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RESEARCH ARTICLE/ARAŞTIRMA MAKALESİ

The Implementation and Use of "Pay as You Throw"

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Abstract

The UK Government has set targets for local Government to reduce municipal landfill, a key to achieving this is to increase household recycling. Despite investment and initiatives, the amount paid in landfill tax continues to rise, (Business Link, 2010). One proven initiative is 'Pay as you throw' RFID enabled schemes to monitor household waste and/or recycling levels. The literature review highlighted a number of benefits of the technology when considered in a supply chain application. It was suggested that fundamentally the technology allows a much greater vision of the inventory within a supply chain (Kazim, 2010; Kim and Garrison, 2010; Park, Koh and Nam, 2010). Adoption of RFID technology for the household waste in order to reduce landfill will be effective at adding value within a supply chain by reducing waste, increasing efficiencies and increasing customer service. The aim of this study is to consider the views of residents, from two County Council areas in UK, towards the use of such technology to monitor their waste and recycling. Neither area is currently on target to achieve 65% of all household waste being recycled by 2020, despite both implementing various initiatives, (GCC, 2010; GMWDA, 2010). The study was completed via two case studies as initiated by Yin in 2003. Secondary data was considered and the research was completed using six focus groups, three for each area. This research recommends that a larger scale study would allow greater social and economic factors of the participants to be considered. Overall the research concluded that with RFID there would be an increase in recycling rates but also an increase in fly-tipping. Usage of an effective method as RFID to manage municipal waste could be substantial savings in terms of landfill taxes on a local and national level and more importantly an improvement in the environmental impact of our

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current culture.

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Introduction

The EU has set stringent targets for the reduction in the amount of municipal waste that is going to landfill, (EU, 1999). These targets are becoming increasingly difficult to meet because populations are increasing (ONS, 2010) and as a result the volume of waste is increasing, furthermore the recycling percentage targets are increasing and therefore there are dual forces on these recycling goals (GCC, 2007).

The UK Government has also set targets for local Government to reduce municipal landfill, a key to achieving this is to increase household recycling. The net result, despite many recycling initiatives, is increasing landfill taxes (Business Link, 2010; Local Government Association, 2010). One solution that may help to readjust this balance is the use of RFID technology to monitor, weigh and charge/reward households for the amount of waste discarded into wheelie bins. A number of examples where the technology has been used this way found had a dramatic influence on reducing the amount of municipal waste going into landfill (AMCS, 2010; Texas Instruments, 2010) and increasing recycling. However a key consideration is the attitude of consumers to this relatively new technology, (Cazier, Jensen & Dave, 2007). Crucially would they be willing to accept RFID monitoring of their household waste in order to reduce landfill and thus landfill tax paid by their local council?

Main aim of this study is to consider the views of residents, from two County Council areas in the UK, towards the use of such technology to monitor their waste and recycling. By doing that a clear understanding of how these consumers feel towards the technology; and in particular if the financial pressures that are currently prevalent have an impact on their acceptance, or will there always be a level of scepticism despite the benefits that the technology may bring will be extracted throughout case studies and focus groups. The county councils that are being considered are arguably typical of the UK, (Local Government Association, 2010). County Council A is in the South West of England, and has a population of 564,559 and County Council B is in the North West of England and has a population of 284,528 (ONS, 2010). Council A spent £23,244,000 and Council B spent £19,729,000 on waste disposal for the year ending 2009, these figures represent 10.3% and 15.7% respectively of their total council tax revenue, (CIPFA, 2009). This figure is set to increase, even if the amount (in terms of physical tons) is reduced, because the actual tax is set to increase by at least £8.00 per tonne each year, (Business Link, 2010). Clearly it is a growing issue that is becoming increasingly pertinent in light of not only the environmental considerations (Environment Agency, 2010)

but also, given the current economic outlook, the financial constraints that local councils continue to be under (Local Government Association, 2010).

RFID is a rapidly growing technology with many useful and innovative applications, in particular it is effective at adding value within a supply chain by reducing waste, increasing efficiencies and increasing customer service, (Cain, 2010; Szmerekovsky and Zhang, 2008; Lee and Ozer, 2007; Niederman et al, 2007; Doerr, Gates and Mutty, 2006). Although we are dealing with municipal waste, this process still forms part of a supply chain, and as such these benefits of RFID can be considered within the scenario of this paper. However, much has been written around negative consumers' attitudes towards the technology, (Gunther and Spiekermann, 2005; Cazier, Jensen and Dave, 2007; Chrysochou, Chryssochoidis and Kehagia, 2009). The authors wish to explore acceptance of the technology by consumers in the UK, therefore this is a cross sectional study which is particularly pertinent given the current environmental and economic outlook, (Local Government Association, 2010).

