line of sight to be read by the reader.	RFID tags can be read and updated without line of sight.
Bar Codes can only be read individually.	Multiple RFID tags can be read simultaneously.

Bar Codes cannot be read if they become dirty or damaged.	RFID tags are able to cope with harsh and dirty environments.
Bar Codes must be visible to be logged.	RFID tags are ultra thin and can be read even when concealed within an item or packaging.
Bar Codes can only identify the type of item.	RFID tags can identify a specific item.
Bar Code information cannot be updated.	Electronic information can be overwritten repeatedly on RFID tags.
Bar Codes must be manually tracked for item identification which makes human error an issue.	RFID tags can be automatically tracked, minimising human intervention thereby eliminating errors.

(Juban & Wyld, 2004)

2.3 Applications of RFID

Companies all over the world were quick to see the benefits of RFID and tried to integrate the technology into the various facets of their respective fields. In the September of 2003, the electronic product code (EPC) was launched which was to replace the UPC and aimed to provide a unique number to every object in the world. The EPC is set to revolutionize the RFID system as individual items can be tracked. This has produced a unique term called “the internet of things” as a computer would be able to know the position of each unique object tagged with RFID with the help of readers (Dodson, 2003). Despite the high costs involved in take up of the new technology and use in itemized tagging (REUTERS, 2005), RFID has garnered huge interest and is finding uses in a vast majority of areas such as manufacturing, retailing, transportation and distribution, security, airline baggage reconciliation, animal tagging, road toll management, attendance management and so on (Smith, 2005).

2.3.1 Government

The United States government has implemented a massive undertaking to put RFID tags in all the passports of its citizens. The RFID tags would carry all the details of the holder such as name, date and place of birth, gender and also a digital photograph. In light of the arguments raised by privacy activists, only passive RFID tags would be used and it would be protected from data skimming thieves by a protective layer of anti skimming material on the passport cover as well as digital signature encryption on the chip itself (Gross, 2005).

Coming June 2009, US citizens traveling across the border to Mexico or Canada have the alternative to carry an RFID tagged pass card which can transmit a signal once it comes within range of the border immigration check post. This system similar to EZ passes used at the toll booths, uses a passive RFID tag which is activated from a transceiver 30 feet away. The Department of Homeland Security (DHS) to prevent the breach of privacy has only put a unique serial number in the RFID tag which when within range of the computer in the immigration post brings up all the details about the holder. No details about the holder are stored in the card itself which if targeted by identity thieves would be of no use. Also preventive measures such as protective metallic card sleeve which disrupts the signal unless close to the border and smart RFID tags that constantly change the serial number makes sure that the movement of the holders cannot not be tracked (Bennett, 2006).

The department of defense (DoD) in the US has been using RFID technology since the 1980's to track military assets which include hardware and food supplies in the battle zone and had all their equipment tagged by 2005 (Vogel, 2004). The armed forces in serving outside US were quick in employing RFID as a method to identify war casualties during their medical treatment as it cut back on the amount of paperwork needed to run a medical centre right at the heart of the war zone. Future possibilities include RFID enabled dog tags to be worn by every soldier for identification (Schachter, 2003). More recently prisoners of war captured during the Iraq war were tagged with RFID wrist bands for easy identification (Dodson, 2003).

2.3.2 Health Care

Among the early adopters of RFID, Washington Hospital Centre in Washington was quick to see the advantages of RFID and deployed the technology in the tracking of patients, equipment and medical personnel within the hospital in 2004. To counteract the possibility of the electromagnetic waves interfering with the medical equipment, the tags and readers only use Ultra Wide Band (UWB) frequencies and also prevent self interference from reflections within the building (Collins, 2004).

On this side of the Atlantic in the UK, similar use of RFID is being carried out to permit surgeons and nurses to get easy access to medical data records of patients admitted in the hospitals. The Birmingham Heartlands Hospital puts a wrist tag with an RFID chip on new admitted patients which has a record of their medical history, medication, type of surgery to be carried out and a digital photograph of them. This method increases patient safety by eliminating human and system errors prevalent in hospitals using paper records. It also tries to increase the efficiency of the hospital in conducting more surgical operations per day as the turnaround time of an operating theatre is decreased due automated data recovery needed during and for the preparation for the operation (Parkinson, 2007).

In 2004, FDA (Food and Drug Administration) of the US approved human tagging which allowed the retrieval of private medical records. The initiative was immediately mopped up by the Alzheimer's Community Care agency in Florida which in collaboration with VeriChip corporation initiated a pilot program which could see about 45 million high risk patients in the US allowing the RFID chip to be implanted in their right arm. The positive impact of the program could be seen by the medical personnel having access to accurate records of the patients in cases of emergency in just a swipe rather than go through searching for it on a computer. Also a tag implanted under the skin has very less chance of getting damaged or lost. Although the take up was voluntary the program got a setback when independent animal tests showed the development of cancerous cells when injected with RFID tags. Due to the independent nature of the tests and intermittent results, the connection between danger of cancer and RFID is highly speculative at present. (Morrissey, 2007)

Recently VeriChip partnered with Microsoft to make their Health Link system accessible through the software giant's Health Vault platform. The persons who had a VeriChip passive RFID tag implanted under their arm could see and maintain their health records online on the Health Link system. They could also set up privacy controls to determine what information can be accessed and by whom. The merger of the Health Vault platform to the Health Link system makes it easy for the equipment such as glucometers, heart rate monitors, weight scales certified by Microsoft at the hospital to automatically upload the data collected during the patients stay at the hospital to his Health Link account. The data can later be accessed from the VeriChip hosted Health Link database during an emergency situation when the person is unconscious, by any health care provider certified by VeriChip through the input of the unique ID got from scanning the RFID chip implanted under the skin (Bacheldor, 2008).

2.3.3 Pharmaceutical Industry

One of the major drug manufacturing company Pfizer is employing RFID tags to make sure that some of its pharmaceutical products like Viagra do not get counterfeited (Appleby, 2004 cited in Laczniak & Murphy, 2006).

IBM went out of line from their unique field of income to develop a technology along with major drug manufacturers like GlaxoSmithKline using RFID embedded in the packaging to check drug authenticity at point of sale along with tracking at each transit point of the distribution channel. The technology takes the RFID to the next level by combining it with an automated secure feedback response between the manufacturer and the retailer to check the authenticity of the drugs thereby preventing counterfeit drugs to be sold (REUTERS, 2006).

2.3.4 Airline Industry

The airline industry walks on a very tight rope in the economic conditions prevalent today. Emerging low cost airlines have snatched away a bulk of the market share from the high class expensive airline operators by basis of the costs involved. Studies have shown that airlines need to focus on value based core competencies and baggage handling is one of them. The failure to deliver baggage in due time to the departing customers affects the loyalty

shown by them towards the airline. Use of RFID system to track baggage is touted as a viable cost saving alternative which can improve customer service. Delta Airlines was the first airline to implement RFID system to track baggage on all its service routes. Efficiency of the baggage handling system led to huge cost savings for the airline as it did not have to reroute the lost baggage, settle claims for baggage that was never found and lesser turnaround time for the aircraft. Also complaints related to baggage decreased which led to an increase in the trust placed on the airline by its customers thereby increasing the revenue generated. This increased revenue shortened the time in getting the return on investment in the new technology. The use of RFID system would also see the start of minimising staff required in baggage handling in the future as automated systems take over leading to additional cost savings for any airline (Wyld, Jones & Totten, 2005).

UK was not to be left far behind when the tracking capability of RFID was put into good use in a trial program at London's Heathrow airport. The British Airport Authority in conjunction with Emirates airlines tried RFID tagging of baggage to increase the efficiency of the baggage handling system at Heathrow which is the busiest airport in Europe. The program attempted to track baggage at all stages of the process and decrease the amount of lost and misplaced baggage in the airport. The perceived benefits are a satisfied passenger and lesser claims for lost baggage. Although still in a trial phase, the results are yet to be analyzed (BBC, 2008a)

2.3.5 Agriculture, Cattle and Food production

In Ireland, RFID is being widely implemented in the dairy farms of the Irish Agriculture and Food Development Authority (Teagasc) for the management of female livestock. RFID helps in the recognition of livestock while in movement on the farms where traditional technologies such as barcodes have become unfeasible due to their non durable nature in farm environment. It also automates the processes in the farm such as feeding, milk recording and weighing when used in conjunction with other devices. Scarcity and rising costs of farm labor and lifestyle issues are prompting the independent family owned farms towards automation which in turn would give a huge boost to RFID use in the present day modern Ireland (O'Callaghan, 2008).

2.3.6 Security Industry

A major jeweler in India has solely based its security on RFID system. Jewelex India has RFID tags attached to its entire inventory. It uses passive tags for less valuable items of jewelry and active tags for the more expensive ones. All its retail outlets have a network of readers at prominent points which set off an alarm if the tag is forcibly removed from a jewelry item or the item itself is taken to an undesignated area in the store or taken out of the store. In addition precious employee time is saved with real time inventory updates due to which discrepancies are nullified and savings made accordingly (Swedberg, 2008).

Most libraries all over the world now use RFID tags to prevent the theft of books and reading materials from their premises. They only use passive RFID tags due to their lesser cost, size and longer lifetime (Muir, 2007).

2.3.7 Cashless Payment Systems

RFID found its way into electronic funds transfer much early in this decade. Promoted by major companies including some in the Fortune 500, RFID cashless payment systems have really caught on with the American public. From being a viable cash alternative, it is also convenient, secure and easy to use. From a retailer point of view it negates the possibility of employee theft and errors in giving out change at the tills. Also the daily reconciliation at the end of business is swift thereby saving time and money (Thomas, 2001).

The point is reiterated by Jones (2005), who reports the huge expenditure in overheads and infrastructure costs made by the government and business organizations related to physical cash handling. The increase in the use of plastic money in the form of credit cards and debit cards in Ireland has led to a decrease in crime and illegal behavior related to cash up to some extent. The future looks at the chip and pin in the cards being replaced by RFID tags which just need to be swiped in front of a reader at the tills.

RFID enabled cards such as the LUAS smart cards and Dublin Bus prepaid tickets are finding wider usage among the Irish public. Although contactless cash payment systems have yet to see the light of day, speculation is high as to the security employed in the technology to maintain privacy and the trust that the people of Ireland would put into it (Jones, 2005).

2.3.8 Retail Industry

When talking of retail industry, the first name that pops up is Wal-Mart which is the biggest retailing giant in the World. Wal-Mart kick started the use of RFID within its stores by making a mandatory requirement for all its suppliers to affix RFID tags on all the incoming pallets and cases by 2005. The move towards RFID proved to be a success according to the assessment of the results from the test stores implementing RFID. Although itemized tagging was not implemented during the testing period, out of stock items were reduced by 26%. The findings also suggested that RFID system did a better job at keeping items in stock and also saved man hours which were devoted to counting and identifying stock levels in the warehouse. This was partly due to the fact that RFID tagged cases could be traced in the warehouse without physically identifying them. The time saved was devoted towards building customer relationships and other tasks (Brown, 2006).

Marks and Spencer have extended the use of RFID tagging in clothing items in most of their stores in the UK after successful trials in 42 of its stores. M&S have been the early adapters of RFID technology when they tested it in their store in Wycombe near London in 2003. The company uses the technology to achieve their goal of 100% stock accuracy through the tagging of complex sized items such as women's trousers and skirts and men's suits. The RFID tags are attached to the clothing in paper throwaway labels and only carry a number unique to the garment. The technology helps in making consistent the availability of the sizes demanded by the customers in particular stores at the right time. This has increased the efficiency of the business and ensured customer satisfaction as well as reduced the time taken in counting incoming stock and items displayed on the shop floor (McCue, 2006).

The first manufacturing company to use RFID tags in individual products was Gillette. In 2003, Gillette put RFID tags into its individual packets of razors to track them from the point of production to the point of purchase (Juban & Wyld, 2004). As razors are one of the most frequently shop lifted items, Tesco created a "smart shelf" which contained a reader connected to a CCTV camera and trialed it in one of their stores. Every time a customer picked up a packet of razors, the tag triggered the camera through the reader and a picture of the customer was taken. The trial was stopped within a week due to

protests by consumer privacy groups who considered the security measure as an invasion of their privacy (Dodson, 2003).

