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Abstract

Purpose – The purpose of this paper is to explore different factors of recycling behaviour with evidence from Malta in order to determine which of these factors emerge as significant predictors of the recycling participation of Maltese residents.

Design/methodology/approach – For this study, the recycling behaviour of 400 Maltese residents selected at random from the e-Electoral Register for general elections and local councils was investigated. A behavioural framework was adopted and the questionnaire used incorporates elements from the Theory of Planned Behaviour (TPB), the Model of Altruistic Behaviour (MAB) as well as other determinants of recycling behaviour (e.g. inconveniences and demographic variables). The participants had the option of answering the questionnaire by telephone or via an online survey which was e-mailed directly to the participants.

Findings – The study shows that nine factors – "personal recycling attitudes, norms and skills", "satisfaction with service provided", "inconveniences", "awareness of consequences", "knowledge of issues", "social recycling attitudes and norms", "motivating factors", "intentions to act" and "scheme preference" – account for 68.5 per cent of the variability in the recycling behaviour of Maltese residents. Additionally, the first three factors highlighted above emerged as significant predictors of recycling participation and together accounted for 48.5 per cent of the variability in recycling participation. In the light of the findings, the issue of adopting a corporate communications programme emerges as a possible strategy aimed at putting mandatory EU recycling targets for Malta back on track.

Originality/value – This study provides empirical evidence from Malta that the incorporation of elements from the Theory of Planned Behaviour, the Model of Altruistic Behaviour as well as other additional variables (e.g. situational factors and demographic factors) makes a significant contribution to the understanding of the recycling behaviour and the recycling participation of Maltese residents.

Keywords Recycling, Behaviour, Waste Management, Malta

Paper type Research paper

Introduction

> Policy makers, planners, analysts and pundits generally adopt a top-down approach to waste management issues. They produce statements like: "If recycling rates were 25 per cent then . . . ". The "then" part of the statement can generally be answered, though the "if" and also the "how" can be quite uncertain. In a top-down approach, the details that actually make things work become turned into assumptions. The alternative is to adopt a "bottom-up" approach: to understand the details and then build these details up to give the bigger picture (Tucker, 2001, p. ii).

An important aspect of an effective and efficient solid waste management (SWM) system is recycling – the process through which materials previously used are

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collected, processed, remanufactured and reused. The most common forms of recycling of household waste are associated with materials such as paper, plastics, glass and metal.

This study comes at a time when the recycling of waste in Malta is becoming a very serious issue. As a member of the European Union (EU), Malta is obliged to recycle from 55 per cent to 80 per cent of its total waste stream by the end of 2013 to avoid facing EU infringements (see LN277/2006, 2006). Currently, the amount of separated waste stands at 5.71 per cent (see Ministry for Resources and Rural Affairs, 2009) when it should be at least 45 per cent. This implies that Malta is dramatically lagging behind its recovery targets. Even so, this issue is bringing a lot of controversy and debate in the local media. On one hand, there are those who claim that there is nothing wrong with the system (e.g. Fenech, 2008) while on the other hand there are others who argue that the current system is inefficient and uneconomic (e.g. Schembri, 2008).

These mandatory recycling targets present a serious challenge to Maltese waste management authorities. To reach such targets, the key is to increase the participation of residents in waste separation schemes (see Tonglet *et al.*, 2004). However, for schemes to be successful, we need to have a thorough understanding of the recycling behaviour of the residents. Additionally, we need to keep in mind that such recycling behaviour is "voluntary, diverse and susceptible to change" and so understanding such behaviour is crucial for "managing, directing, facilitating and influencing those behaviours towards the community good" (Tucker, 2001, p. 11).

Aim of study

The aim of this study is to investigate the recycling behaviour characteristics of Maltese residents. More specifically, this study will seek to identify and characterise the current recycling behaviour of Maltese residents and will seek to determine which factors emerge as significant predictors of recycling participation. In the light of the findings that emerge, recommendations for enhancing recycling participation in Malta will be proposed.