This research has a number of strands that may be of interest to the wider business community. The consideration of industrial waste will become increasing important for any business that currently creates waste destined for landfill. In addition, growing landfill taxes provide an opportunity for business innovation. One example is the introduction of RFID as highlighted by this report, a company in the United States has used RFID technology to manage municipal waste by rewarding consumers with loyalty points for increased waste that can be recycled, (Recyclebank, 2010). Another key interest for business is the attitude of consumers towards RFID technology in general. Cazier, Jensen and Dave (2007) stipulate that the increased use of the technology in various commercial applications results in the technology becoming ever more prevalent in consumer goods, arguably consumer attitudes towards the technology therefore should be a key consideration in its use by businesses, particularly if it is viewed in a negative way.

The study is organized as follows. Initially, there is a section on RFID technology which describes what RFID technology is, its categories within supply chain, current use of this technology, advantages and disadvantages of RFID technology. Section 3 evaluates two methods available for utilising RFID technology to reduce the amount of municipal waste that finds its way into landfill. Section 4 discusses the research methodology and case studies. Section 5 presents findings on case studies. Results and discussions will be in Section 6. Finally, conclusion will be in Section 7.

RFID Technology, Its Use and Supply Chain Management

Radio Frequency Identification (RFID) is the name given to electromagnetic tags which utilise radio frequency to interact with a reader (Ustundag, Kln and Cevikcan, 2010). These small tags can be fixed to various assets and contain information pertinent to that which they are attached, (Akpnar and Haptan, 2010). Landt (2006) discloses that there are three aspects to the system; the RFID tags

themselves, the readers to harvest the information on the tags and finally a local computer to compile the data from the reader. Chawla and Ha (2007) construct the origins of RFID technology from World War II, where the emerging technology was used to identify friendly aircraft.

Chawla and Ham (2007) advise that the physical tags fall into three categories, passive tags, semi-passive and active tags. Boriello (2005) declares that passive tags are defined by their lack of a personal power source, consequently they need to be scanned at close proximity to the reader, Schwartz (2005) proposes just a few feet, the author states that they then become active through this reading action of the scanner which emits an electromagnetic wave. Borriello (2005) captures the strength of this attribute by arguing that the lack of a local power source results in a reduction in both production cost and physical size. An additional benefit this may bring is the longevity of the tag when placed within a supply chain context, which may involve many months where the tag lies dormant with no requirement for power. Chawla and Ha (2007) clarify that semi-passive tags have their own battery but are not able to transmit as they have no transmitter. Finally for active tags, Schwartz (2005), clarifies these as having their own internal battery and transmitter, this results in the ability for them to be scanned around 300 feet away and has clear benefits where there are a much larger number of items to be scanned; although the author states that their transmission can be activated (as opposed to being on permanently), this still leaves the implications of a limited battery life for both semi-active and active RFID tags[1].

There are increasing uses of RFID that seem almost limitless. Many diverse uses have been implemented already, for example Luvis et al, (2009) discuss the use of RFID to track the life cycles of expensive grape vines. Yao, Chao-Hsien and Li, (2010) and Ohashi et al., (2010) demonstrate the use of RFID to identify patients in hospitals and to ensure correct drug administration. Another diverse application is portrayed by Rohlwing, (2010) who shows the potential to record the lifecycle of expensive HGV tyres to ensure that value is being achieved and maintenance tasks completed through embedded RFID chips in the actual tyres themselves. The same technology, as discussed by Lin et al., (2010) can be used to track and find lost children in large open amusement parks. The plethora of

[1] Borriello (2005) determines the operational difference between the three is not just the ability to read from near or far. The author shows that passive tags hold a limited amount of preloaded static data about the item to which they are attached; whereas both semi-active and active tags have the ability to record further details. Borriello (2005) clarifies that these further details may be the history of the assets journey or environmental changes such as temperature or humidity that they have been subject to. Ustundag, Kln and Cevikcan (2010) state that the utilisation of RFID tags is ever increasing in a wide range of business applications due to their ability to operate in a multitude of environmental conditions. The authors highlight that this makes their use particularly valuable to supply chains as the tracking of assets can be achieved much quicker than conventional methods (barcodes) as they are transported to different geographical locations. When we add this mustering convenience to the active tags ability to record historical details of a journey, then we can just begin to expand the level of value that such technology may bring to any operation involving storage, monitoring, mustering or movement of numerous geographically dispersed assets.

potential applications continues when we consider service applications. Tan and Chang, (2010) discuss their use to increase customer recognition and service in restaurants through RFID loyalty cards, Adam (2010) demonstrates RFID enabled wristbands to be used at concerts to aid queuing and reduce counterfeiting and more simply Hou and Chen, (2010), discuss the use of RFID to assist consumers in finding products within a large supermarket to increase their purchasing experience.