Gillette at present uses RFID to track the effective distribution and display of its razors through a network of RFID readers placed at prominent places within the premises of a retailer. Instead of tagging individual razors with RFID tags, only pallets and cases are tagged (Smith, 2005 cited in Hingley et al, 2007). Gillette receives confirmation about the delivery of its cases from readers placed at the receiving end of the retailer. They also had a reader placed at the box crushing machine which reads the RFID tags on cases being brought for crushing suggesting that the razors in that box are put out on display on the shop floor. Knowledge about the stores where the razors are not on display gets fed back to the marketing department which takes the necessary action. This real time data gives Gillette an edge over its competitors in an industry worth \$10 billion globally as it takes less time for a new product to get to the shop shelves thereby increasing sales and productivity savings from an efficient supply chain (O'Connor, 2006).

The METRO group which is the fifth largest retailer in the world in collaboration with IBM is using the tracking capability of RFID to enhance the shopping experience of its retail consumers. All retail stores at major locations have RFID tags attached to the clothing items which are tracked by readers placed at optimum places which generate key information about the item being picked off the shelf and also being taken to the dressing room. The dressing room sports a "magic mirror" which identifies the clothing item and suggests availability of different colors, sizes and additional accessories to go along with it through an interactive touch screen. This process helps in cross selling and up selling thereby adding to the revenue generated. Additionally the standard advantages of RFID itemized tagging such as real time inventory reports make sure that popular items are always in stock and maximize revenue by reducing logistical costs and efficient use of merchandising space. (IBM, 2008)

2.4 Hindrances in the Wide Scale Implementation of RFID

In a nutshell we can say that the potential benefits of RFID when applied to various processes within the numerous fields of industry are endless. From

the above few examples we can clearly see that the implementation of RFID systems leads to cost savings from improved traceability of products, real time inventory information resulting in a faster and efficient supply chain. The retail organizations employing the new technology stand to benefit from increase in productivity due to consistent availability of stock and improved customer satisfaction originating from quicker checkouts and reduction in shrinkage. The organizations would also make savings on valuable employee time and money due to automation of the product count systems which nullifies human error (Hingley, Taylor & Ellis, 2007).

Although RFID use is on the increase, there are some major factors which are halting the extensive use of RFID tags in itemized tagging.

2.4.1 Cost

As with any new technology the costs associated with RFID has prevented it from getting wider acceptance. Tagging of individual product items has been hit with negative response by many companies citing high costs. The take up of RFID was swift by the high priced technology and apparel sectors but the food and retail sector was yet to invest due to the tags being expensive (REUTERS, 2005).

The high costs of RFID tags prompted major pharmaceutical manufacturers in the European Union towards two dimensional barcodes which is a stack of 90 one dimensional barcodes each three hundredths of an inch high instead of RFID tags to prevent counterfeiting and parallel imports (Attaran, 2007). Companies like Bayer, Eli Lilly and Sanofi-aventis also cited high costs for their ground breaking decision which was a major setback to wide scale use of RFID tags (Hirschler, 2007).

Concerns about the cost of RFID technology resounded in the comments made by experts who help businesses adapt to new technology as price is the critical issue in the wide scale implementation of RFID in itemised tagging. But promoters of RFID have a different outlook stating that the advantages of the technology far outweigh the costs and they are bound to come down as usage increases (Jackson, 2004).

Wal-Mart has its top 100 suppliers attach RFID tags on all pallets and cases since 2005 (Jones & Hill et al, 2004) forcing the use of RFID tags which has

led experts of retailing to state that if similar large companies become the driving force behind a new technology it can and lower the costs (Sparkes, 2006).

Recent strides in printing technology also plan to bring the cost of RFID to less than a cent. New developments in inkjet printing where the inks are replaced by liquefied metals from which RFID tags are printed directly on the products bring the futuristic vision of each item in shop having an RFID tag very close to reality (Romano, 2007).

2.4.2 Electromagnetic Interference

The use of RFID within hospitals for locating personnel and equipment is a huge logistical and operational breakthrough but eyebrows have been raised over its use within close proximity of life saving equipment. Tests conducted in Netherlands found electromagnetic interference emanating from RFID chips to cause life threatening occurrences of defibrillators, pace makers and ventilators to stop functioning. The tests were conducted in a controlled environment but concerns about the use of RFID in hospitals cannot be laid to rest (Kahn, 2008). Precautions taken towards limiting the frequency of the electromagnetic waves radiating from RFID sources deployed in the hospitals can be of no use if there is no control on the RFID tags embedded in any items of food or clothing carried in by the visitors as they can also affect the working of the devices in the hospital (BBC, 2008b).

2.4.3 Security Issues

New innovations always tend to carry an Achilles Heel and RFID is no exception. As RFID use increases, more and more people are trying to break the security guarding the RFID tag and use it for their own demented purposes. The methods of preventing RFID hacking are available readily but it falls upon the organizations to have them implemented and considerations made on costs as chips having security features are expensive.

EZ toll booth passes having unlocked RFID chips which are used in many countries world wide can be hacked in and a tracking cookie placed into it by using a transceiver which can be easily fabricated using parts bought off the shelf from any major electronic store. The information on the toll booths from which the car has passed can be downloaded at a later date from the RFID

tag embedded in the EZ pass which raises questions about the trust placed by the general public in the new technology and the organizations using it (Newitz, 2006).

As RFID technology becomes the norm, security is often traded for simplicity of usage. Sparkes (2006) gives an overview of the methods used to attack an RFID chip and then using the information for illegitimate purposes.

2.4.3.1 Sniffing

The information is read from a tag by using a reader within a readable distance. The reader can be a coil of copper wire being used as an antenna connected to a portable PDA (Personal Digital Assistant) running a software cloning software which copies the data emitted from the RFID tag. The RFID tags need not be of the active type to do this.

2.4.3.2 Spoofing

The information read from an RFID tag by sniffing can then be copied on to another RFID chip and used to get unauthorized access to the places and services accessible to the original RFID chip.

Hotels which use RFID keys to open rooms can be sniffed and their data copied on to another RFID tag which can be used to open the doors to the rooms (Newitz, 2006).

2.4.3.3 Tracking

The information or the unique code embedded in the RFID tag in a person's car keys, credit card or bought item after being sniffed can then be tracked using a powerful transceiver. This allows for the person to be tracked against his wishes. The information on the car keys can also be used to open the car and start it up resulting in theft of the car.

2.4.3.4 Virus Attack

The contents of an RFID chip can be deleted or replaced with a rogue code which can crash the whole control system thereby forcing manual stock checks.

The information on a RFID tag attached to a product can be replaced by a malicious code which when scanned by a reader in the store can jumble sales data, create errors in the prices and create a way for an outsider to gain

access to the internal databases (Kharif, 2006). The prices of expensive products in a retail outlet using itemized RFID tagging for quick checkouts can be swapped with the price and detail of a cheaper item. These can only be possible if the tags have no password protection for preventing unauthorized change of data (Newitz, 2006) or employees, to save time leave the tags unlocked so that the prices can be changed quickly and easily. Another reason for this can be attributed to untrained employees who do not know to use the system (Tan, 2007).

All of the above methods of RFID hacking are possible and can easily be done by anybody having some knowledge of electronics and software. The possibilities are endless. Preventive measures such as putting a digital encryption lock on the contents of a RFID tag holding information about the price of products inside a shop can prevent anybody from changing the prices. Using a pseudo-random number generator in the RFID enabled car keys that generates new codes at specific intervals of time can stop unauthorized access preventing theft of the contents of the car or the car itself. Sniffing of RFID tags within credit cards and passports can be prevented by keeping them in a wallet lined with protective material which stops any electromagnetic waves from coming in or going out (Sparkes, 2006).

2.4.4 Invasion of Privacy

The new technology has attracted its own devout group of skeptics who are up in arms against the use of RFID chips in the retail sector as they are concerned about the customers being tracked after they have bought products having RFID tags resulting infringement on privacy of the customer (Smith, 2005).

There are many independent organizations that are up in arms against itemized tagging. EPIC (Electronic Privacy Research Centre), EFF (Electronic Frontier Foundation) and CASPIAN (Consumers Against Supermarket Privacy Invasion and Numbering) are some of the top establishments which try to spread the knowledge about emerging privacy issues in the electronic age and advocate legislation for protecting consumer rights, privacy and right to

information. But before delving deeper into how itemized tagging by RFID tags can affect privacy, the term privacy needs to be explained.

2.4.4.1 Privacy

Privacy, according to various authors privacy has been cited to be a universal need of every individual regardless of age, gender and cultural background (Alalouch et al, 2008). Privacy is a very difficult term to be defined in today's multicultural world. Different cultures around the world have different notions about privacy which depend upon the society's perception of personal space, and trust accumulated over time. Also, the perception of privacy differs in each individual and it changes according to the situation (Kervenoael et al., 2007). Privacy is defined by many in numerous different ways.

"privacy is the condition of not having undocumented personal knowledge about one possessed by others." (Parent, 1983 cited in Kemp and Moore, 2007)

"the state of possessing control over a realm of intimate decisions, which include decisions about intimate access, intimate information and intimate actions." (Inness, 1992 cited in Kemp and Moore, 2007)

"the realm of the private, to be whatever is not, according to a reasonable person in normal circumstances, the legitimate concern of others." (DeCew, 1997 cited in Kemp and Moore, 2007)

Another definition is given by Bok (1983) cited in Kemp & Moore (2007).

"privacy is the condition of being protected from unwanted access by others – either physical access, personal information or attention."

A more simple understanding of privacy is given in a website Privacilla (2003). According to it, privacy is a condition a person experiences when two factors are in place – The first being the power to control the information about himself or herself and the second to exercise control that is consistent with his or her interests and values.

All the above inferences about privacy can be seen in an article in the European Convention of Human Rights which states that, *"Everyone has the right to respect for his family and private life, his home and his correspondence."* But in the modern electronically connected world we live in, the realm of privacy is intruded upon numerous times, unknowingly and

knowingly by various organizations and private entities for their own commercial and monetary well being (Robertson, 1989). But an individual cannot control the information about himself given to the government when filling up forms for permits, licenses or tax returns.

Westin (1967) and Miller (1971) cited in Warren (2002) gave a modern outlook to information privacy in accordance to the modern day world. According to them, information privacy means the claim of individuals “to determine for themselves when, how and to what extent information about them is communicated to others” and “the individuals ability to control the circulation of information relating to him” which resounds in the definition of privacy given by Privacilla above.

The definition given by Kelly & Erickson (2005) combines all the notions of privacy stated above in relation to the information privacy in the modern digital information age. According to them, “*Informational privacy refers to the right of an individual to retain control over the collection and use of personally identifiable facts and information about their daily lives.*” The two authors also go on to state that knowledge about an individual’s physical position and movements also come under the concept of privacy.

For allowing the citizens of any country, the right to information privacy, Burkert (1999) cited in Warren (2002) suggested that legislation be put in place to allow the individual access to information related to them without reason and the right to correct inaccurate data being held. Burkert also suggested that a supervisory authority should be established to oversee the handling of personal data and to look into complaints. In this research, the importance and processes for safeguarding an individual’s privacy in relation to the use of itemized RFID tagging would be dealt with.

2.4.4.2 Legislation

The European Union has strict guidelines for information privacy called the “European Community Directive on Data Protection.” The EU recognises information privacy as the right of an individual and makes it mandatory for member countries to adopt a national legislation for protecting it. The EU Directive states that information can only be collected if

- An individual has expressly opted in and given an unambiguous consent to the use.
- The data is needed to complete a contract
- The data is required by law or needed to protect the subject's vital interest.
- The data is needed for law enforcement purposes.

(Kelly & Erickson, 2005)

In light of the recent outcry by various consumer groups against the invasion of privacy by itemised RFID tagging, the European Commission in February 2008 put forth a set of draft guidelines to be made into a law and adopted by all 27 countries. The guidelines state that items carrying an RFID tag should carry a unique symbol clearly visible denoting the presence of RFID and the tags should be deactivated at the checkout unless the consumer states otherwise (Jones, 2008). The draft was cancelled by Viviane Reding - EU Information Society and Media Commissioner a month later in March stating that EU had enough laws already that governed data privacy on mobiles and the internet which could be adapted for RFID use as well. The Commissioner also pointed out that self regulation by the industry would be a better alternative rather than legislation to promote the growth of the technology (Zawadzki, 2007).

