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ATTITUDES AND BEHAVIOUR TOWARDS NON HOUSEHOLD WASTE
MANAGEMENT IN THE DUBLIN, IRELAND REGION

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Abstract

The hypothesis of this research was that attitudes and behaviours towards the management of biodegradable municipal waste (BMW) are spatially variable among the commercial sector (non-household sector), even within a city of modest (1.2 million) population. For a select number of representative electoral districts in the Dublin, Ireland region, businesses were surveyed regarding attitudes and behaviours towards waste management in general, and BMW management in particular. A total of 100 establishments were invited to fill in surveys with 71 completed surveys collected. Door-to-door interviews produced 20 responses; these were supplemented by 51 responses to a web-based survey. This resulted in a 71% response rate for the waste survey. It also showed the preference among businesses to the use of web-based survey modality rather than face-to-face interviews.

Statistical analyses of the survey responses showed the majority of commercial respondents (34%) regarded “reducing the amount of waste generated” as the most important future issue they face. The majority of privately owned businesses (as opposed to publically owned enterprises, such as schools) believe they should pay for waste management services. These statistical results proved the hypothesis of the research and demonstrated that waste management initiatives designed for one area of the city (or, indeed, for uniform application to the city as a whole) could ignore the needs of some sectors. The survey responses suggest that targeted intervention strategies would lead to improved diversion rates of BMW from landfill, a requirement of the Landfill Directive 1999/31/EC.

Key words: waste attitudinal surveys; Dublin; biodegradable municipal waste; commercial waste.

1. Introduction

Emery et al. (2003) found that in the residential sector, socio-economic status and housing characteristics affect not only the amount of municipal waste that individuals generate, but also how they manage it. This may also be true for the non-household sector. Previous surveys conducted in the Dublin, Ireland region by the authors concentrated on the residential sector (Purcell and Magette 2010). This research focuses on the non-household sector.

Much research has been carried out about residential waste management. Positive relationships have been identified between participation levels and number of waste segregations individuals must make at source (Noehammer and Byer, 1997); collection frequency and the type of collection container used (Platt et al., 1991); the day of the week when collections are made (Folz, 1991); and economic incentives (Harder and Knox, 1992). Social pressure has also been found to influence behaviour regarding waste management (Barr, 2003). Logically, no single, uniform solution can be expected to address all waste management requirements in a diverse commercial region; nevertheless, this is how many municipal solid waste management systems are currently planned and operated (particularly for the residential sector).

Huge demographic and economic changes have occurred in the Dublin region over the past 15 years. For example, the population in Dublin increased by 14% (1991 – 2006), Economic growth is linked with waste generation. In general there is a strong link between GDP (Gross Domestic Product) and waste generation (European Environmental Agency, 2001). In 2008, municipal waste generation in Ireland fell by 5%, in line with GDP (EPA, 2009a). A fall of 5% in the amount of municipal waste generated by Irish homes was reported in 2009, but this is mirrored by a 5% dip in the country's GDP over the same period (Bond, 2009). Increases in waste have been linked to economic growth (as measured by GDP), (Coakely and Cunningham, 2003) particularly in the last decade. It is reasonable to assume that major changes in attitudes and behaviours towards waste management have transpired as a result of economic changes over the past number of years. Solid waste management is receiving increasing attention due to its impact on the public concern for the environment (De Oliveria Simonetto and Borenstein, 2007) but also because of the looming requirements laid down in the Landfill Directive 1999/31/EC where we must progressively reduce the proportion of biodegradable waste going to landfill.

Any successful waste strategy must be inclusive, fully integrated with economic and social practices, and incorporate all sectors of society. This means that a wide range of social groups and actors must be actively involved (Coakley and Cunningham, 2004) in successful waste management planning. “Waste management” is a process set within a wider framework of social, political (EPA, 2006) and legislative structures and, therefore, needs to be considered in these contexts.

Education programmes can be very important to the effectiveness of a waste management strategy (Noemhammer and Byer, 1997), with schools being a valuable communication avenue (Long, 1989), potentially influencing large numbers of people in both the short and long terms. However, it is important that waste issues are promoted in a consistent manner in awareness campaigns (through education and media). The impact of the individual's behaviour on waste from households and small businesses is the principal target of the current waste management promotion in Ireland – ‘Race against Waste’ (Lyle et al., 2004).