There are numerous advantages to be realised in terms of RFID being used in a supply chain; i) If the municipal waste is considered as part of a supply chain, then we can begin to consider further efficiencies that the mover (local council authority) may be able to realise for the customer (tax payer); ii) One of the key benefits that partners in a supply chain may obtain by using RFID is a clearer vision of inventory configuration, (Kazim, 2010; Kim and Garrison, 2010; Ko et al., 2010; Park, Koh and Nam, 2010; Lee, Fiedler and Smith, 2007; Tzeng, Chen and Pai, 2007) clearly this ability to actually see the inventory is a key starting point in terms of gaining efficiency, iii) The literature defines two further clear benefits to reducing stock levels. Firstly labour costs become lower as the need to physically count stock is removed (Szmerekovsky and Zhang, 2008; Kim et al, 2007; Lee and Ozer, 2007; Niederman et al, 2007; Rekik, Evren and Dallery, 2007; Doerr, Gates and Mutty, 2006) and secondly a number of authors underline the downward trend of asset shrinkage (inter alia theft, loss) across a supply chain that may also be realised from reduced stock (Sarac, Absi and Dauzère-Pérès, 2010; Szmerekovsky and Zhang, 2008; Lee and Ozer, 2007; Niederman et al., 2007; Doerr, Gates and Mutty, 2006); and iv) There are further benefits that RFID may offer, if we move our focus up from the physical stock perspective, we can begin to consider wider benefits for the supply chain as a whole. The ability to communicate with different supply chain partners is a key benefit (Lee & Lee, 2010; Bottani, Montanari and Volpi, 2009; Lin, 2009; Kim et al, 2007). Most notably this visibility has an impact in the reduction of the bullwhip effect (Bottani, Montanari and Volpi, 2009; Lapide, 2004) where lack of up and down stream visibility results in amplified ordering.

In the case of the municipal waste process ultimately value will be created in terms of reduced costs overall when we consider to begin to conceptualise added value for the consumer (tax payer). Much of the literature brings together this base concept; that by adopting RFID then there is the potential for a fundamental increase in the overall efficiency of a supply chain, (Lee & Lee, 2010; Bottani, Montanari and Volpi, 2009; Szmerekovsky and Zhang, 2008; Kim et al, 2007; Lee and Ozer, 2007; Niederman et al, 2007)

Although the literature suggests that there are fundamentally far less drawbacks than benefits to RFID, some of the drawbacks are potentially quite substantial. Niederman et al., (2007) consider the challenges of utilising a large number of tags within an industrial workspace; the authors discuss how interference from many materials found in workspaces can cause disruption to the correct working of the system. Sundaram et al., (2010) and Niederman et al., (2007) comment on

problems arising from the growth in data borne from RFID. Chang, Klabjan and Vossen, (2010) challenge the idea that RFID is always beneficial as measuring the efficiencies from greater visibility of the supply chain is very subjective. The inability to quantify any return from implementing RFID appears to be a serious issue for many companies (Ferrer, Dew and Apte, 2009). This problem is confirmed by Lee and Lee (2010) and Lin (2009) whom calculate that the sheer cost alone is a substantial barrier for a number of companies, (and therefore perhaps for a county council under budget pressures also)[2].

Current Use of RFID to Manage Municipal Waste

There are currently two mainstream methods available for utilising RFID technology to reduce the amount of municipal waste that finds its way into landfill.

RFID rewards scheme: "Recyclebank"

The first application is through a rewards scheme, a typical key Company in this market is 'Recyclebank'. In association with local government, this company operates by providing RFID tagged plastic recycling bins to households, the bins are then collected and the amount of waste is transmitted via their RFID reading trucks. The household 'Recyclebank' account is then credited with reward points and therefore consumers are rewarded for recycling (Recyclebank, 2010).

This business model has had a great deal of success and as a result has been adopted by around 37 municipalities in the United States (US) and a smaller but increasing number of local councils in the United Kingdom (UK) (Recyclebank, 2010). Some of the key cases stories are shown below:

Table 1. Recyclebank Case Study Results

Township/Municipality	Results
Cherry Hill, New Jersey	Recycling rates increased by 135% in 1st week
Wilmington, Delaware	Recycling rates increased from 0 to 37% in first 6 months
Elk Township, New Jersey	Recycling rates increased by 135% since implementation of system* *(Date not known)

Source: (Texas Instruments, 2010)

[2]A number of authors determine that in terms of security, there are two fundamental issues with RFID technology; first there is the weakness of the tags themselves, (Atzori, Iera and Morabito, 2010; Yeh et al., 2010; Peris-Lopez et al., 2009) and secondly the use of a wireless network for reading the data, (Atzori, Iera and Morabito, 2010; Yeh et al., 2010). Potentially RFID chips placed in household wheelie bins are left unattended for lengths of time and clearly would be open to their data being exploited. It is obvious that these weaknesses are serious considerations when we consider the context of this study and cannot be ignored.