Ireland has a very strong legislation for the protection of personal data of an individual. In general the Irish Legislation gives the rights to an individual to be informed when and by whom the personal data is being collected, the reason for collection of such data, have access to the data retained by the data controller (organisation collecting the data) and ensure that the data is processed in accordance with the data protection act. The law also empowers the individual to prevent the use of his personal data for purposes other than stated at the time of collection of data and rectify the data held by the data controller if not factually correct. The data protection act states that personal data should be collected fairly, stored securely, retained for a necessary time period and be used for only for specified & lawful purposes stated during the collection of such data. (Data Protection Commissioner, 2007)

The very first initiative to regulate the use of RFID was taken by Senator Deborah Bowen who introduced a bill that required businesses or government

agencies using the technology for tracking to notify the people of its use and data gathering capability. The bill also made it obligatory for the organisations to get the consumers consent before gathering information and kill or remove the RFID tags from the products before they leave the retail outlet (Gilbert, 2004).

2.4.4.3 RFID: A Tool for Intruding on Privacy

“Technology... is a queer thing. It brings you great gifts with one hand, and it stabs you in the back with the other.” (Snow, 1971 cited in Albrecht & McIntyre, 2005)

A synonymous relationship can be drawn between the use of a firearm and RFID technology. In the wrong hands both can create disastrous consequences but if used correctly both can benefit the mankind.

The repercussions of human tagging which was approved by FDA came not from the US but far away in Indonesia where lawmakers of a province called Papua plan to pass a bylaw making it mandatory for some extreme HIV/AIDS patients showing active sexual lifestyle to be implanted with RFID tags as preventive measure against spread of the disease. The authorities plan to use the technology to track the infected people and limit their movements and sexual activities as well as impose tough penalties if found liable in order to stop the spread of AIDS. The proceedings have come under fire from the human rights organisations as well as the National AIDS Commission of Indonesia calling the procedure inhumane and an infringement of privacy of the individual (Anjani, 2008). The implications brought to the forefront caused the famous actor turned Governor of California Arnold Schwarzenegger bring in legislation in his state banning forced implantations of RFID tags in humans (Grossman, 2007). Scenarios of human RFID tagging can be seen in many Hollywood movies namely Robocop, Total Recall and Casio Royale to name a few in which government agencies are shown to play big brother by keeping tabs on the members of public which makes us question the authority of wide scale implementation of RFID.

Personal information about an individual such as their place of residence, economic and marital background has been available before the digital age through public sources such as the judicial system. In the present day, the

above information and more is accessed by commercial organizations having huge databases which they have developed over the years. A good example would be the loyalty cards used by major supermarket joints which let them compile huge amount of data about the buying habits of their customers (Kelly & Erickson, 2005). Marketers over the years have been creating databases of information having customer profiles based on their buying habits and using it to target specific products to the customers with the intention of increasing the profits of the corporate giants they work for. The information a company has about their customers when correlated with the data other companies have about them can lead to monstrous data bank having intimate details which can lead to the erosion of the realm called private (Curran & Richards, 2004). In the light of the recent terror attacks in many parts of the world, the governments in many countries have put legislations in place which has increased their reach into the private lives of the citizens (Hayden, 2008). Already, data relating to phone calls and faxes are kept on record for at least three years. Mobile phone companies also record the location of the caller during the initiation of a call. The spate of the recent acts of terrorism makes the surveillance seem legitimate but then there is also an issue of somebody watching your every move thereby giving a whole new meaning of the word private. RFID chips that claim to be a harmless tool for improving the supply chain and operations within any manufacturing organization can be used to track individuals buying products tagged with RFID chips inside and outside the store if precautions are not taken to disable them at the point of sale (Heffernan, 2007).

Ohkubo et al (2005) considers two issues concerning privacy to be the main culprits behind the negative outlook towards RFID technology. The first issue deals with anybody having a reader getting the knowledge about the products carried or worn by an individual from RFID tags which have not been killed after the products have been bought. The second one pertains to an individual's movements and his or her spending patterns being tracked over an extended period of time. This can be made possible by linking the individual to the products through RFID tags embedded in the products being used by individual. The feature of the RFID tags to be unique to any

individual product item which can be read without any permission from the bearer is to be blamed for the above two issues.

CASPIAN was founded by Katherine Albrecht in 1999 to protest against the collection of personal data by the retail outlets through the use of loyalty cards has teamed up with Liz McIntyre to stop the use of RFID tags on individual product items. According to them, RFID tags if not killed or detached from the products after being bought can be used to track the consumer's movements in possession of the items by a third party having a reader or a network of readers. The supermarkets gather information about the buying habits of shoppers and build up a database of personal profiles of the consumers in order to target them with more specific products. But this information about the buying preferences of an individual is a straight violation of his or her privacy according to the two activists which led them to write a book called *Spychips* to create awareness about the potential dangers of RFID product tagging and advocate legislation against its use (Albrecht & McIntyre, 2005).

The repercussions are reiterated by Kelly and Erickson (2005) who conjure up a hypothetical scenario where burglars equipped with readers scan the garbage bins of households for trashed packaging of expensive equipment to plan on their next offensive.

2.5 Factors Affecting Positive Response to RFID Product Tagging

RFID itemised tagging is still in its infancy and therefore any research that has been done to evaluate the consumer response is totally based on the feedback received on scenarios put forth during the course of research. Angeles (2007) has done a quantitative study on the anticipated consumer response to RFID product tagging in Canada. Juban and Wyld (2004) have also used the quantitative method of surveying to put their perceived theories to the test in determining the factors that would affect the acceptance of RFID. A more radical new approach was used by Lee, Park & Yoon (2007) to associate the element of consumer trust in the acceptance of RFID.

Rebecca Angeles (2007) applies the theories of procedural justice and expected utility along with secondary literature to identify issues surrounding the willingness of the consumer to buy RFID tagged products. The research

also tests the inclination of the test subjects towards buying RFID tagged products for getting a perceived benefit. Rusty L. Juban and David C. Wyld (2004) have used the results from two industry surveys done by Cap Gemini Earnest & Young in 2004 and Allied Business Intelligence Research in 2003. They used the two surveys in conjunction with three models namely Theory of Reasoned Action (TAM), Technology Acceptance Model (TRA) and Innovation Diffusion Theory to point out the main factors associated with the adoption of RFID by the general public.

To accurately verify the main elements regarding the acceptance of RFID tagging at product level both the research papers go to great lengths to find out the consumer perspectives about the new technology. Angeles (2007) describes the meaning of privacy and the effect it would have on the decision making process of the consumer in favour of RFID. She goes on further to create a hypothesis on consumer buying behaviour of RFID tagged items with the knowledge of PIPEDA (Personal Information Protection and Electronics Document Act) in force.

Juban and Wyld (2004) just add credibility to the three theories from the results got from the two surveys. They speculate on the consumer acceptance of RFID to the benefits received in exchange. Angeles (2007) on the other hand reflects on the price the consumer would be willing to pay for those benefits.

Lee, Park and Yoon (2007) use a method called system dynamics (SD) which is normally used to investigate industrial dynamics for examining the complex issues associated with the acceptance of RFID. The literature defines trust and discusses the connection between the benefits provided by the implementation of RFID tagging to the development of trust over a period of time. The authors speculate on the level of trust built up during the various stages of transactions using the SD model.

All the above literatures show that there many social variables and performance elements at play in deciding the perception of the consumer towards RFID tagging at product level. Their research arrives to the conclusion that consumers have varying privacy thresholds and they have different perceptions towards the efficiency of legislation to protect their privacy. They further state that educating the consumers about the new

technology would greatly impact their outlook and tend to increase the level of trust placed by the consumer in the technology. The element of trust is also alleviated by increasing the transparency in the implementation of RFID and procedures put in place to protect the privacy of the consumers. This increased trust would radically create a positive outlook towards RFID in a short period of time which would bring the organisations employing it in positive light.

2.6 Summary

RFID technology like any other new kid on the block has to overcome many obstacles and scepticism related to the features it encompasses in order to gain wider acceptance among the general public. The technology is still in its infancy and the full extent of its features has not yet been employed.

The technology has varied applications in the fields of supply chain management and customer relationship management where it has been put to good use. Marketers in possession of the technology plan to use it to target more specific products to the consumer. Use of RFID tags at product level has created a wave of criticism from privacy activists partly due to its innovative features and unique ability to be tracked over distances and be able to store massive amounts of data.

The rapid deployment of RFID technology by many big government and private organisations provides credibility to its advantages but raises doubts over its uses. The concerns highlighted by many literary sources over its use at product level gives an insight into the reasons behind it. Lastly it falls upon the establishments using the technology to see to it that civil liberties and rights of the consumer are not breached whilst letting them take advantage of its unique features.

This research tries to explore the problems faced with the deployment of RFID tagging at product level in Ireland and suggest ways and means necessary to tackle them thereby producing positive response for the new technology.

3.0 RESEARCH DESIGN

3.1 Introduction

The aim of this research is to gain insight into the behaviour of the consumers towards the uses and information collected by the retailers of itemised RFID tagging. Based on the findings of the research, suggestions would be made to help retailers create a positive outlook among the consumers towards the procedure of itemised tagging. This section of the document explains the methodology followed for this research and the type of data analysis done to achieve the objectives of the study.

3.2 Research Philosophy

The main aim of my research is to assess the implications of the implementation of RFID tagging at product level in Ireland. Employing RFID at product level affects the retailer and consumer in many different ways. This research would try to measure the power of the benefits of RFID technology that play a critical role in the buying decision of the consumer towards RFID tagged products.

As RFID tagging at product level is not yet employed by retail outlets in Ireland, hypothetical scenarios based on the reviewed literature have to be used to gain insight into the consumer response towards the new technology. This research would speculate on the advantages and disadvantages of RFID technology that would hold sway over the buying of RFID tagged products by consumers in Ireland. This entails for direct responses to features concerning RFID technology which would make a clear connection between the cause and the effect they would have on the privacy of an individual. This would increase the knowledge about the behaviour of the consumer which makes it appropriate for a realist approach to the research. Quantitative data has been used to get the facts related to the research and base the conclusions. This proves the approach to research as being realistic for information is provided about the relation between the variables of acceptance of RFID and the procedures followed to ensure the privacy of the consumer. The realist approach also attributes to co relate the research with an individual's perspective of social reality.

Furthermore, suggestions for the retailers towards creating a positive response in the consumer base in Ireland towards the implementation of RFID tagging at product level would be depend on the measurement of variables of the buying interest of consumers in relation to the advantages and disadvantages of RFID technology.

3.3 Research Methodology

RFID product tagging is a fairly new practice which is still in the trial phase in many retail organisations all over the world. The impact of the practice on the buying behaviour has been researched by very few people and some credible theories have been postulated and tested but the author did not manage to find proof of sufficient amount of academic and practical work done in context of RFID implementation in Ireland. This situation begs to follow an inductive approach to research and do an exploratory study to analyze the perception of consumers towards RFID and the importance of the various factors affecting the positive response towards RFID itemised tagging in Ireland. According to Robson (2002) cited in Saunders et al (2007: p133), "*exploratory study is a valuable means of finding out what is happening; to seek new insights; to ask questions and to asses phenomena in a new light.*"

Exploratory research would help in understanding the problems to be encountered by the retailers in creating a positive outlook among consumers towards RFID itemised tagging. Exploratory research is an effective means of diagnosing the situation, assessment of alternatives and discovering new ideas (Zikmund, 2003). In this research, the secondary data collected during the literature review provides a unique insight into the advantages and disadvantages, uses and privacy concerns surrounding RFID technology. The collection of primary data would enlighten us on the factors perceived by the people in Ireland which are derogatory in the practice of itemised RFID tagging. The primary data would also help in identifying the reason and extent of the negative understanding of RFID. Suggestions would then be made for Irish retail sector based on the findings from the primary data to put itemised RFID tagging in positive light if implemented in Ireland.

3.4 Research Methods

For the purpose of this research a survey would be used to gauge the consumer response towards the possible usage of RFID tags at product level in Ireland. Survey is a good tool for doing exploratory research (Saunders et al, 2007: p138).

Although survey falls under quantitative method of data collection, it also has a qualitative side to it which is suggested by Zikmund (2003: p175), *“In new product development surveys, the qualitative objective of a survey is often to test and refine new product concepts.”* The purpose of this research fits very perfectly with the survey method of primary data collection as the behaviour of Irish consumers towards buying products tagged with RFID tags in light of privacy concerns is being conceptualized. *“...survey research is related to the simple idea that to find out what people think, you need to ask them.”* Survey is also an inexpensive, quick and precise way to gather information regarding a section of the population which is a requirement of this research (Zikmund, 2003).