The Irish situation and basis for this research

Previous research by the authors (Purcell and Magette, 2010) found that there to be spatial variations with attitudes and behaviours towards waste management in the residential sectors and this research aims to investigate this pattern in the non-household sector. While gains have been made in managing some solid wastes, Ireland is in real danger of missing mandated targets for the diversion of biodegradable municipal waste (BMW) from landfill, as set by the Landfill Directive 1999/31/EC (EPA, 2009).

2. Objectives

Previously, Purcell and Magette (2009) showed that waste generation was spatially variable in the region (Dublin, Ireland) where the research reported here was to be conducted. A previous residential survey (Purcell and Magette 2010) found the attitudes about the management of waste in the residential sector are spatially variable. This

research investigated if this is also true in the non-household sector. The hypotheses of the present research were that attitudes about the management of BMW, as well as about waste generation, are also spatially variable in the non-household sector. If both hypotheses are true, as with the recent residential study, this research reasons that non-household management of BMW can be better accomplished by targeting site-specific intervention strategies than by using the “one size fits all” approach characterised by current design practice.

3. Methods

This study was conducted in the greater Dublin, Ireland region which is comprised of four Local Authority areas, namely Dublin City, Fingal, South Dublin and Dún Laoghaire-Rathdown. In 2006, the population of the region was approximately 1.2 million. Each Local Authority manages solid waste separately, but all co-operate in doing so under a regional waste management strategy. The scale of study was the Electoral District (ED) (the smallest administrative area for which population statistics are published). There are 322 Electoral Districts located throughout the Dublin region, all of varying sizes and ranging from inner city districts with high population densities and busy commercial sector to rural areas with more dispersed populations and economic activity. Businesses from seven different commercial types distributed across the four Dublin local authorities, from inner city to rural fringes, were investigated; ranging in size from the large supermarkets and busy city centre restaurants to rural hotels and small corner shops.

3.1 Survey Compilation

Questionnaires offer the opportunity to simultaneously collect information on a number of topics in order to understand and predict behaviours or other relationships in the survey population. A survey was devised to examine non-household behaviours and attitudes towards waste management, particularly BMW, for the Dublin region. Recent research (Purcell and Magette, 2010; EPA, 2006; Steel, 1995; Davies, 1999) guided the selection of topics for the surveys. Questions and topics were selected to gauge not only attitudes and behaviour towards waste issues, but also perceptions and future concerns about waste management in Ireland (similar to a recent residential survey in the same area). In hopes that the research hypotheses would be proved true, questions were devised to help delineate intervention strategies that would lead to optimal diversion of BMW and could be tailored to specific areas within a Local Authority not just for the residential sector but also for the non-household sector. A desire to understand the reasons behind different waste behaviours and perceptions for waste activity were an important part of this research, as these details often were lacking from previous research. There is also a lack of research into the non-household sector in Ireland relating to waste management attitudes and behaviours. The surveys also considered that phenomenal waste management changes have occurred recently in the region, not only in the numbers and types of waste services providers, but also in waste practices (*i.e.* increase in private waste collection services, waste management packaging regulations 2007 etc.). Sixteen waste management questions were included in the questionnaires and six general information questions. Surveys were kept as concise as possible to keep respondents'

interest by minimising response time, while at the same time getting enough information from which to form realistic conclusions.

3.2 Questionnaire Design

Questionnaires included forced choice, scaled and open-ended questions on waste management topics and general information about the business, for example, the business location. Qualitative questions were included so respondents could expand on their ideas and opinions. Quantitative questions gave measurable insights into respondents' waste behaviour and future concerns. The questionnaire was designed with two sections containing the following:

Section 1. Waste Management

- Waste services questions,
- Waste behaviour,
- Attitudes about services,
- Influences,
- Perceived behaviour,
- Factors that may limit good behaviour,
- Attitudes / actions to waste,
- Future concerns.

Section 2. Specifics about the business

- Business location, business type, and local authority business was located in.

More detail about the questionnaires can be found in Purcell (2009).

Thirteen Electoral Districts were chosen from the 322 districts in the region for inclusion in the door-to-door survey (these were the same electoral districts included in a recent residential survey). Selection of these districts was based on two factors:

1. Predicted BMW generation rate (Purcell and Magette, 2009). Contiguous electoral districts were sought representing a high rate of generation and a low rate of generation.
2. Coverage among local authorities. Electoral districts were sought that would represent all four local authorities, *i.e.* Dublin City, South Dublin, Fingal and Dún Laoghaire Rathdown.