RFID charge scheme: "Cork County Council in Ireland"

Cork county council in southern Ireland implemented a similar RFID tagged wheelie bin system in 2004, (AMCS, 2010). The results since 2005 have been a substantial 40% reduction in the amount of waste collected, fewer collections being needed overall, a reduction in the average annual household bill (against a fixed weight scheme) and the amount of glass collected by bottle banks seeing an increase of around 44% (AMCS, 2010).

It can be seen that the use of RFID technology in all of these cases has had a significant and very rapid impact on the amount of municipal waste that is progressing to landfill sites.

Methodology

Saunders, Lewis and Thornhill (2007) consider different research strategies and conclude that the best research strategy is the one sit well with the research question. This paper uses a case study method in order to try and answer the research question and will consider the views of residents from two English county councils. There are a number of reasons why this strategy suits well with this study. Firstly the study is not testing a theory or even beginning with a theory, as highlighted by Baker (2003), but rather looking to extract consumers' attitudes to such technology. The literature review suggests that there is not one clear attitude and that furthermore it is one that is changing as the technology evolves, (Muller-Seitz et al., 2009). Secondly Baker (2003) and Yin (2003) propose that a case study is ideal for considering the whole view of what is taking place, arguably there could be many reasons for consumers' views of the technology, that have not ever been considered or that may not be discovered through a different approach.

Because the key empirical research aspect of this study is to 'explore' the views of local residents, then Baker (2003) shows that this leans itself towards the richer qualitative style. Further to this the use of focus groups to help explore these views also, as described by Yin, (2003) lends itself to the semi structured qualitative style of interviewing. These will be completed using questions or themes obtained from the literature.

The study aims to hold six separate focus groups with up to five people in each group. As Saunders, Lewis and Thornhill, (2007) state that participants are selected because they have some traits in common; in the first instance they will all be part of the catchment area as outlined above and secondly the three groups will be compromised of similar age bands within each focus group. So that focus groups will be used to extract the data and template analysis will be used to consider the data for analyzing qualitative data.

All participants will be given a copy of the 'informed consent form' prior to the start of the focus groups/interviews. Clearly this lays down the basic foundation that the participants will remain anonymous. Because of the philosophy of the

research (interpretivist view), inductive approach and focus group techniques, then there has to be a level of interpretation and real world influence that simply cannot be replicated perfectly again. Furthermore there is the question of access and time constraints.

Findings and Analysis

The findings based on the work carried out from the above methodology commence in this chapter. A discussion and evaluation of these results takes place and they are critically analysed and compared against the results discussed in the earlier literature review. Table 2 and Table 3 will sum key focus groups and group responses respectively.

Table 2. Key to Group Names Indicating Area and Age

Age Groupings	20-40	40-60	60+
Council A	Group 1	Group 2	Group 3
Council B	Group 4	Group 5	Group 6

Table 3. Group responses to Question 1

Question 1	Focus Group Overall Response	Key Themes from Literature Review
What prior knowledge and/or awareness of RFID and its applications does the group have? Article 1: What is Radio Frequency IDentification (RFID)?	In groups 1 and 4. All participants, except one, had some prior knowledge of RFID technology with one person highlighting its use specifically for monitoring household waste.	1.There is an increasing consumer awareness of RFID technology 2.There is an increasing consumer awareness of the implications of the technology 3.The technology is moving downstream and this is creating more awareness Cazier, Jensen & Dave, (2007)

	Groups 2 and 5. Only two of the five participants had some prior knowledge, one was a vague awareness "through sort of discussions with friends" but with no specific use and the second identified its use in tagging domestic pets.	1.There is a general consumer ignorance about RFID technology Hossain & Prybutok, (2008)
	Groups 3 and 6. Again one person had a vague knowledge and two other participants knew of the technology through the tagging of domestic pets, "I would say yes, I can relate to this, because it is the identity chip that you put in a pet" and in both cases again this was their dogs.	

Table 4. Group Responses to Question 2

Question 2	**Focus Group Overall Response**	**Key Themes from Literature Review**
From your knowledge of the technology, would you have any health concerns? Article: 2, RFID and some of its potential uses	In groups 1 and 4, both areas 1 and 2 had no concerns when considering this technology, person B in area 1 asked if it was the same technology as used in domestic pets, concluding "which is fine" when this was confirmed. In area 2 the use o RFID to tag new born babies was adequate justification to underline their lack of health concerns.	1.Health concerns are an issue for consumers when they consider RFID Chrysochou, Chryssochoidis & Kehagia (2009)

Table 5. Group Responses to Question 3

Question 3	Focus Group Overall Response	Key Themes from Literature Review
Would you have any concerns about your personal data?	Group 1 had no major concerns about the use of RFID and data privacy.	1.The actual use of the data is a key factor to consumers' acceptance 2.The type of data being held is a key factor also to consumers' acceptance Ohkubo, Suzuki & Kinoshita, (2005)
	Group 4 Had a fundamental mistrust of the technology.	1.There is a spectrum of consumers' attitudes towards the use of RFID when used to collect/ store personal data Angeles, (2007)
	Group 2 Portrayed a cautious acceptance of the technology.	
	Group 5 Also portrayed a cautious acceptance but more acceptance than group 2.	
	Group 3 Proposed it would depend on the type of data that was actually being held.	
	Group 6 A complete laissez faire attitude towards their personal data being held, as it was already held in numerous places anyway.	