In Malta, research in the area is relatively lacking. This quantitative study therefore will focus on determinants that will then highlight the broader scenario rather than concentrating on a narrow focus and this will possibly generate interesting avenues for future research. We also intend to focus on residents rather than on householders because we believe that all citizens can contribute to the separation of recyclables (i.e. paper, plastic, glass and metal) in an attempt to reach the mandatory recycling targets set by the EU. Apart from this, residents are not limited to separate recyclables from their domestic residence since they can do so elsewhere (e.g., offices, schools, universities, recreational places, etc.).

Background to the study

Malta

The Republic of Malta lies at the centre of the Mediterranean Sea – 93 km south of Sicily and 288 km north of Africa, and has an area of 316 km^2 (see Figure 1). It consists of an archipelago: Malta, Gozo and Comino and three other smaller uninhabited islets. The climate is Mediterranean with hot, dry summers and mild winters. Malta currently has 395,742 inhabitants (NSO, 2009), thus making it the second most densely populated country in Europe with 1,309 persons per km^2. The residents in Malta are mostly

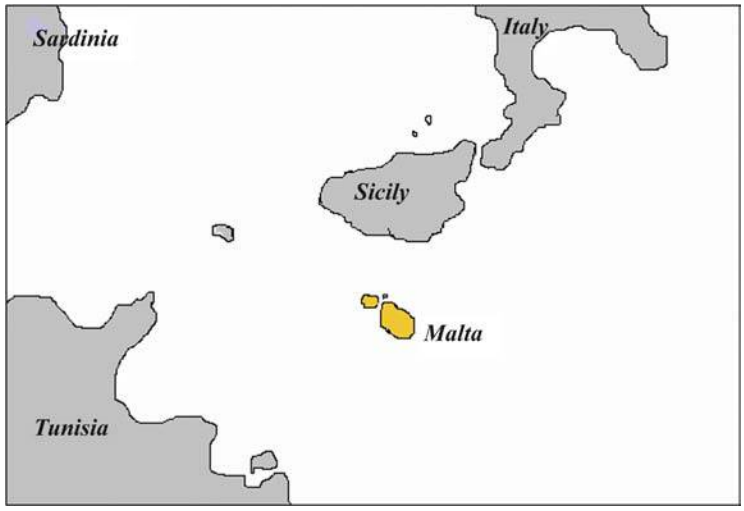


Figure 1.
Schematic map of the position of Malta

Maltese (95.6 per cent), Catholic and can speak both Maltese and English. Moreover, Malta receives around 1.2 million tourists per year, mainly originating from Europe. Malta became a member of the EU in 2004.

Legislation

Waste management is "the collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker" (Directive, 2008/98/EC, 2008).

The European waste management industry is in a period of major change and is expected to result in consolidation and restructuring. Several initiatives have influenced the development of EC directives intended to harmonise environmental policy in Europe by creating common definitions, standards and responsibilities. These directives define waste priorities such as prevention, recycling and reuse, and the safe disposal of non-recoverable residues. Recent legislation is redirecting the prevention issue to the manufacturers of materials which eventually end up in the waste stream. The plastic and packaging industries are urged to simplify the materials they produce and to focus on recycling their products. The first priority is to put pressure on the manufacturers to "prevent, or at least, minimise waste". The second priority, "waste recycling and reuse" is a prominent part of legislation, however until recently, the economics of recycling and the desire to use waste as a secondary raw material to generate energy were often at odds with political realities. The third priority, "safe disposal of non-recoverable residues" states basically that landfills are to be relied on only as a last resort.

National waste management strategies

In addition to EU legislation, the planning requirements of the waste management framework and other directives have led to the production of national waste management strategies which are now in place for Malta.