3.3 Non-household Survey

A questionnaire was developed for the commercial or 'non-household' sector, which included the following seven business types:

- Education (primary, secondary, 3rd Level institutes)
- Grocery
- Hotel
- Restaurant
- Takeaway / Fastfood
- Hospital
- Public house (i.e. bars and lounges *etc.*)

The same survey was used for all business types and was designed to be used in face-to-face interviews and a web-based instrument. Business locations surveyed deviated from

the electoral districts included in the door-to-door residential survey due to the more sparsely located nature of the commercial sector within particular areas. Within each of the four local authorities, selection of the individual establishments for inclusion in the research was based on:

1. Business type and location. Representatives were sought from each of the seven sectors distributed among all four local authorities,
2. Access to businesses/establishments,
3. Time and labour available (2 interviewers, 2 months),
4. Willingness of the sector to participate.

Commercial Web Survey

The web-based survey served to enhance the response rate and add to the range in respondent type (different business type *etc.*). In order to identify any repeat respondents and avoid multiple counting of their responses, the survey collected the respondent ID number from their computer and the time and date of survey completion. As with other questions, the survey relied on the honesty of respondents when reporting their local authority of residence. The web-based survey complemented the paper questionnaire and facilitated responses from the commercial sector. The non-household web-based survey was hosted on a commercial website (www.surveymonkey.com). The link to the survey was given to businesses that were too busy to have a face-to-face interview or where the relevant manager / person in charge were unavailable.

3.5 Conducting Surveys

Face-to-face interviewing of businesses was chosen above other means of surveying (*e.g.*, telephone interviews or postal surveys) as it was postulated that this would elicit a more substantial response rate. Surveys administered by interview in research by Zhuang *et al.* (2008) yielded a 95% effective response rate, as did Huang *et al.* (2006) in their survey handed out in public areas. Door-to-door surveys carried out by Vidanaarachchi *et al.* (2006) also generated a high usable response rate of 90%.

Surveys administered by post were not considered to be viable due to the generally low response rate reported for this technique in the literature. Postal surveys by Wilson and Williams (2007) generated a 42.1% response rate, while postal surveys carried out by Martin *et al.* (2006) generated a 33.3% response rate. Although door-to-door, face-to-face interviews were believed to be more personal and better suited than other methods of surveying as the primary method of eliciting responses, it was believed that internet-based survey instruments could supplement the traditional paper-based surveys and would be very suitable to the non-household sector. There is a lack of Web based survey in the literature.

Surveys were assembled using the Survey Monkey™ web site (Survey Monkey, 2008). Surveys were conducted from 31st January to the 18th March 2008. If a business declined to be interviewed, the link to the web survey was given and interviewers proceeded to the next business until the desired sample size of respondents was achieved. One hundred commercial establishments were contacted either in person or by email and asked to participate in the survey. To complement the face-to-face interviews for the commercial

sector the internet-based survey was hosted on the Survey Monkey™ website. An electronic link to the survey was emailed or given personally to those commercial businesses that, when contacted initially, expressed a preference for participating in the survey by this online facility.

3.6 Statistical Analyses

Responses were analysed using the Statistical Package for Social Sciences (SPSS, 14.0) (SPSS, 2006). Logistic regression (Agresti, 1996) was used to determine the strength of relationships between factors. Logistic regression is a generalised linear model, used to predict the probability of occurrence of an event by fitting data to a logistic curve. Logistic regression predicts the probability of a response (yes or no) on a scale of 0 to 1, which transforms probabilities to odds (likelihood). The *p*-value (significance) less than 0.05 was used by convention (Agresti, 1996). Linear multiple regression was also used to examine relationships between more than one factor. Linear multiple regression was used to predict each of six importance response variables (*i.e.*, the level of importance respondents ascribed to different elements in an integrated waste management system).

The total of 71 survey respondents (out of 100 asked to participate in the survey) were collected. For the analysis it should be noted the chi-square test (χ^2) (Agresti, 1996) to test for statistical significance was limited on many occasions because the minimum requirement of having at least five expected values per cell in the contingency tables was not met. When this occurred, Fishers Exact Test (in the *R* programme of SPSS) (Agresti,

1996) was used to verify if results were comparable; occasionally analysis relied on chart and count observations.