Table 6. Group Responses to Question 4

Question 4	Focus Group Overall Response	Key Themes from Literature Review
Are convenience and service more important than data security?	Group 1 considered that convenience and service were important factors in adopting the technology	1.Data concerns are less of an issue for consumers than service and convenience Belanger, Hiller & Smith, (2002)

	Group 4. Invasion of privacy was a continued theme and ultimately the benefits offered for this group did not outweigh their privacy concerns.	1.Offering direct value in some way to the consumer will increase the likelihood the acceptance of RFID technology Lin, Sheng & Hsieh (2006)
	Group 2. Overall the group did not arrive at a definite answer to the question.	1.Increased levels of convenience over time will eventually outweigh concerns about data security Hossain & Prybutok (2008)
	Group 5. The group did not conclude their overall attitude on privacy concerns it do not emerge as a dominant problem.	
	Group 3. Similar to group 2 in that they did not arrive at an overall answer and were generally non committal.	
	Group 6. Service and convenience readily and easily outweighed data concerns for this group.	

Table 7. Group Responses to Question 5

Question 5, 6	**Focus Group Overall Response**	**Key Themes from Literature Review**
What are the group's initial thoughts on this? Article 3: Current use of RFID to manage municipal waste.	Group 1: This group wholly endorsed the use of technology in this way and were very much in favour of the potential use of RFID to help manage municipal waste levels. There was a small level of concern about whether everybody would use the system correctly, but fundamentally this was not a strong enough concern to avoid using the system.	1.There should be a greater consideration of consumer data privacy issues as RFID moves more downstream within a supply chain towards the end consumer Cazier, Jensen & Dave, (2007)

	Group 4 This group was also in favour of this system given their concerns over landfill increasing. However they did have a small number of caveats to their acceptance. Firstly there were concerns over the some members of society may be penalised financially because of the process of having to wash items to be recycled (resulting in higher charges where water meters are fitted) Secondly they felt that some other concessions should be made such as a reduction in water rates and/or council tax bills in recognition of the unpaid work of preparing items for recycling.	1.Consumer concerns about data privacy and RFID would generally dilute the positive effects of convenience that RFID may bring. Gunther and Spiekermann, (2005)
	Group 2 This group was generally reserved about the use of RFID in this way, there main concerns were a mistrust of the local council, inability to avoid packaged products and a concern that certain members of society will simply not work within any system. They were also the first group to highlight the potential increase in fly tipping that may occur as people attempt to avoid the charges	1.Acceptance of RFID technology is dependent upon the application for which it is used Lin, Sheng & Hsieh (2006) Eckfeldt, (2005) Ohkubo, Suzuki & Kinoshita, (2005) Belanger, Hiller & Smith, (2002)
	Group 5 This group had an overall mixed response to the article, there main concern was based around varying charges for their waste (making budgeting more difficult). However they were in favour of a potential reduction in their council tax bills. Finally this group echoed concerns from group 2 about the potential for an increase in fly tipping.	1.Increased value for the consumer from RFID technology will increase the levels of its acceptance Lin, Sheng & Hsieh (2006) Eckfeldt, (2005)

	Group 3 This group was generally very positive about the potential for being rewarded for recycling. They highlighted that another positive aspect is that such a system would target non recyclers and felt that this was a positive aspect. They did have a small negative concern about the lack of local recycling facilities currently available.	
	Group 6 This group was largely positive of the use of the technology in this way. In particular they echoed the views of Group 3 in that it would target all members of the public and in particular those that currently do not recycle. A small but minor point they raised was that implementation of the charge system for household waste would potentially be seen in a very negative light by the public as a whole.	

Table 8. Group Responses to Question 6

Question 6, 9	**Focus Group Overall Response**	**Key Themes from Literature Review**
What are the group's initial thoughts on this? Article 4: An extract from an English County Council website regarding landfill taxes	Group 1 Was not against the landfill tax charges per se with a caveat that the money should be re-invested locally in order to improve recycling.	See Next section (Q10)
	Group 4 Were not surprised at the figures and concluded that there will always be an element of waste to be landfilled anyway.	
	Group 2 Were shocked and dismayed at the figures but drew parallels with group 4 in that there will always be an element to be landfilled	
	Group 5 Generally were shocked and surprised at the high levels of the figures.	