The first initiatives to establish a sufficient legislative and physical infrastructure for the proper management of solid waste on the Maltese Islands were consolidated through the publication of *The Solid Waste Management Strategy for the Maltese Islands* in October 2001 (Ministry for Resources and Rural Affairs, 2009). This identified 56 initiatives and the strategy has the overall purpose to provide a policy and decision-making framework for the future management of waste and for the preparation of implementation plans. WasteServ Malta Ltd has the responsibility, on behalf of the Ministry for Resources and Rural Affairs, to set up the technological infrastructure necessary where private initiative is lacking and to ensure that a sufficient capacity for waste management exists to be able to attain the aims and objectives of the strategy. Numerous developments in the waste management sector have occurred since 2001. These include:

- the setting up of WasteServ Malta Ltd to provide facilities and services in relation to waste management;
- the closure and rehabilitation of the Maghtab, Wied Fulija and Qortin landfills;
- the opening of an interim engineered landfill facility at Ta Żwejra;
- the introduction of bring-in sites;
- the development of civic amenity sites;
- the upgrading of the Sant'Antnin Solid Waste Treatment Plant;
- the introduction of construction and demolition (C&D) landfill to cease dumping of C&D waste at the engineered landfill; and
- the evaluation of the introduction of waste to energy facilities.

In February 2008, a new Material Recovery Facility (MRF) began operations at the Sant'Antnin Solid Waste Treatment Plant (SASWTP) in Marsascala. This MRF facility (funded through the EU Cohesion Fund) was originally designed to receive and process single streams of separated dry recyclable wastes (mainly household) such as paper, cardboard, plastics and metals collected from bring-in sites located around the Maltese islands. This investment represents a positive shift towards a more sustainable and environmentally friendly system of waste management, with recovery and recycling acknowledged as being the way forward.

In May 2008, the Maltese government introduced a new door-to-door collection scheme promoted as *Irriċikla t-Tlieta.* The Maltese version of this slogan was selected because it is a play on words. *It-Tlieta* means Tuesday and it also means three and so they are using this concept to separate three materials – plastics, paper and metals – which are collected together in one grey bag in a kerbside collection on Tuesdays. Although this has made it easier for households to get involved in recycling, it has also caused problems with regards to the operation of a plant designed to receive and process mono streams only.

A revision to the Solid Waste Management Strategy of 2001 was issued for consultation in January 2009. Amongst others, this outlines the fact that land-filling of untreated waste remains the least preferred option and thus other developments are required. It is important to note that private initiatives have been set up in order to recover funds from the recently implemented Eco-Contribution tax. Furthermore, it is currently hoped that the recycling rate in Malta will be pick up with the aid of third parties (e.g. importers) who are participating in a self-compliance scheme.

Literature review

In this section, we will first overview two models that have been applied successfully in the theoretical framework of several studies for understanding recycling behaviour. These are the Theory of Planned Behaviour (Ajzen, 1985, 1991) and the Model of Altruistic Behaviour (Schwartz, 1977).

Theory of planned behaviour

The Theory of Planned Behaviour (TPB; Ajzen, 1991) stems from social psychology and is an extension of the Theory of Reasoned Action (Fishbein and Ajzen, 1975).

According to this theory (see Figure 2), the immediate determinant of behaviour is the individual's intention to perform or not to perform that behaviour. Such behavioural intentions are then guided by three factors:

(1) *Attitudes.* A psychological emotion that determines whether the individual's evaluation of performing the behaviour is positive (producing a favourable attitude) or negative (producing an unfavourable attitude).

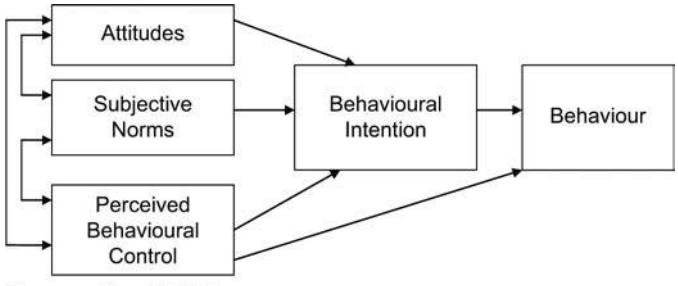
(2) *The subjective norm.* The individual's perceived perception of social normative pressures that he or she should perform or not perform the behaviour.