Characteristics of respondent sample

The response rate of 71% for the commercial sector was, on occasion, too small to have strong statistical power in the analysis. Nevertheless, it gave a good idea of the attitudes and behaviours for the 7 types of commercial establishments (education, grocery, restaurant, takeaway, pub, hotel and hospital) in the Dublin region. Respondents from businesses located in the city centre (~70%), in rural locations (~17%) and in shopping centres (~10%) were included in the commercial survey, representing each local authority.

4.0 Results and Discussion

A total of 71 (combining web-based and onsite interview) non-household surveys were analysed. The response rate for the commercial surveys was 71% (29 of the 100 businesses contacted declined to participate). A sample size of 71 surveys at the 95% confidence level from the overall 2261 commercial points (identified in Purcell and Magette, 2009) in the region gave a confidence interval of 11.45. Twenty businesses were interviewed on site while 51 filled in surveys using the on line facility.

4.2 Commercial Survey

A total of 35 responses from Dublin City; 12 from South Dublin; 10 from Fingal; and 14 from Dún Laoghaire Rathdown local authorities were collected, representing each of the

seven sectors included in the research. Publicly-owned commercial establishments comprised 21% (15) of the respondents; the majority (56 or 79%) were private businesses. The distribution of respondents among the commercial types in the survey was as follows:

- 14.1% Grocery
- 24% Restaurant
- 9.9% Takeaway
- 12.6% Hotel
- 18.3% Public Houses
- 4.2% Hospital
- 16.9% Education.

Non-Household Self Ratings as Managers of Waste

Businesses were asked to rate themselves as managers of waste on a scale of 0 to 3 (very poor to excellent). Data responses were scaled from 0 to 3 to aid interpretation in the regression model ($N= 71$, Minimum = 1, Maximum = 3, $M = 2.41$ $SD = 0.550$). The median rating of 2.0 (“good” manager of waste) was the same for both privately owned and publicly owned establishments. There were no ratings from the publically owned business group below a 2 (*i.e.* no public business rated them selves as either poor or very poor). Concurrently, although there was at least one rating of 1.0 (poor) from the private business group, there were no ratings of 0 (very poor).

Difficulty Managing Waste

Businesses were asked if they experienced difficulty managing their waste. The chi-square test results suggested a statistically significant association between difficulty businesses encounter in managing waste and local authority in which they are located ($\chi^2(3) = 8.043, p = 0.045$). The Fisher Exact Test (in the *R* programme of SPSS) revealed a comparable result ($p = 0.046$). In Dublin City, approximately 28% of respondents experienced difficulty in managing waste. Among Fingal and Dún Laoghaire Rathdown local authority respondents, approximately 40% said they had difficulty managing waste. However, in South Dublin this was a higher percentage with 75% of respondents reporting difficulty managing their waste (Figure 1).

For those that had difficulty managing waste, there was no statistically significant association between the type of waste causing difficulty to manage and the local authority in which the business is located. However, these results are suspect given the sparseness of counts ($\chi^2(12) = 15.698, p = 0.205$). The results from *R* the Fisher Exact Test (Agresti, 1996) grants a *p*-value of 0.221.

Non-Household Waste Service Satisfaction

The survey asked respondents to rate their level of waste service satisfaction. The chi-square test results suggested a non-significant association between the local authority in which the business is located and the waste service satisfaction rating ($\chi^2(6) = 8.121, p = 0.229$) in the surveys. There was difficulty using the chi-square test due to the number of high expected counts being less than five. Using *R*, the Fisher Exact Test (Agresti, 1996), grants a *p*-value of 0.3614, also suggesting a non-significant association.

Payments for Waste Service

Businesses were asked about their views on payments for waste services. The chi-square test results suggested a statistically significant association between type of business (education, restaurant, hotel *etc.*) and their views on paying for waste services ($\chi^2(6) = 17.401, p = 0.008$). However, as with the previous questions, there were concerns with low cell counts (50%), prompting the use of Fisher's Exact Test (Agresti, 1996), which granted a *p*-value of 0.008. The latter result suggests that the majority (~80%) of publicly owned businesses (education and hospital) do *not* support paying for waste services, while the majority of private businesses (~60%) *do* support the concept of paying for waste services. Nevertheless, there was diversity of opinion in the private commercial sector on this topic; approximately 35% of surveyed restaurants believe they should not have to pay for waste services, while 85% of takeaways believe they should not have to pay for waste services. The number of public house respondents that believe they should have to pay for waste services is similar to the number that do not believe they should pay (Table 1).