To gain the necessary understanding and scope of the research, secondary data has been collected from a variety of sources such as journal articles, business magazines, newspapers, case studies and websites. The reviewed literature has helped in formulating the questionnaire to be administered in the survey.

Survey is usually associated with the deductive approach to research (Saunders et al, 2007) hence this method is being used to deduce the importance of the many factors affected by RFID itemised tagging that go against the perceived realm of privacy in the Irish population.

3.5 Data Collection

For the survey, a questionnaire aimed at assessing the behaviour of a sample of the Irish population towards itemised RFID tagging has been designed taking into account the positive and negative aspects of the practice. Due to the time constraint governing this research, a convenience sample has been chosen which makes it an ideal choice for the exploratory research.

To make the questionnaire relevant to answer the research questions, screened items borrowed from Angeles (2007) study of the anticipated

consumer response to RFID were used. Students and the faculty of the Graduate Business School, Griffith College were used to participate in the survey.

The respondents were given a brief lecture by the author on RFID technology and its uses in supply chain management. They were also subjected to hypothetical scenarios arising from RFID tagging at product level in a retail outlet. This minimised the non respondent error in the sample to some extent that could have arisen from little or no knowledge about RFID technology. Deliberate falsification of data and social desirability bias was curbed to some extent by using unidentifiable questionnaires which could not be traced back to the respondent. Unconscious misrepresentation bias was also minimised by the lecture given on the topic.

In accordance with the research questions, the questionnaire was divided into four main parts. The first part was simply to ascertain the demographic status of the respondent and to find out his knowledge about RFID technology preceding the lecture. The second part gathers data on the importance placed on the perceived benefits provided by using RFID tags at product level by the respondent. The third part entices the respondent to provide his views on use of information collected by the retailer using RFID technology and procedures followed to safeguard privacy while using RFID tags on individual products. The final part of the questionnaire collects his personal view on the concerns surrounding the technology and gathers recommendations for steps to be followed while implementing RFID tagging at product level.

A major part of the questionnaire used simple closed dichotomous structured questions. Responses regarding the importance of the benefits got by itemised RFID tagging and privacy issues were collected on a Likert scale.

3.6 Data Analysis

After the collection of quantifiable data from the survey, the data is coded using simple coding processes and input into an Excel data matrix. The data is then presented in the form of bar charts along with line graphs for analysis. Statistical analysis of the data using median and mean is also done to minimise errors in the analysis.

3.7 Summary

This chapter has established the research methodology, data collection and analysis techniques to be undertaken in this study. The research would be carried out using a quantitative approach of survey for collecting primary data and then analysed using statistical analysis techniques complimented by secondary data to reach on a conclusion.

4.0 FINDINGS

4.1 Introduction

The literature review gives an idea about the issues surrounding RFID technology and the concerns generated by its use in tagging individual products. This part of the study tries to measure the concerns and significance of the benefits with the help of a questionnaire (see appendix 1) to derive responses. Section 4.3 tries to conceptualize the realm of privacy while section 4.5 measures the concerns of the sample towards the uses of itemised RFID tagging. In section 4.4 the importance given to the benefits received by RFID technology is measured while 4.6 gives an understanding of the procedures that would be create wider acceptance of the new technology.

4.2 Demographics

The first part of the questionnaire was aimed at getting an idea of the demographic characteristics of the survey sample for this research. The sample population was also tested for the preliminary knowledge about RFID technology before the presentation.

Figure 4.1

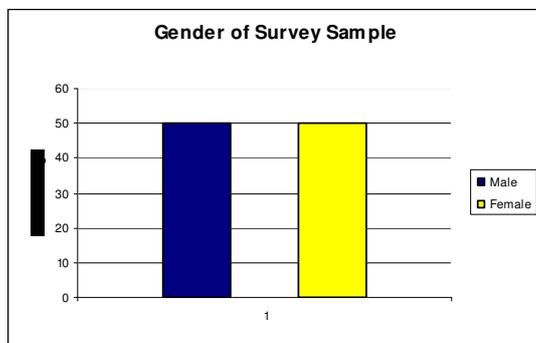


Figure 4.2

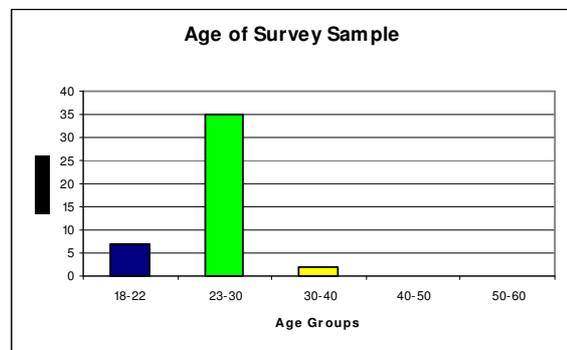


Figure 4.3

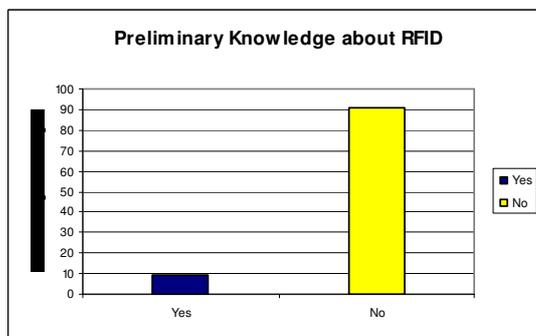
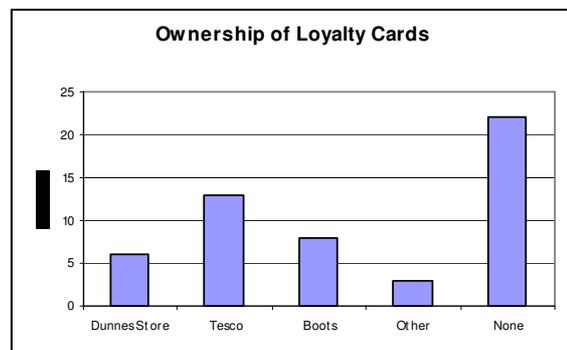


Figure 4.4



The survey received a total of 44 responses from the convenience sample chosen for the research. The following data was tabulated from the responses for the preliminary questions-

- Gender: Out of 44 respondents, half (50%) of them were male and half (50%) female (Figure 4.1)
- Age Groups: 18-22 - 7 (15.9%)
 23-30 – 35 (79.55%)
 30-40 – 2 (4.55%) (Figure 4.2).
- Knowledge about RFID : Yes- 9.09%, No-90.90% (Figure 4.3)

The above data reaffirms the primary research done by the author during the proposal stage that knowledge about RFID technology as such among the Irish population is almost non-existent.

4.3 Perception of Privacy

Before going further, an understanding about the realm of privacy has to be deduced. The questions in this section aimed to determine the importance given to the collection of information by the retailers. The respondents were questioned if they would buy RFID tagged products which may lead to intrusion of their information and physical privacy.

Figure 4.5

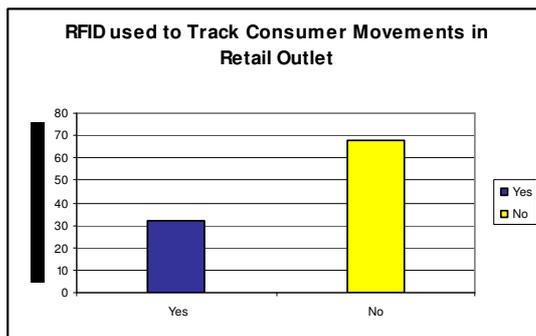


Figure 4.6

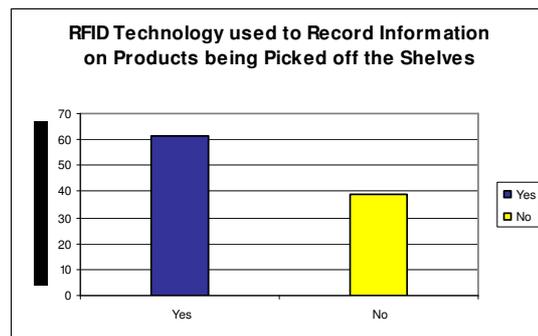


Figure 4.7

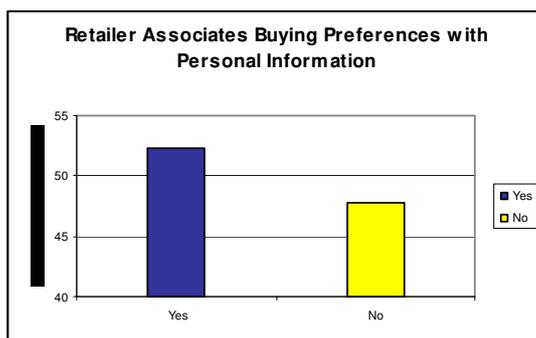
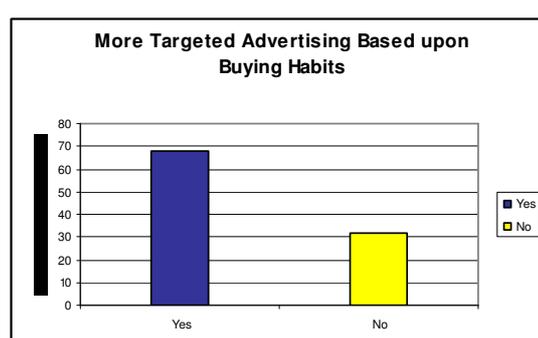


Figure 4.8



The analysis of data received from the above questions suggests that around 69% (Figure 4.5) of the respondents considered their privacy to be compromised if the retailer used RFID tags embedded in the product packaging to track their movements in the store itself.

But on the other hand 61% (Figure 4.6) of the respondents were comfortable with the retailer recording information about the products being picked off the shelf. 68% (Figure 4.8) of the sample answered affirmatively to more targeted advertising based on the information gathered by the retailer through the use of RFID technology.

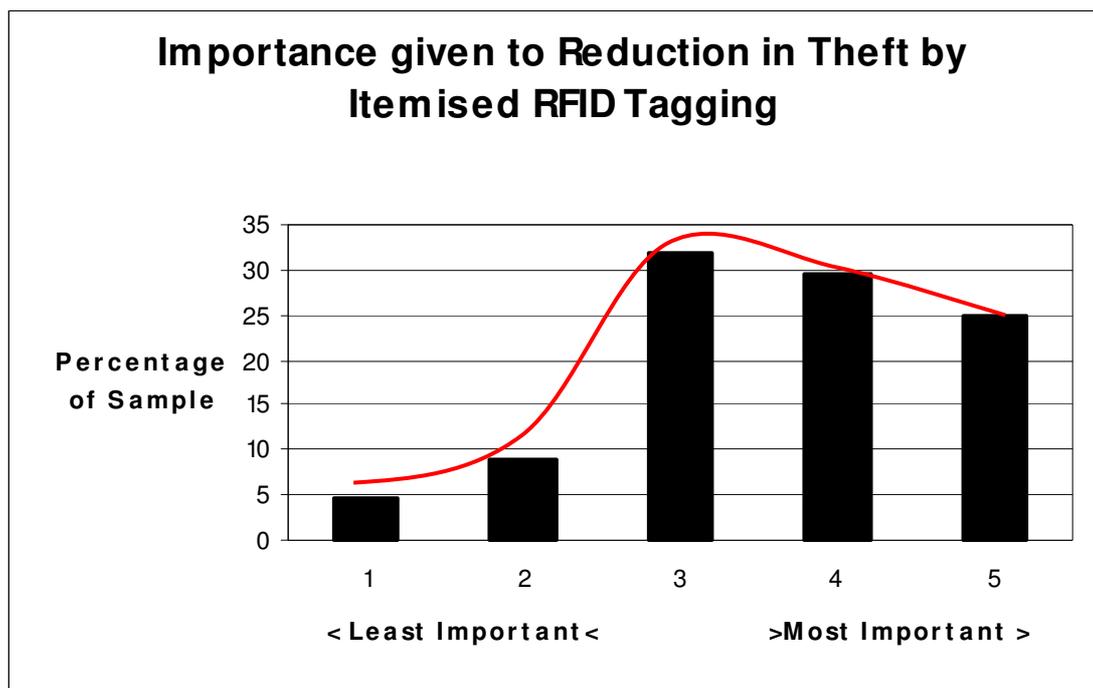
The respondents were divided 52%-48% (Figure 4.7) on the association of their buying preferences with their personal information.