(3) *Perceived behavioural control.* The individual's perception of their ability (ease or difficulty) to perform the behaviour. It comprises facilitating conditions (or convenience factors- compatibility with available resources and lifestyle) and self-efficacy (one's belief of whether he or she will perform the behaviour successfully based on the adequacy of knowledge). Perceived behavioural control can also influence behaviour directly.

There is considerable support for the TPB in understanding the recycling behaviour of householders (e.g. Boldero, 1995; Davis *et al.*, 2009; Tonglet *et al.*, 2004). The general picture that emerges from these studies is that the stronger the attitudes and the subjective norms towards recycling are, the greater the perceived behavioural control becomes and consequently the intention to recycle waste becomes stronger.

The model of altruistic behaviour

In this cause-and-effect model, Schwartz (1977) addresses the impact of social norms (the pressure by society to perform a said task) and personal norms (a moral obligation to do the right thing) on individual behaviour in the decision making process. He argued that social norms do not influence behaviour directly. Social norms are



Source: Ajzen (1991)

Figure 2.
Theory of planned behaviour

translated into personal norms and these are acted upon by two key components – "awareness of consequences" and "ascription to responsibility." Without these two components, behaviour does not necessarily follow (see Figure 3).

Generally speaking, studies (e.g. Aung and Arias, 2006; Davies *et al.*, 2002; Vining and Ebreo, 1992) indicate that recycling becomes "the right thing to do" when this notion is perceived by society at large, when the individual has recycling knowledge and is aware of the consequences for not recycling, and not only believes that his or her contribution is effective but also feels a moral obligation to recycle.

Other determinants of recycling behaviour

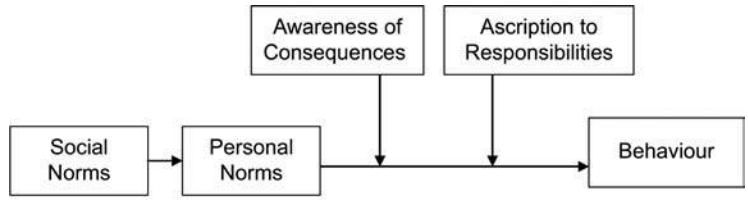
Many researchers have used these theories in conjunction with other variables in order to provide a more comprehensive picture of recycling behaviour. In the following section, we will overview five of the factors that received particular attention in the research literature.

1. General environmental concern. Environmental values encompass the underlying attitudes towards the environment. Studies show that "ecologically concerned people do not seek economic advantage but rather the general satisfaction of knowing they are doing something worthwhile and beneficial" (Hopper and McCarl Nielsen, 1991, p. 198) and those persons who are concerned about the environment for its intrinsic worth are more likely to behave in environmentally appropriate ways (Vining and Ebreo, 1992). Thus, by implication, persons concerned with the environment are more likely to recycle waste. However, there are very few studies that support this relationship (e.g. Aceti, 2002; Lansana, 1993; McGuiness *et al.*, 1977); many others found a weak or negligible relationship (e.g. Oskamp, 1995; Vining and Ebreo, 1992).

Schultz *et al.* (1995) argue that the reason why it is difficult to find that environmental concern is a significant predictor of recycling performance is due to the fact that today more people are recycling, that both recyclers and non-recyclers have pre-environment attitudes and so their reasons for recycling are more widespread. They add that general environmental concern appears to be related to recycling only when recycling requires a high degree of effort.