Reasoning behind attitudes towards payments for Waste Services

Businesses were asked for reasons why they believe they should pay for or not pay for waste services. The responses were grouped into six categories for analysis: government related reasons, feeling of responsibility, reluctant acquiescence, bad service, pro active environmental policy, and good service. The chi-square test of independence revealed marginally significant associations between reasons given for beliefs on payments for

waste services and whether businesses were publicly- or privately owned ($\chi^2(30) = 42.135, p = 0.07$). However, given that all cells in the analysis had expected counts less than five, Fisher's Exact Test (Agresti, 1996) was used. The results from Fisher's Exact Test *R* grant a *p*-value of 0.006, which confirmed an association. Thus, for publically owned businesses, almost all reasons were government related. For private businesses, the reasons behind beliefs for payments for waste services were approximately evenly distributed amongst all categories with the exception of "bad service". Few respondents stated "bad service" as a reason for their views on payments for waste services.

Composting and Business Location

The survey asked commercial respondents about their composting activity. The survey also asked respondents, from a prescribed list, to identify the type of setting in which their businesses were located. This information was combined for analysis to examine if composting activity is associated with business location. The chi-square test of independence results suggested a statistically significant association between composting activity and business location ($\chi^2(2) = 11.191, p = 0.004$). Fisher's Exact Test in the *R* program (Agresti, 1996) was conducted because of the high number of cell counts less than 5; this test indicated the results were comparable ($p = 0.004$) to the chi-square test. Nearly 60% of respondents located in rural locations said they composted their waste, while no respondents located in shopping centres said they composted their waste. Only 21% of respondents located in city centre streets said they compost waste. The mechanism by which city centre businesses accomplish the composting process was not

explored; since several private waste collection services also provide a composting service, it is possible that these businesses used a waste collection service that took the wastes away to be composted.

Non-household Waste Management Influences

The survey asked respondents to identify, from a prescribed list of influences, those that affected their waste management behaviour. The chi-square test of independence results suggested a statistically significant association between the local authority in which respondents were located and their choice that legislation / regulations was an influence on their waste management practice ($\chi^2(3) = 9.11, p = 0.028$). (The corresponding Fisher Exact Test p -value was 0.029.) Most (~80%) businesses in Dublin City and South Dublin local authorities said “No” to “legislation/regulations” acting as an influence on their waste management practice. All businesses in Fingal said “No” to this. However, the percentages for respondents who said “Yes” and “No” to legislation / regulations being an influence on them were approximately equal for those located in Dún Laoghaire Rathdown local authority (Figure 2). Likewise, the chi-square test of independence results suggested a significant association between local authority location and “business image” acting as an influence on waste management practice for businesses ($\chi^2(3) = 9.87, p = 0.02$). (The corresponding Fisher Exact Test p -value was 0.016.) The percentage of respondents who said “Yes” and “No” to business image acting as an influence on waste management practice was approximately equal for commercial operations in Dublin City. The percentage of respondents who said “Yes” to business image influencing their waste management practice declined to approximately 40% for South Dublin, 20% for Fingal,

and 7% for Dún Laoghaire Rathdown Local Authorities (Figure 3). These results seem to suggest that peer pressure among businesses is a stronger motivator in the centre of the Dublin region (*i.e.*, Dublin City local authority) than it is in the surrounding local authorities.

Non-household Future Waste Issues

Commercial respondents were asked about their future waste concerns and specifically, what they considered to be the single most important waste management issue for the future. The chi-square test of independence suggested a non-significant association ($\chi^2(18) = 27.281, p = 0.074$) between the local authority in which the respondents were located and the waste issues they believed to be most important in the future. Unfortunately, these results are suspect due to the high number of cell counts (92.9%) less than 5. Nevertheless, interpreting the results descriptively indicated that 33% of respondents identified “reducing waste generation” as the most important future waste issue. “Reducing waste to landfill” (for respondents in South Dublin local authority) and “improving recycling facilities” (for respondents in Fingal local authority) also rated high as important future waste management issues.

4.3 Discussion

“Reducing the amount of waste generated” is the most important issue facing Ireland in the future according to the non-household respondents. (This was also the case among residential respondents in a recent residential survey for the same area (Purcell and Magette 2010).

Perrin and Barton (2001) found that storage/handling problems, along with inconvenience/lack of time (Coggins, 1994) to be among the most common reasons for people not recycling. Most negative responses to composting in research by Price (2001) were cited as being lack of knowledge/awareness or the perception that too much effort was required.