4.4 Importance of Benefits

RFID itemised tagging provides numerous benefits to the consumers and retailers alike. In this section the sample was asked to rate those benefits it considered beneficial for improved satisfaction while shopping in a retail outlet. For these questions, responses were recorded on a Likert scale. The respondents were told to write between the numbers 5 and 1.

4.4.1 Reduction in Theft

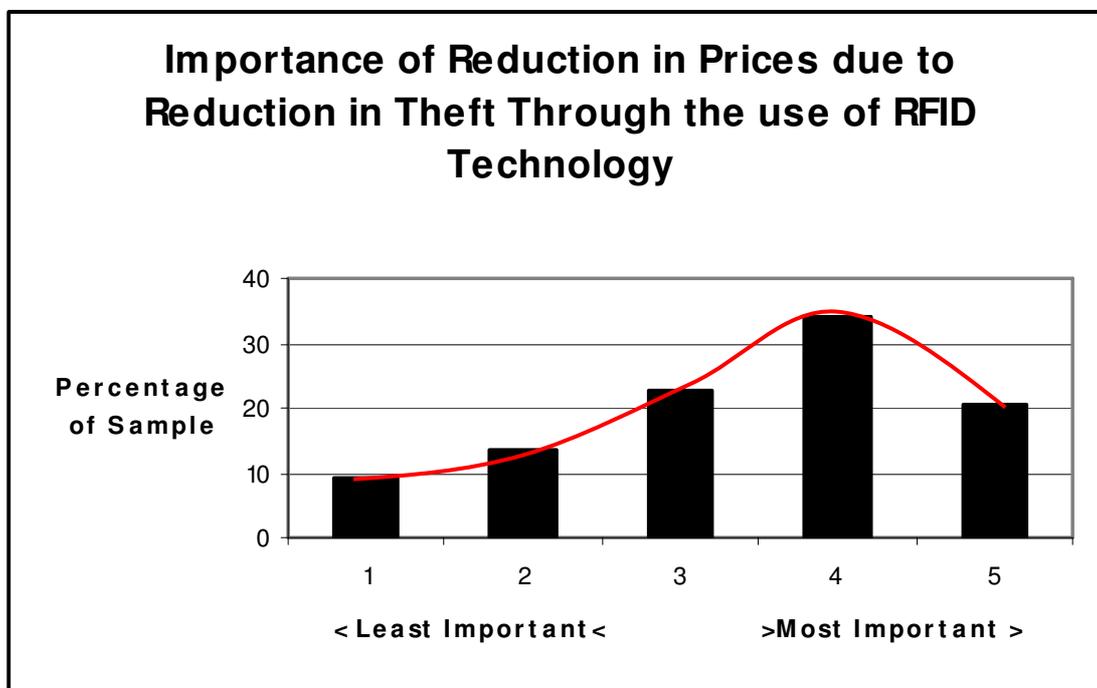
Figure 4.9



From the above figure it can be easily seen that the distribution of responses was uneven but most (55%) of the sample considered reduction in theft to be an advantage of itemised RFID tagging. This can be deduced from the calculated mean of the responses which was 4. The curve plotted with the peaks of the bars as the points resulted in a non-symmetrical negative skewed curve. The data also shows that more than half of the respondents agreed to the usage of RFID tags for reducing theft.

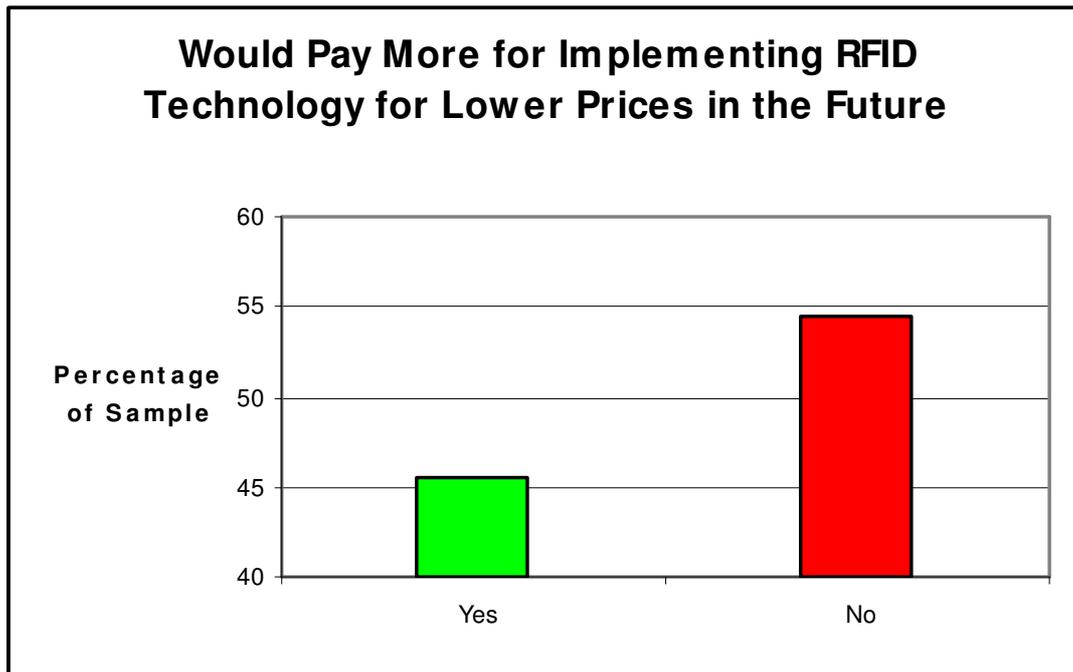
4.4.2 Reduction in Prices

Figure 4.10



This question also received a similar response as the previous question and also resulted in a non-symmetrical skewed curve but a bit flatter. This suggests that the sample was dispersed on paying less for products although about 55% of the sample stated lower prices to be of importance. Furthermore a majority did not want to pay more initially for the technology to be employed which could lower the prices in the on the long run. This is graphically shown in Figure .11 below which was plotted from the dichotomous responses received on the same question about paying more initially for implementing the technology.

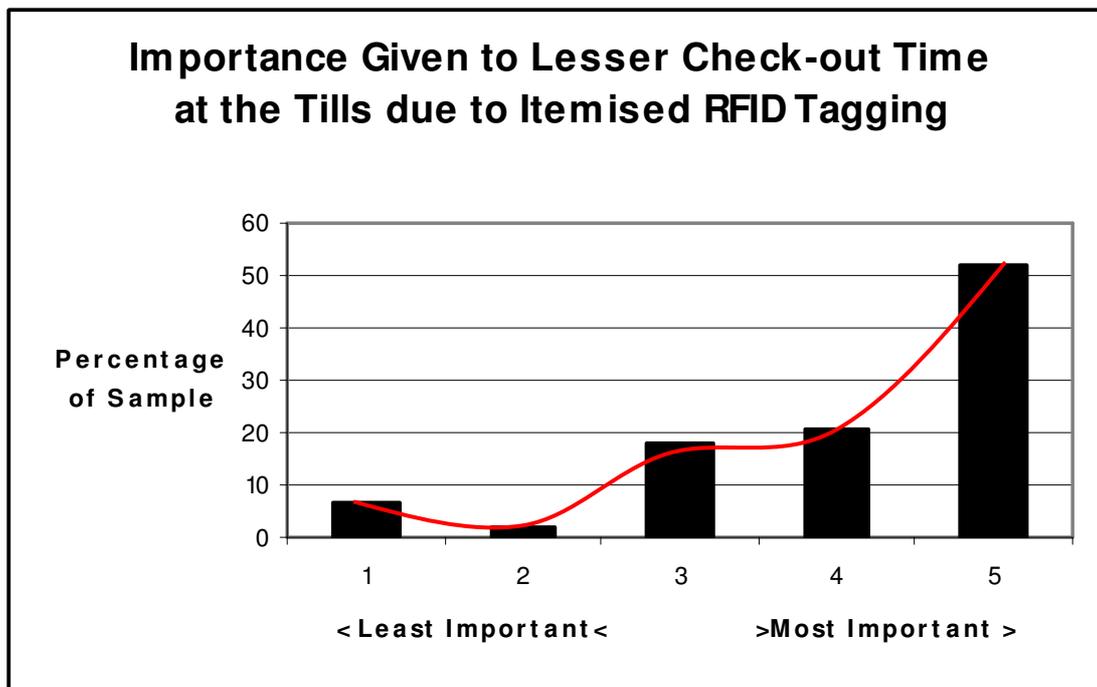
Figure 4.11



4.4.3 Faster Check out at the Tills

This question received a far greater positive response which resulted in highly skewed curve with a median of 5. 72% of the sample wanted to get out of the retail outlet quickly after choosing their purchases.

Figure .12

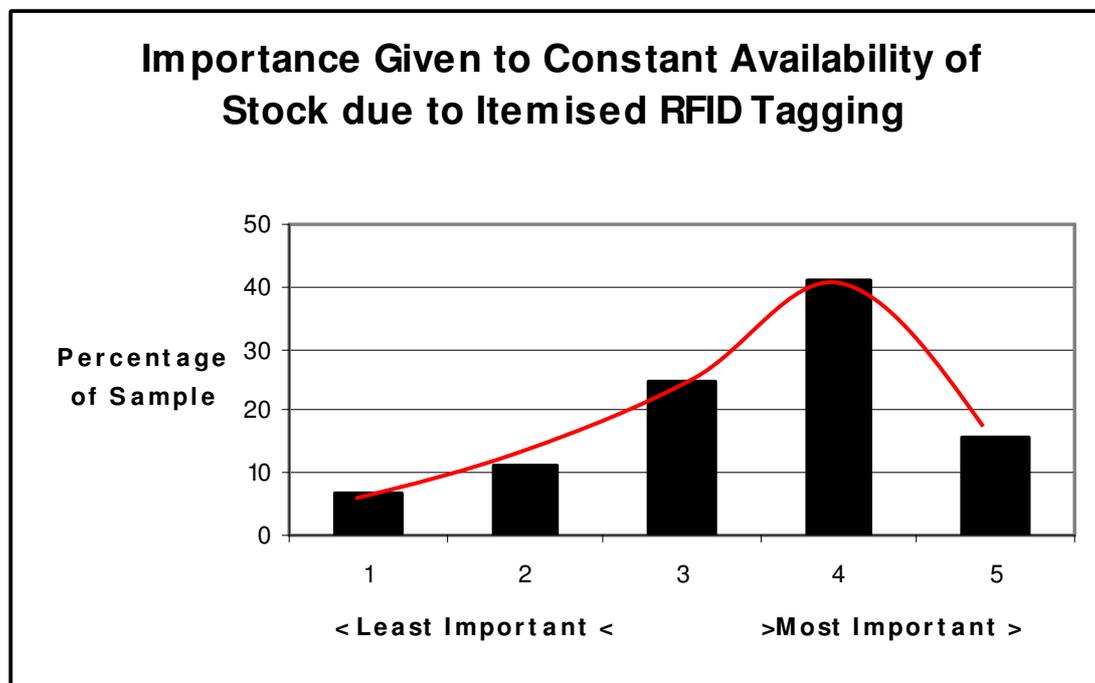


4.4.4 Constant Availability of Stock

Constant availability of stock plays a major role in increasing the productivity of any retail organisation. Consumers also benefit from getting what they came in the store to buy and are less disappointed by not getting what they desire.

The responses generated produce a non-symmetrical negative skewed curve with a median of 4 which is towards the positive side. 55% of the sample would love to have their regular place of shopping stocked up with their most desired products.