Tucker (2001) argued that the research literature indicates that recycling knowledge such as procedural knowledge, general background and performance aspects (such as feedback) is more important that "general environment concern". He adds that "lack of knowledge, or the understanding or acknowledgement of it, generally inhibits recycling or leads to poor recycling performances" (Tucker, 2001).

2. Situational factors (inconveniences). Situational factors are those factors which contribute to the set of conditions to which a person acts or reacts and embrace enabling and disabling influences. Understanding what inhibits individuals from



Source: Schwartz (1977)

Figure 3.
Model of altruistic behaviour

recycling is the first step towards increasing participation. Aceti (2002) claimed that those persons with a stronger perception of recycling as inconvenient recycled less or did not recycle. He concluded that the types of difficulty encountered include:

- lack of time to recycle;
- lack of space to store recyclables;
- pest concerns;
- messiness;
- difficulty in moving a recycling bin or barrel to kerb; and
- too few drop-off sites in inconvenient locations.

Kline (1988) argued that we should not expect individuals to engage in conservation behaviour if "the expected behaviour is regarded as cumbersome, inconvenient and ineffective". Many other researchers have confirmed that cost-benefit tradeoffs (e.g. cost in time and effort of recycling) are crucial factors that influence the recycling behaviour of individuals and if these cost-benefit tradeoffs are higher than the benefit (e.g. altruistic feeling), then recycling is less likely to occur (Neale and Vitartas, 2009; Vining and Ebreo, 1990). In such a case, the promotion of availability, ease and convenience of recycling is necessary (Barr and Shaw, 2006).

3. Subjective norms. This concerns the influence by others in forming norm behaviours. Aceti (2002) argued people are motivated to recycle by actual pressure they receive from family and friends to do so. Furthermore, simply knowing that family, friends and neighbours participate in recycling activities increases the likelihood of participation. However, Vining and Ebreo (1990) highlight that the social influence is high only when the visibility of the behaviour is high. When the visibility is low (e.g. in drop-off schemes), the social norms are not significant.

Hopper and McCarl Nielsen (1991) introduced prompting and information strategies into the community recycling programme to examine the impact on norms and attitudes and on recycling behaviour. Results showed that the two strategies introduced had no impact on norms and attitudes but had an impact on recycling behaviour. The greatest impact on recycling behaviour (and independent of norm) was from block leaders followed by prompts and information strategies respectively.

4. Financial motive and reward schemes. It is generally agreed that short-term monetary incentives such as lotteries that reward a random recycler for the effort does not produce lasting behavioural change. Additionally, those who respond to the reward recycling technique show a low intrinsic interest in recycling (see Meneses and Palacio, 2006) and have not assimilated a favourable attitude towards recycling and recycling involvement (see Bohlen *et al.*, 1993).

Recently, many communities (particularly in the USA) are introducing the pay-as-you-throw (PAYT) programme as a tool of urban waste management. PAYT is a system where residents are asked to pay for the amount of garbage they produce, on a per-container basis. The United States Environmental Protection Agency (2009) argues that PAYT is an effective tool for communities that are struggling to cope with soaring waste management expenses since it creates a direct economic incentive to householders to recycle more so as to produce less garbage.

5. Demographic factors. There are various demographic factors that have been considered in studies related to recycling behaviour. However, the three factors that

seem particular relevant for the present study are gender, educational level and age. The following is an overview of the major findings:

- *Gender*. Some studies indicated that females are more likely to recycle than males (e.g. Aung and Arias, 2006; Davis *et al.*, 2009; Granzin and Olsen, 1991) while many others reported that gender was not an important factor as both males and females claimed to be the main recycler in the household (e.g. Aylesford Newsprint, 1996; Vining and Ebreo, 1990).
- *Educational level*. Some studies found that persons with a higher educational level are more likely to recycle (e.g. Katzev *et al.*, 1993; Lansana, 1993) while others found no relationship (e.g. Gamba and Oskamp, 1994; Vining and Ebreo, 1990).
- *Age*. There are studies which reported that older persons are more likely to recycle (e.g. Davis *et al.*, 2009; Lansana, 1993; Vining and Ebreo, 1990) while others reported no significant correlation (e.g. Boldero, 1995, Gamba and Oskamp, 1994).