	Groups 3 & 6 Had the same reaction as group 5.	

Table 9. Group Responses to Question 7

Question 7, 10	Focus Group Overall Response	Key Themes from Literature Review
Does this change the groups' views on RFID in wheelie bins? Article 4: An extract from an English County Council website regarding landfill taxes (Appendix B)	Groups 1 and 4 For both of these groups there were no changes in their views on the use of the technology to manage household waste. They had been in favour of the technology initially anyway so the figures in the article confirmed their views.	1.There should be a greater consideration of consumer data privacy issues as RFID moves more downstream within a supply chain towards the end consumer Cazier, Jensen & Dave, (2007)
	Group 2 This group did become more accepting of the technology when they considered the large costs currently associated with landfill from article 4.	1.Consumer concerns about data privacy and RFID would generally dilute the positive effects of convenience that RFID may bring Gunther and Spiekermann, (2005)
	Group 5 This group moved from mixed views of the technology more towards a position of acceptance once the landfill taxes currently being paid were considered.	1.Acceptance of RFID technology is dependent upon the application for which it is used Lin, Sheng & Hsieh (2006) Eckfeldt, (2005) Ohkubo, Suzuki & Kinoshita, (2005) Belanger, Hiller & Smith, (2002
	Group 3 This group had been in strong favour of the technology also, and the article merely confirmed their acceptance, although there was a little scepticism based around the charge system.	1. Increased value for the consumer from RFID technology will increase the levels of its acceptance. Lin, Sheng & Hsieh (2006) Eckfeldt, (2005)
	Group 6 Although sceptical about other uses of the technology, they had been strongly in favour of the technology used in this way to manage municipal waste. Therefore the article simply emboldened their acceptance of the technology.	

Conclusion and Limitations of the Study

The literature review highlighted a number of benefits of the technology when considered in a supply chain application. It was suggested that fundamentally the technology allows a much greater vision of the inventory within a supply chain (Kazim, 2010; Kim & Garrison, 2010; Park, Koh & Nam, 2010; Lee, Fiedler & Smith, 2007; Tzeng, Chen & Pai, 2007) . From the literature reviewed, it was proposed that the benefits to a supply chain are exponential when applied to an increasing number of supply chain partners, ultimately, when considered together, these combined benefits can add to the overall level of service and value available to the consumer, in order to offer a superior level of competitive advantage.

The literature discussed two business models for using RFID to manage municipal waste. The first scheme was run by a private company in the US and worked on the premise of rewarding households for the amount of recyclable material that they gave, RFID chips were used to relay the weight of the recycling wheelie bin. All three case studies produced significant increases in recycling rates (Texas Instruments, 2010). The second model involved using RFID to weigh wheelie bins whose contents were destined for land fill, the premise being that the heavier the bin the greater the charge to the household. The one case study that was available also produced a dramatic increase in local recycling rates and thus a reduction in landfill waste (AMCS, 2010).

Conclusion 1 is that the findings from the focus groups indicate that the dramatic increase in recycling rates, seen in the literature, would potentially be replicated as far as the focus groups were concerned. One of the strongest themes that emerged from the empirical research was that the schemes would raise a real awareness of the current waste that people generate. In particular this awareness would be raised not only with people that currently recycle but with most members of society, therefore having a greater impact. A caveat to this was a weaker theme that there will always be a small part of society that simply will not take part. Some groups considered this would be due to a simple unwillingness, but a stronger reasoning was a general lack of space for composting and storage for certain members of society.

Conclusion 2 is that fly tipping would potentially increase also in both areas a and b, particularly where the charge scheme was implemented, this was a seam of concern that ran few a number of groups but was not identified in the literature review.

Conclusion 3 that can be draw from the focus groups is that privacy issues would not be a particularly strong barrier to implementation for the participants in either Council area a or b, provided that the technology was replacing data that was already being held somewhere else anyway. Where such data is not already being held (for example on individual household waste levels) it also emerged from the focus groups that privacy would not be a major issue, provided that the greater benefits (value) added for the groups was sufficient enough. In effect this does not

align very well with the study of Gunther & Spiekermann, (2005) whom proposed that privacy would be a major barrier; however it affirms very strongly the work of Peslak, (2005) who proposed that the purpose for which the technology is used is a key factor.

Conclusion 4 proposes that there was, to a certain level, a spectrum of attitudes towards the technology, as proposed by Angeles (2007). In particular this spectrum of attitudes was based upon the actual application, this aligns to a degree with the work of Hossain & Prybutok, (2008), whom concluded that added benefits for the consumer do motivate acceptance. This is portrayed through some of the extracts below (See Table 10 each set of statements are from the same participant:

Table 10. Examples of Distinct attitudes to RFID, When Different Applications are Considered

Focus Group & Participant	Application	Direct Quote
FG3 Person B	RFID chips in humans for medical records Monitoring household waste	"I don't think it really changes my views on the chip going into humans [..] I don't really like that idea, that, no I don't like that at all" "So this to me is good, I like the idea of the chip, the wheelie bin thing"
FG2 Person A	Monitoring household waste Automated supermarket checkouts	"Well personally if such a system were introduced, I would like to embrace it, because we do produce far too much waste" "I don't like a lot of the technology side of things because it becomes very impersonal doesn't it?"