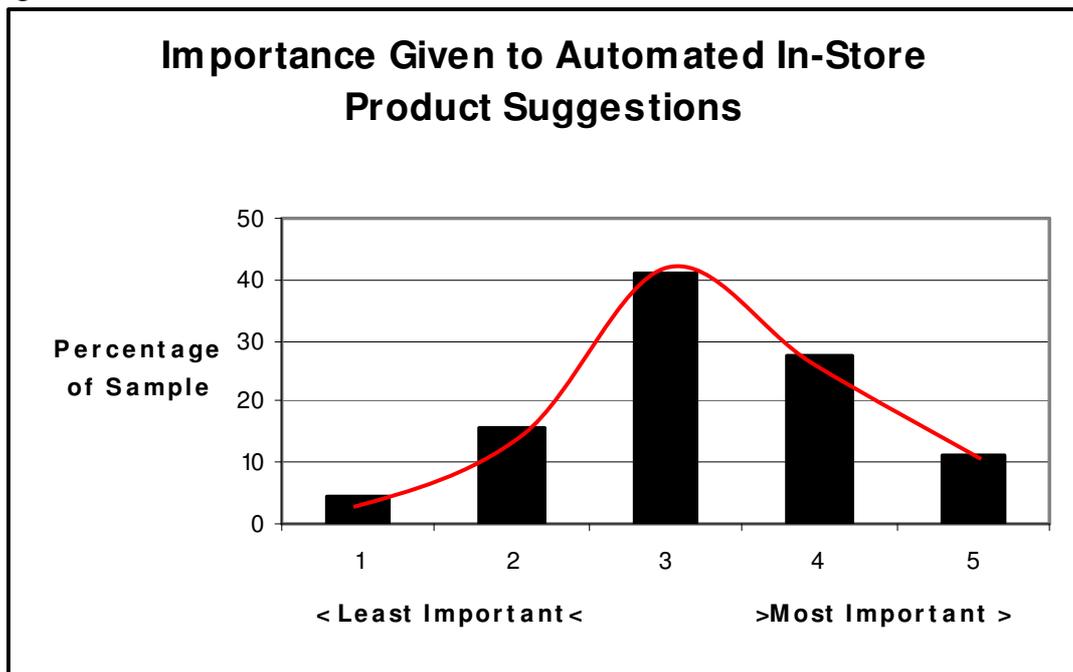
Figure 4.13



4.4.5 Automated In-Store Product Suggestions

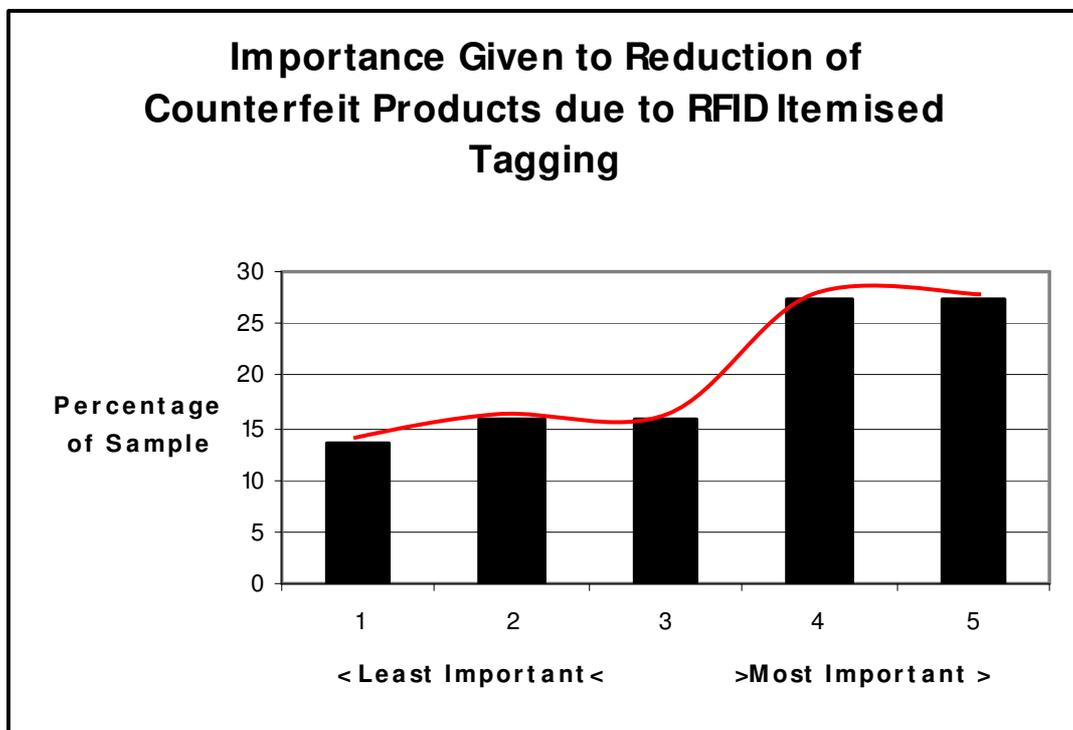
The responses to this question saw the sample stick to the middle thereby producing an almost flat distribution and a median of 3 suggesting that the sample could do without the targeted accessory suggestions while shopping. But a flare in the distribution towards the positive side (mean of 3.25) belies it and suggests that some respondents in the sample would like to be pampered. Only 36% considered this benefit to be important. The example of RFID implementation in METRO stores (IBM, 2008) was given in the lecture administered beforehand to give an idea to the respondents about the benefit.

Figure 4.14



4.4.6 Reduction in Counterfeit Products

Figure 4.15



The curve (Figure 4.15) produced by the responses for this question can be stated to be a classic natural curve but a mean of 4 and a median of 3.38 suggest that there was too much dispersion in the responses which leads to the observation that the sample was unsure about the effectiveness of itemised RFID tagging for preventing counterfeiting. Although 54% of the sample was of the view that RFID technology would be decisive in reducing counterfeit products.

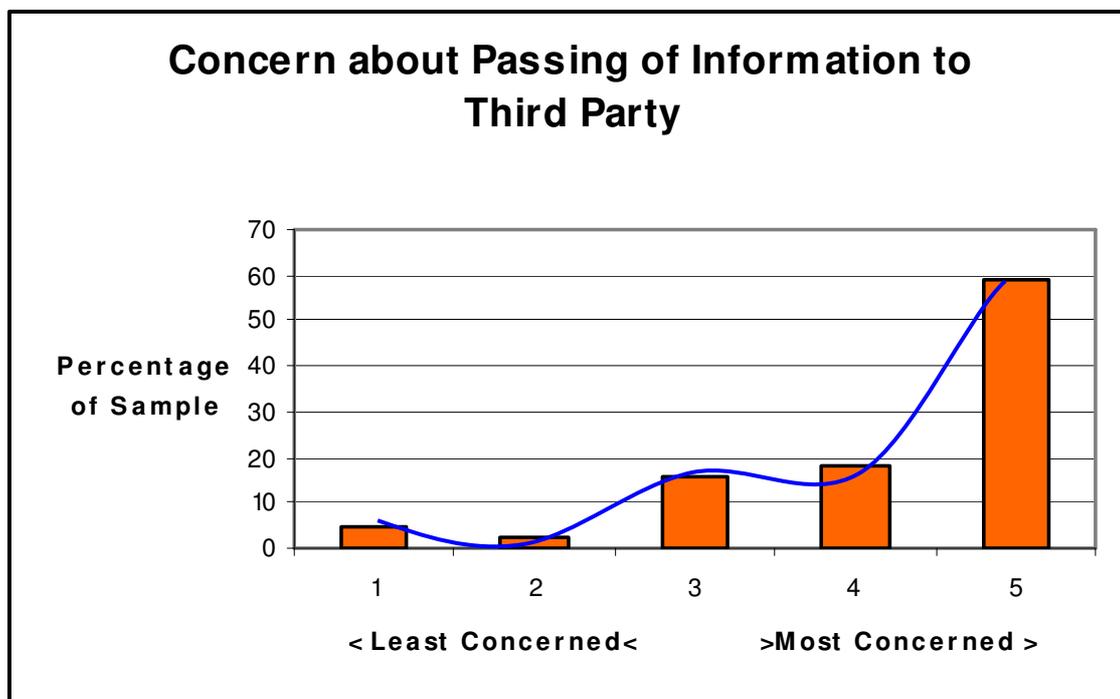
4.5 Concerns towards Itemised RFID Tagging

The last set of questions tried to measure the concerns of the sample towards Itemised RFID tagging. The responses were invited on a Likert scale of 5 - 1. 5 depicting most concern while 1 depicting least concern.

4.5.1 Passing Information on to a Third Party

The responses to this question produced a negative skewed curve (figure 4.16) with a mean of 4.25 and a median of 5 giving ample proof that the sample was very wary about their personal information being passed on to a third party. A whopping 77% of the sample was very concerned about this issue.

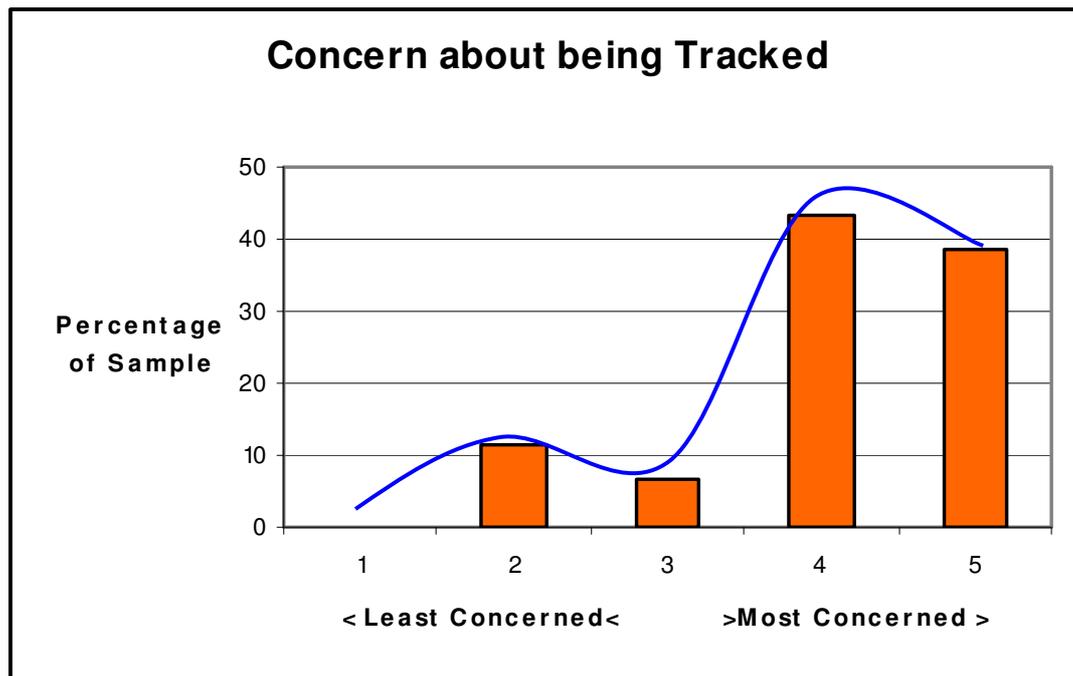
Figure 4.16



4.5.2 Possibility Being Tracked if RFID Tag not Killed after Purchase

By looking at the graph (Figure 4.17) the responses seem to produce a bi-modal distribution. But the mean of 4 and a median of 4 as well, suggested that the sample had a huge concern of having their movements tracked if the RFID tags on the products they bought from a retail outlet were not killed. About 81% of the sample was mindful of the tracking capability of RFID tags.

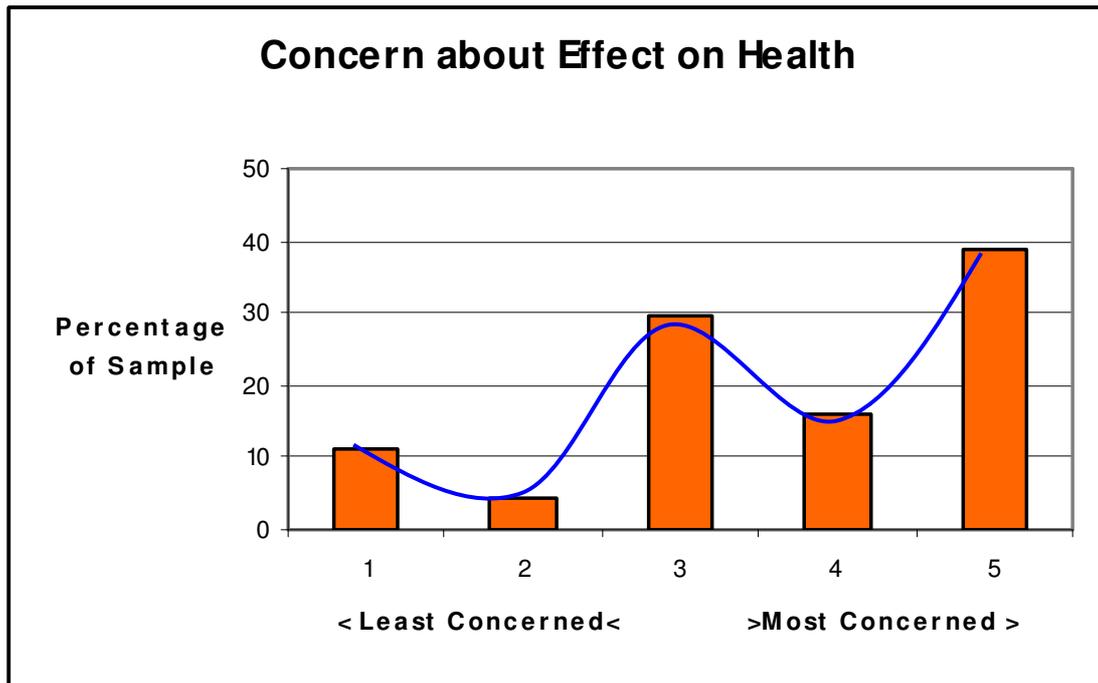
Figure 4.17



4.5.3 Effect of Electromagnetic Radiation on Health

The sample was very eager to point themselves as very conscious about their well being and health. The mean of 3.65 and a median of 4 clearly announced their thoughts about having another technological breakthrough in their daily lives affecting their health. Only 53% (Figure 4.18) of the sample showed major concern towards the risk of electromagnetic waves emanating from the readers on their health.