Business respondents located in Dublin City local authority said they had the least problems managing waste (28%), while businesses located in South Dublin reported having the most problems managing waste (75%). Respondents in both of these local authorities reported “large/heavy” items as being problematic, which was the same waste category causing trouble for residential respondents in these local authorities.

The majority of respondents from privately owned businesses said they believe that they should pay for waste services and said that “responsibility” for waste generated was the main reason for this.

Only 18% of respondents in city centre located businesses reported composting waste onsite, while this was 58% for the rurally located businesses (schools made up a number of these). As might be expected, the main reason for respondents in city centre businesses not composting was that the “facilities deter” this activity; conversely the reason given for carrying out composting by businesses in the rural areas was “pro-active environmental actions”. Research by (Mee et al., 2004) has also found space (or lack of)

influences waste behaviour. While space constraints would logically prevent composting in heavily urbanised areas, solutions to this problem are available; for example, closed in-vessel composting is practiced at Dundrum Town Centre (Coles, 2007), one of Europe's largest shopping centres and located in Dún Laoghaire Rathdown local authority.

The reported influences on waste practices by commercial respondents differed among local authority areas. "Business image" was reported as most important by respondents in Dublin City (50%) while it was only reported as important for 7% of Dún Laoghaire Rathdown businesses. "Legislation / regulations" were reported as having an influence on Dún Laoghaire Rathdown located businesses (50%), while no business located in Fingal indicated legislation / regulations were an influence on waste practice. (Coincidentally, the lowest number of residential respondents in recent research said legislation / regulations were important influences on their waste management behaviour were also located in the Fingal local authority.) Advertisements were important influences for both Fingal and Dún Laoghaire Rathdown local authority commercial respondents (~20% each), while approximately 8% of South Dublin and Dublin City respondents chose this as an influence. (Interestingly, previous research of the residential respondents reporting that advertisements influenced their waste behaviour, the fewest of these were also in the Fingal and Dún Laoghaire Rathdown local authorities.)

The selections of the most important future waste management issues for the commercial respondents differed among local authorities. Dublin City and Dún Laoghaire Rathdown

businesses chose “reducing the amount of waste generated”, while South Dublin businesses chose “reduce landfill”, and Fingal businesses chose “improve recycling facilities” as the most important future issues. It could be argued from these results that respondents in Dublin City and Dún Laoghaire Rathdown have accepted the waste hierarchy, in which preventing and reducing the amount of waste generated is placed at the top of the hierarchy. While Fingal local authority respondents said improving recycling facilities was the most important issue for them in the future, this aspect of waste management is a lower priority in the waste hierarchy than waste reduction. In other research waste prevention has been reported less than recycling (Read et al., 2008) and may be more difficult to measure / understand than recycling. Although waste reduction through waste minimisation is the most effective means (Tonglet et al., 2004) to deal with waste at source, it can be a difficult concept to promote (Price, 2001). WRAP (2006) reported that local authorities have found waste reduction activities difficult to justify because it is difficult to measure the benefits. Overcoming difficulties in promotion, and measurement or monitoring waste reduction, may be an important step towards improving waste management by commercial establishments in the region. Coles (2007) showed that substantial financial savings can be achieved by businesses when they implement green business practices.

The Green Schools Programme (An Taisce, 2003) and the Greening Irish Hotels Programme (Irish Hospitality Institute, 2006) introduced by the EPA in 2005 should have a positive impact (immediate and long term) on the Dublin region in terms of general waste education and diversion.

5. Conclusion

This research proved the hypothesis that attitudes held by the commercial / non-household sector towards waste management vary spatially within the Dublin region, although some general attitudes are common across the region. The statistical analyses of survey responses also proved that waste behaviours are spatially variable.

By logical extension of the hypothesis, waste management initiatives designed for one area of the region (or, indeed, for the region as a whole) could ignore the needs of other areas in the region. The survey responses indicated that targeted intervention strategies designed for specific geographic areas are essential to improving diversion rates of BMW from landfill, a requirement of the Landfill Directive 1999/31/EC.

Interestingly, the attitudes and behaviours regarding waste management in the commercial sector are somewhat similar to those expressed in the residential sector in recent research by the authors; however, the strength of some of the statistical analyses was compromised due to the relatively small number of commercial establishments that participated in the research. Further study using a larger number of respondents is required for a more complete description of the commercial sector's attitudes, behaviour, perceptions and views on future waste management issues. This information can be utilised to formulate new waste management strategies and modify existing ones.

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