Conclusion 5 from the focus groups, is that none of the groups would have health concerns based upon the everyday use of this technology. With the exception of Chrysochou, Chryssochoidis & Kehagia (2009) none of the studies in the literature review proposed concerns over health as being an issue and therefore a barrier to acceptance; this lack of concern was a very dominant outcome in all of the focus groups within this study also.

Conclusion 6 is that both sets of focus groups were in particular favour of the rewards system and also, to a lesser extent, the charge system. Acceptance of the charge system would be likely but with a number of caveats; firstly there would need to be adequate and accessible recycling facilities for all members of society, secondly the ability for other people to discard their rubbish in your bin would need to be overcome, and finally a small reduction in perhaps water or council taxes would be a positive step in overcoming general negative feelings about such a system.

In terms of limitations, in the methodology, the selection of the participants was proposed. A more defined selection process, whilst more challenging, may have given different or more detailed results. Instead of simply selecting participants on age, an indication of maybe their social or economic background may have be more appropriate.

With the exception of one, the five other focus groups contained three people only. Whilst this was justified in the methodology as more practical for an inexperienced moderator, hindsight suggests that larger groups would have resulted in much greater discussion.

In addition only six focus groups were completed in total (three per area) ideally a much larger number may have allowed generalisations to be made (particularly if the selection criteria was more representative) However physically co-ordinating only 17 different people was a difficult task for one researcher, and typing the transcripts alone took around three full weeks, therefore more groups was simply not practical given the resource and time constraints.

The methodology proposed central, neutral locations in order to bring a level of consistency to the groups. However in reality many participants were just simply unable to attend. Due to practical issues of parking and shortage of time resulting in some non attendance, the central locations became a much less viable option as the process continued. Eventually a number of the focus groups had to be carried out within the homes of the participants, with one or two others attending to take part. From a practical aspect this worked very well and produced some good discussion; however from a critical aspect it removed a layer of physical consistency from the process and also meant that the groups were completed at different times of the day, this resulted in one particularly subdued group as it took place in the early evening at the end of their normal working day.

The physical questions asked produced some good discussion and results. However of the ten questions asked to all of the focus groups, three were eventually discarded altogether in the analysis stage. Two of these questions were simply answered by another previous question and they revealed no or little response in all cases. The third question to be removed was found to be almost a duplicate of a previous one, in the initial groups this resulted in confusion, it was eventually removed completely towards the final focus group sessions.

Finally this study did not consider the viewpoint of the local Councils themselves. A lack of direct access along with the large number of focus groups completed meant this was simply not a feasible option given both the time and word limit constraints placed upon this study.

In the future study a similar qualitative study could be completed but on a much larger scale and a much more rigorous selection criteria could be applied for the group participants. Furthermore, consideration of the views of the local council and opinions on the technology and its potential use within their area could be taken to add another dimension to the research.

Such a study could give a definitive picture of whether such effective methods as RFID to manage municipal waste could have a real impact on reducing landfill and increasing recycling. The net result could be substantial savings in terms of landfill taxes on a local and national level and more importantly an improvement in the environmental impact of our current culture.

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Appendix 1

1. Preliminary Focus Group Guide

Welcome

Informed consent form / anonymous

Length of session

Rules – no right or wrong answers

Tapes destroyed – nobody named personally

Explanation of 'Read out sentence' aloud for voice recognition on tape

Begin tape:

My Name

Date:

Location:

Purpose:

Continue with Interview questions/articles.

2. Focus Group Questions

(Show article 1, What is Radio Frequency IDentification (RFID)?)

Q.1. What prior knowledge and/or awareness of RFID and its applications does the group have?

(Show article 2, RFID and some of its potential uses)

Q.2. Is this a good or bad technology?

Q.3. Would you have any concerns about your personal data?

Q.4. Are there any advantages for the consumer?

Q.5. What are the group's initial thoughts on this?

(Show article 3 – Current use of RFID to manage municipal waste)

Q.6. What are the group's initial thoughts on this?

(Show article 4 – An extract from an English County Council Website regarding Landfill Taxes)

Q.7. Does this have any effect on the groups previous views on RFID in wheelie bins?

(Show article 4 – An extract from an English County Council Website regarding Landfill Taxes)

3. Focus Group Articles

Article 1: What is Radio Frequency IDentification (RFID)?