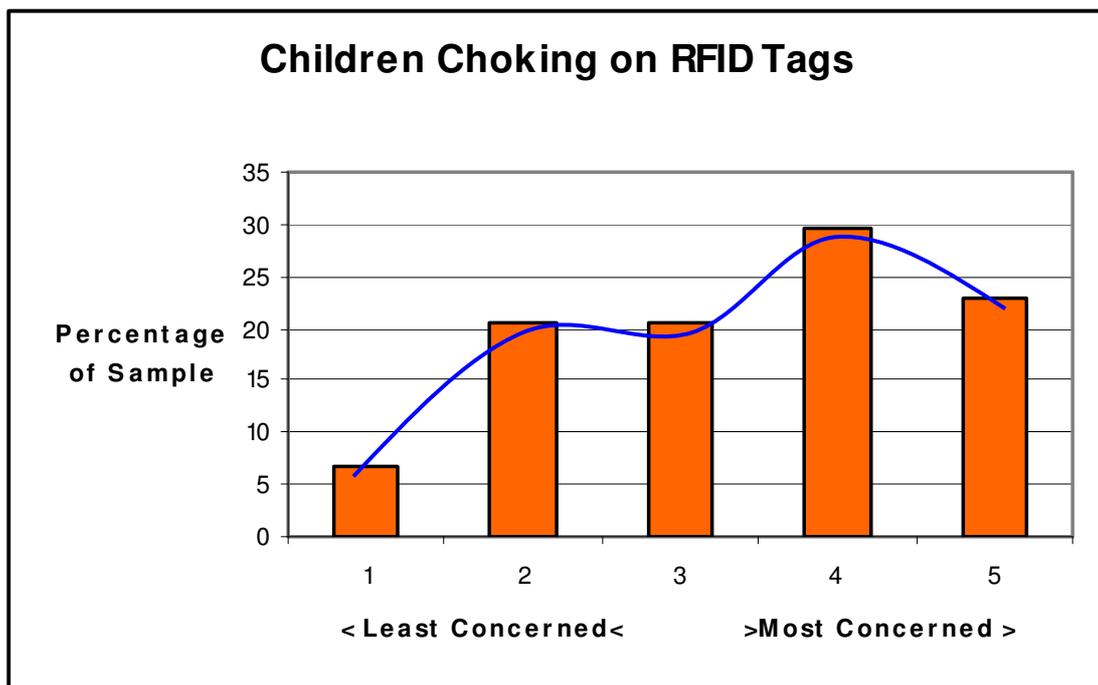
Figure 4.18



4.5.4 Children Choking on RFID Tags

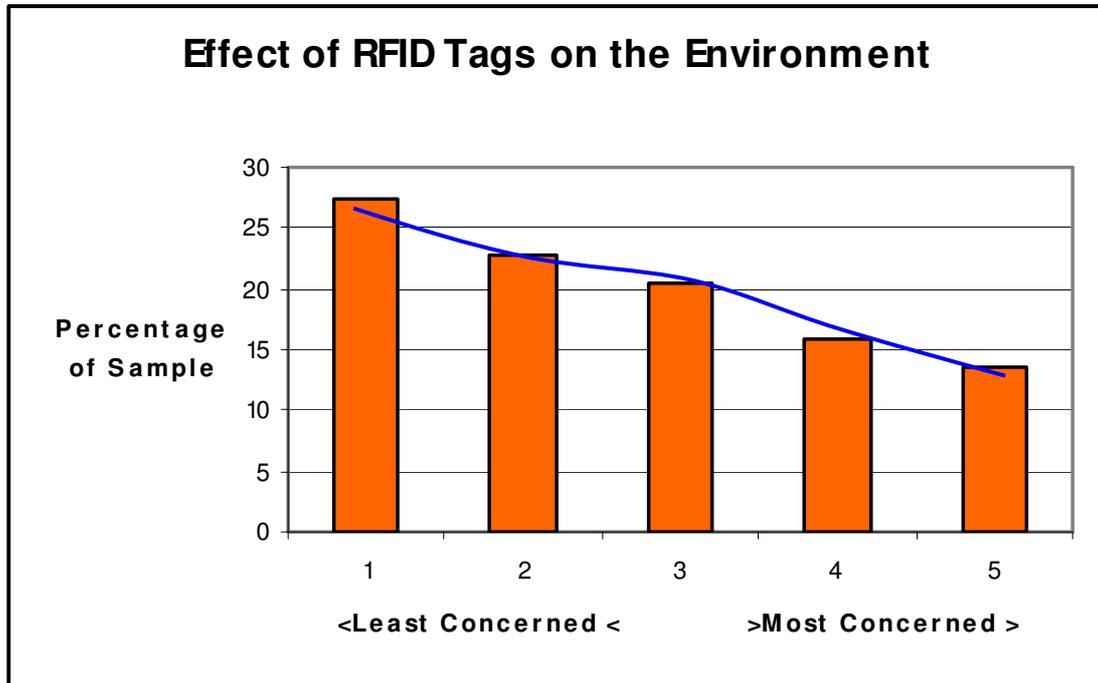
A small example from the movie Mission Impossible-1 was stated to the sample in order to give an idea about the size of RFID tag with reference to the book Spychips (Albrecht & McIntyre, 2005). The responses produced a median of 4 and a mean of 3.4 suggesting concern about the welfare of the young although the graph produced is very distributed and flat (Figure 4.19).

Figure 4.19



4.5.5 Effect on Environment

Figure 4.20



On observing the graph (Figure 4.20) the sample doesn't seem to be concerned about the environment getting polluted from the metals used in making the RFID tags if not disposed off properly. A straight line graph along with a median of 2.5 and a mean of 2.65 suggests very little knowledge about how the RFID tags can pollute the environment.

4.6 Procedures Followed to Protect Privacy

A set of four procedures were put before the sample for gathering their views on their acceptability and effectiveness on securing their privacy. Dichotomous responses were gathered and the results are depicted in the figures below.

Figure 4.21

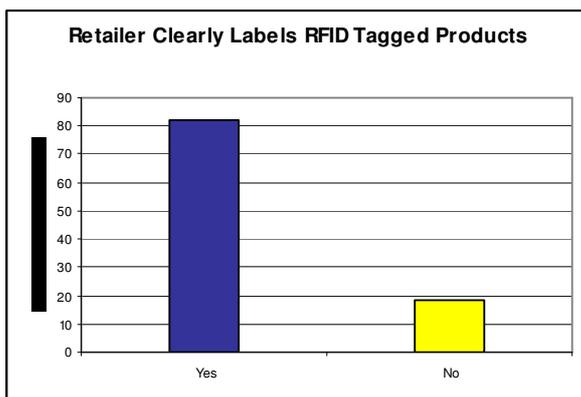


Figure 4.22

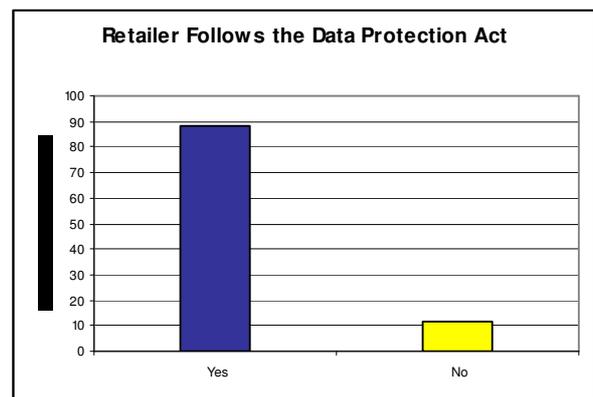


Figure 4.23

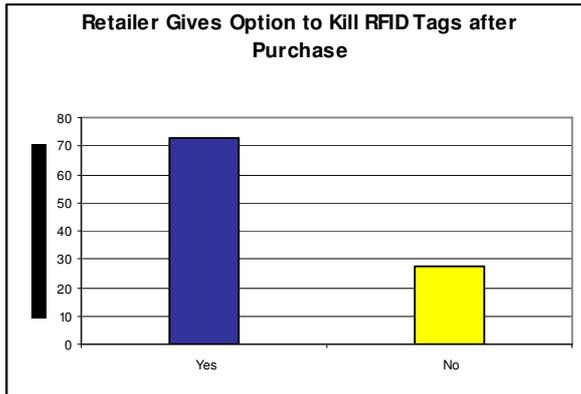
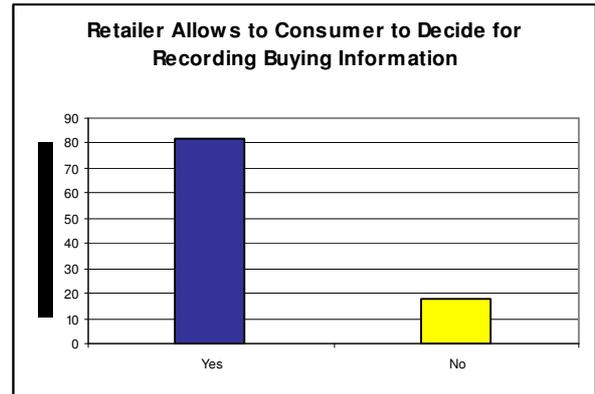


Figure 4.24



All the above figures give a clear indication that all the four measures suggested in the questionnaire for safeguarding the privacy of the consumer were welcomed with a huge majority by the respondents in the sample.

4.7 Summary

This chapter explored the findings relating to the questions put forth in the questionnaire. Concerns and benefits related to the new technology were measured along with the efficiency of the procedures followed to ensure the privacy. The next chapter would analyse and discuss the findings on the basis of the research questions.

5.0 ANALYSIS AND DISCUSSION

5.1 Introduction

In this segment of the study, analysis of the data from previous section would be done to answer the research questions. The analysis would be complimented with the secondary data got from the review of literature on this topic.

5.2 Research Questions

This research was conducted to do an exploratory study of the consumer response towards itemised RFID tagging in Ireland. Three research questions were formulated for attaining the specified purpose.

- RQ1- What would be the consumer response in Ireland to the possible implementation of RFID tagging at product level along with procedures to safeguard the privacy?
- RQ2- What is the basis of such consumer response towards RFID tagging?
- RQ3- What can the retailers do to ensure maximum positive response towards RFID tagging at product level in Ireland based on the conclusions of this research?

In order to answer the first research question the second one has to be answered first as it would form the basis for it.

5.3 Basis of Consumer Response towards RFID

RFID is a totally new technology and awareness about it is very negligible among the Irish population found from the primary research done during the proposal stage and proved in the research sample (figure 4.3). One of the primary reasons is that this technology is still not widely used in Ireland which begets the non awareness about it.