Radio Frequency IDentification (RFID) is a technology that allows automatic identification of objects, animals or people by incorporating a small electronic chip on its "host". Data is stored on this chip and can then be "read" by wireless devices, called RFID readers.

The concept is similar to traditional barcodes. [...] Compared to barcodes, RFID tags are "smarter": the information on the micro-chip can be read automatically, at a distance, by another wireless machine. This means RFID is easier to use and more efficient than barcodes: there is no need to pass each individual object/animal/person in front of a scanner to retrieve the information contained in each tag.

http://ec.europa.eu/information_society/policy/rfid/about_rfid/index_en.ht (European Commission, 2010)

Article 2: RFID and some of its potential uses.

RFID is used for tracking physical goods.

RFID-enhanced museum exhibits can be realised through reader packages mounted on museum exhibits, with RFID tags carried by visitors on cards or necklaces.

In libraries, RFID has been implemented for easy checkout of books and inventory control. Further, small passive tags can be put into items of clothing to protect their integrity and to prevent counterfeit products as well as to reduce theft.

The upscale clothier Prada has implemented RFID in its New York store, providing enhanced information about products to customers when they scan RFID-tagged clothes with portable readers. The dressing rooms are also RFID-enabled, giving customers video displays of runway shows or matching clothes and accessories to the items tagged.

In homes, RFID tags in clothes could potentially "talk" to a washing machine that automatically chooses the appropriate wash cycle to avoid damaging the fabric (Juels 2006), while sensors in refrigerators can detect expiry dates, keep up stock, reorder food over the Internet, and potentially provide relevant recipes for certain foods.

A more established application is RFID used in security keys. RFID-enabled keys are used for access control, such as car keys and automatic opening of car gates and doors at home

Automated toll payment for automatic cost deduction is a huge success, where RFID-tagged devices are attached to car windscreens.

In hospitals, RFID can be used to monitor a person's health and to give reminders about medication and pending refills.

ExxonMobil, the world's largest oil company, has used RFID in its SpeedPass, a service for automatic fuelling.

There are also plans for using RFID in bank notes and credit cards. The European Central Bank wishes to embed RFID chips into Euro notes as an anti-counterfeiting measure, to reveal money laundering attempts, and for counting and sorting money.

In tracking of animals and people, i.e., pets, children, and patients, using active RFID tags is another application that is already in operation.

Tracking patients (autistic and dementia patients) and preventing abduction of babies from hospitals is yet another practical application.

[...]

Item-level RFID can also yield new information and insights into shopping habits, as RFID leaves an "information trail" (Roussos 2006) of recordings about location, how and when consumers and products have engaged, and how the products travel through the value chain. It is expected that retailers, in their hunger for information about consumers, will want to follow this trail to gain knowledge of how the product is used in everyday life. This will make it possible to tailor more individualised offers and promotions to consumers as they return to the store, by connecting their profiles, interests, and lifestyle choices to available products.

(Slettemeås, 2009)

Article 3: Current use of RFID to manage municipal waste

By placing RFID chips into household wheelie bins, a local council could easily weigh the wheelie bin automatically on collection and then charge or reward the household according to the weight of recycling in the bin.

These two methods of RFID applications to monitor and manage household recycling rates are explained below:

1. RFID Rewards Scheme

The first application is through a rewards scheme, a typical key Company in

this market is 'Recyclebank'. In association with local government, this company operates by providing RFID tagged plastic recycling bins to households, the bins are then collected and the amount of waste is transmitted via their RFID reading trucks, the household [...] is then credited with reward points and therefore consumers are rewarded for recycling (Recyclebank, 2010).

This business model has had a great deal of success and as a result has been adopted by around 37 municipalities in the United States (US) and a smaller but increasing number of local councils in the United Kingdom(UK) (Recyclebank, 2010). Some of the key cases stories are shown below:

Township/Municipality	Results
Cherry Hill, New Jersey	Recycling rates increased by 135% in 1st week
Wilmington, Delaware	Recycling rates increased from 0 to 37% in 1st 6 months
Elk Township, New Jersey	Recycling rates increased by 135% since implementation of system* (Date not known)

(Texas Instruments, 2010)

2. RFID Charge Scheme

Cork County Council in southern Ireland implemented a similar RFID tagged wheelie bin system in 2004, (AMCS, 2010). The results since 2005 have been a substantial 40% reduction in the amount of waste collected, fewer collections being needed overall, a reduction in the average annual household bill (against a fixed weight scheme) and the amount of glass collected by bottle banks seeing an increase of around 44%

(AMCS, 2010).

Article 4: An extract from a County Council Website regarding Landfill Taxes

"We are currently charged £48 by the government in tax for every tonne of waste we put into landfill. This is on top of what we are charged by the landfill owners to use their sites. This year the council expects to pay approximately £7.7 million in landfill tax alone. Landfill tax increases every year, and next year it will be £56 per tonne."

(GCC, 2010)