From the meagre research work done by other researchers to gain insight about the causes of consumer behaviour towards RFID, a common theme seemed to emerge. The author came across many literatures where it was suggested that the issues with RFID acceptance by the consumers depended upon its ability to gather vast amounts of data and the implications surrounding the use of that data by the data collector. This brings us back to

the issue of information privacy which is so much highlighted in the book *Spychips* (Albrecht & McIntyre, 2005). Collier (1995) sums up the threat to privacy as *“the perceived threat to our individual privacy owing to the staggering and increasing power of information processing technology to collect vast amounts of information about us, whether accurate, relevant, complete or otherwise and then store, analyse, interpret, compare and exchange it at high speed outside our knowledge, let alone our control.”*

So it can be fairly stated that the acceptance of RFID itemised tagging depends upon the way data is collected through it and used. Returning back to this research, it was very difficult for the author to get the outlook of the sample towards RFID due to non awareness about the technology. The sample had to be given a lecture by the author on the possible uses of RFID tags, the benefits, drawbacks and how it can be used to collect data.

On being questioned about them being tracked within the retail outlet with the help to RFID tags embedded in the products, 68% of the sample refused to buy products tagged with RFID tags which suggests that tracking the movement of any individual even within the store can create a sense of insecurity and lead to lack to trust on the retailer. This feedback is complimented by data received for another question which states that 81% of the sample was very much concerned about them being tracked outside the store if the RFID tags are not killed at the check out.

The observation the author can make from the above information is that the respondents value their physical privacy and do not want to part with it at any cost. Similar can be said about information privacy as well. 77% (figure 4.16) of the sample were most concerned about the data gathered by the retailer (data collector) being passed on to a third party without their consent. Granular data can be collected by RFID system which in layman term means that the system can recognise one particular box of a product segment in the possession of a consumer (Angeles, 2007). Such information if passed on can prove disastrous for any individual if it is used for diabolical purposes. This can prove to be worse if the tags are not killed at the checkout and thieves with portable readers can scan houses to check what products are inside the house (Kelly and Erickson, 2005).

On the other hand the 61% (figure 4.6) of the respondents in the sample did not mind the data collected on the items picked off the shelves which is further complimented by the finding that 68% (figure 4.8) of the sample did not mind targeted advertising based on the data collected by RFID system in the store. This may be explained by the find that 50% of the sample used loyalty cards of a major retail outlet which do mail offers and information on their new products and services. This is clear from the data gathered for another question where 52% (figure 4.7) of the sample had no issues towards the retailer associating their buying preferences to their personal data.

The other concerns of the children choking on RFID tags and the effect of the tags on the environment concerned only 51% and 28% respectively which made them less important against all the other concerns.

Going on the pattern of collected information the author can state that the consumer response towards RFID itemised tagging would depend upon the retailer maintaining information privacy and physical privacy of the consumers.

5.4 Consumer Response towards Implementation of Itemised RFID Tagging with Procedures to Safeguard Privacy

Ohkubo et al (2005) states that *“In order to increase consumer acceptance of RFID technology, RFID advocates must promote and implement comprehensive security measures along with consumer education, enforcement guidelines and research in and development of practical security technologies.”*

In order to cross examine the responses given by the sample towards the concerns surrounding RFID tags, four dichotomous response questions were asked in the questionnaire for finding the response of the sample towards itemised RFID tagging alongside procedures to prevent intrusion of privacy.

From the findings, it can be seen that 88% (figure 4.22) of the sample were positive about buying RFID tagged products if the retailer followed the laws governing the Data Protection Act. Furthermore 81% of the sample was at ease with the tagged products if the retailer labelled the products to having RFID tags (figure 4.21) and allowed the consumer to decide if they wanted the retailer to store information on their buying preferences (figure 4.24) which

voices similarities to figure 4.16 where 77% of the sample were uncomfortable about the data collected being passed on to a third party.

72% (figure 4.23) of the sample voted in favour of killing the RFID tags after the purchase which was similar to the concern voiced by 81% (figure 4.17) of the sample for their movements being tracked if the tags are not killed.

From the findings it can also be assessed that a maximum majority of respondents voted positively for implementing itemised RFID tagging for getting the benefits stated.

Thus it can be seen that there is a big picture being painted over here which suggests positive response to RFID itemised tagging but only if the following conditions are met-

- The retailer uses clear marked labels on the products to inform the consumers about the presence of RFID tags.
- The retailer allows the tag to be killed after the purchase of the product.
- The retailer follows the laws governing the data protection act.
- The retailer allows the consumer to choose if data regarding his buying preferences is stored.

5.5 Measures taken for Maximum Positive Response towards Itemised RFID Tagging

From the above information it can be seen that the threat to privacy is a major issue that dictates the positive outcome of the move towards the new technology.

The respondents were asked one open ended question about measures to be taken by the retailer to safeguard privacy elicited the following main responses from the sample-

Respondent 9- *“the movements should not be traced and private information should not be passed on to third party.”*

Respondent 12- *“make sure the information associated with RFID tag is not given and accessed by the third party as well as the RFID tag cannot be read by anybody else.”*

Respondent 14- *“Kill the tag after purchase of the product. Responsibility of the staff to follow data protection law.”*

Respondent 16- *“Letting customers decide how exposed they want their private lives to be exposed to the companies responsible for the RFID use.”*

Respondent 21- *“Deactivating the tag upon immediately after purchase.”*

Respondent 22- *“should not reveal the details to anybody else and delete the data after a while.”*

Respondent 24- *“using third party or government agency.”*

Respondent 27- *“should inform customers about all the technicalities and should take them into confidence.”*

Respondent 43- *“data collected should be used to gain a competitive advantage rather than sharing with third party.”*

In light of the above responses the author tries to suggest some measures from the secondary data which would create a favourable response towards itemised RFID tagging in Ireland.

5.5.1 Kill Function

Killing a RFID tag after purchase of the product is the easiest and cost effective way to ensure privacy protection of the consumer. It should be left on the consumer if he or she wants to have the tag killed. This also prevents anybody from tracking the consumer through the tag attached to the product. But killing the tag won't allow for the consumer to take advantage of products which take advantage of RFID tags to make their life more comfortable. A good example here would be of a smart fridge which has a reader that can detect what products are inside it and inform the consumer if any of them has expired.

5.5.2 Use of Smart Tags

The above problem can be taken care of by a smart tag which has a rewritable chip protected by encryption. The encryption would allow the tag to be only read by the reader having the key to open it. Also a pseudo random number generator can be used in the RFID chip to change the ID stored at specific intervals so that the tag cannot be tracked continuously.

5.5.3 Limiting the Range of the Electromagnetic Transmissions

Limiting the range of the electromagnetic transmission from an RFID tag can limit the readability of it from a greater distance. At present tags can be read from as far as 30 feet. Designing a smaller antenna for the RFID chip can limit

the effective distance it can transmit thereby ensuring that products can only be tracked within a visual distance of the reader which negates the tracking concern of the consumer even if the RFID tag is not killed after purchase.

5.5.4 Education

The consumers should be educated by retailer on the benefits provided to them by having the tags on the products and reaffirm that the data collected by the use of RFID tags would be handled in accordance with the Data Protection Act. . The consumer should also be notified of the procedures in place to prevent the breach of his or her privacy. This would build trust among the consumers towards the retailer and ensure positive response towards the process.

The benefits of reduced cost of products along with faster check out times at the till can be the decisive factor for maintaining a positive consumer mindset towards itemised RFID tagging. Educating the consumer about the benefits accorded by RFID tags can greatly increase the chances of it being widely accepted.

5.5.5 Cost

RFID tags provide retailers with the buying preferences of their consumer far better than the loyalty cards used at present. Additionally RFID technology offers the retailers with numerous other benefits such as an efficient supply chain and savings in employee time spent on stock counts. This relates to potentially huge amount of savings which can be passed on to the consumer which would have a knock on effect on the consumer preference of retailer for his shopping needs. Also due to the increased productivity, the cost of implementing the new technology does not have to be paid for initially by the consumers though increased prices of the products.

5.6 Summary

The data collected by the survey has been analysed for getting the answers to the research questions put forth for this study. The next section would take note of the analysis and try to provide a gist of the whole research along with the lines for a more thorough study with a wider sample.

6.0 CONCLUSION

The secondary and primary data collection done for this research has given a very wide insight into the implications of itemised RFID tagging in Ireland. Focus has also been given to the factors affecting the consumer perspective towards the new technology. Various methods used to put RFID tagging in positive light have also been discussed in this study.

As with any new technology, Radio Frequency Identification or RFID has some inherent flaws which raise concern about its use among the general consumer population. The lack of security features in the technology which leaves it wide open for anybody with knowledge of electronics and software to hack in and use it for demented purposes does not do any good to its image. The organisations using RFID technology are susceptible to attacks from low security features on the tag itself which can be taken advantage of through sniffing and spoofing a RFID tag (Sparkes, 2006).

The advantage of an RFID tag to be read from a distance on 30 feet can also be used by scrupulous elements in the society such as burglars to read the products in a house and plan their next heist (Kelly and Erickson, 2005). The lack of procedures in place to kill the tags embedded in the products after purchase can lead to the above scenario. The movements of the consumer outside the retail outlet can also be tracked through active tags (Albrecht and McIntyre, 2005) which create insecurity in the mind of the consumer due to breach of his or her privacy. Granular data collected by the RFID system installed on the premises of a retail outlet also creates concern among the consumer due to lack of knowledge about the future use of the data by the retailer. This tends to minimise the trust placed in the retailer using the technology for purposes to his advantage (Juban and Wyld, 2004).

Processes and methods put in place to increase the security of the RFID tags would go a long way in increasing the positive outlook of the consumer towards the technology. The main aim of all the methods used to promote the new technology is to try to increase the trust of the consumer placed in the retailer using it.

Educating the consumer on the benefits he or she can gain from itemised RFID tagging and processes put in place to prevent the breach of privacy

would go a long way in creating wider acceptance of the new initiative. The increase in trust put by the consumer in the retailer would see both the retailer and the consumer enjoy the benefits RFID technology has to offer.

However, it may seem that consumer is the one dictating the terms here but it's the retailer who gains all the ultimate benefits from use of the technology.

Limitations of the Study

Although this study has touched all the factors relating to the implications of itemised RFID tagging there are a number of limitations. First of all, the data was gathered from a convenience sample which cannot be generalised for the whole population of Ireland. Secondly the sample was picked from the students in Griffith College which comprised of maximum students in the age group of 23-30 years and belonged to many different nationalities which may have different perceptions about privacy. Lastly as the sample of respondents had no prior knowledge about RFID technology, administration of hypothetical scenarios of use of RFID technology in a retail environment might have created bias in their responses. Also presence of the author during the survey may have also caused response bias.

Furthermore due to this research being exploratory the claims need to be justified for the whole population in a subsequent research keeping in mind the problems defined for getting a positive response towards RFID itemised tagging.

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APPENDIX 1

QUESTIONNAIRE

1. Gender

Male

Female

2. Occupation

What is your current job title or job description _____

3. Which age group do you belong?

18-22

23-30

30-40

40-50

50-60

4. Which part of the world do you come from?

Ireland

Rest of Europe

USA

Rest of the world

About RFID

5. Before the presentation, did you know about RFID?

Yes

No

6. If yes, what did you know about it?

7. From which sources did you get to know about RFID?

Friends

Family

Newspaper

Website

Any other _____

8. If you had heard about RFID, what do you think about RFID ?

Positively

Negatively

9. Do you use any of the loyalty cards?

Dunnes Store Card
Boots Advantage Card

Tesco Club Value Card
Any other _____

10. Do you receive promotional discount offers and vouchers on using any of the above cards?

Yes

No

11. Imagine a retail outlet (eg: Dunnes or Tesco) which uses RFID tags on its products. Some of the benefits of RFID product tagging are given below. Rate them according to what you think is important to you.

Most Important

Least Important

5

4

3

2

1

Rating
(5-1)
Would you pay more initially for an RFID tagged product to get this benefit(Yes/No)

- Reduction in theft
- Savings from reduced prices due to reduction in theft
- Faster checkout at the till
- Less product stock outs
- Instant recognition leading to automated product suggestions in the store
- Reduced product counterfeiting

12. If the retail outlet follows the following conditions for the RFID tagged products, would you buy or not buy products tagged with RFID from them? Tick one of the boxes on the right.

I would buy RFID tagged products I would not buy RFID tagged products

The retailer uses clear marked labels to inform customers about the RFID tags on the products

The retailer follows the laws governing the data protection act
The retailer allows you to kill (deactivate) the RFID tag on the product after purchase

The retailer allows you to choose if you want them to keep information about your buying preferences, collected by the RFID system

Your movements in the store was tracked by the RFID system using the tags embedded in the products