Proposed framework

This paper seeks to incorporate elements of the Theory of Planned Behaviour, the Model of Altruistic Behaviour as well as other additional variables related to recycling behaviour in an attempt to provide a comprehensive explanation of the recycling behaviour of Maltese households. More specifically, the proposed framework is behavioural and includes "knowledge of issues", "awareness of consequences", "social recycling attitudes and norms" "personal recycling attitudes and norms", "inconveniences" (or situational factors), "motivating factors", "intentions to act", "knowledge of recycling skills", "satisfaction with service provided", "scheme preference" as well as three socio-demographic factors (gender, age and educational level).

Method

Participants

The targeted population in the present study consists of all Maltese residents while the sampling frame consists of all the local residents who were listed in e-Electoral Register (ER) for general elections and local councils (April 2009) and whose details could be matched in the local e-directories. This means that the sampling frame used excluded persons that might not be in the ER since they did not have a permanent residence at time of compilation as well as other persons who are listed in the ER but are not listed in the local telephone directories. In this study, the sampling technique employed was simple random sampling.

The instrument

In the preliminary stage, an interview was conducted with 20 Maltese residents (selected at random from the sampling frame) to request information on their general behaviour towards waste separation. This information was incorporated with the knowledge obtained from the literature and used as the basis for the design of a questionnaire. The resulting questionnaire items were discussed with these householders to ensure that no items were ambiguous or unclear. Following this

exercise, some items were reworded in a way to render the questionnaire more comprehensible.

The resulting "Recycling Behaviour of Maltese Households Questionnaire" was then presented to the Chief Executive Officer (CEO) of WasteServ Malta Ltd to give a quality judgement on the appropriateness of the questionnaire items. Following discussion with his Technical Personal Assistant and with the Operations Executive, it was concluded that the questionnaire encompassed all the relevant content areas. A second opinion was obtained from an independent expert in the field who also confirmed the content validity of the instrument.

The questionnaire consists of 33 items and respondents were required to respond to the items on a five-point Likert scale ("1" = strongly disagree to "5" = strongly agree). Where necessary, items were reverse coded and then recoded to maintain consistency. Such items are marked with an asterisk (*). Prior to exploratory factor analysis, the questionnaire contained the following sections:

(1) *Knowledge of issues*:
- I am aware of the recycling targets set for Malta by the EU.
- Land is scarce in Malta and so land filling is not the best solution.

(2) *Awareness of consequences (personal)*:
- Recycling preserves natural resources for the benefit of present and future generations.
- The little I produce is part of the burden for my country.

(3) *Social recycling attitudes and norms*:
- In our society, recycling is the right thing to do.
- The responsible authorities are doing their best to address the issue of waste management.
- The general public is doing its part to address the issue of recycling.

(4) *Personal recycling attitudes and norms*:
- I believe that recycling is good and rewarding.
- I feel the responsibility to separate waste.
- I encourage other people to separate and recycle their waste.

(5) *Inconveniences (situational factors)*:
- Waste separation takes too much time.
- Waste separation takes too much space.
- Waste separation is too complicated.

(6) *Motivating factors*:
- I am more likely to recycle if grey bags and containers are distributed free of charge.
- I am more likely to recycle if recycling schemes are linked with reward incentives such as lottery prizes.
- I am more likely to recycle if households are charged for each bag of waste they produce.

(7) *Intentions to act*:
- I am willing to contribute in the costs involved in waste management systems.
- If a group in the community goes house by house picking up plastic, paper, metal and glass, I would give them these items.
- I am willing to participate in information campaigns aimed at improving awareness about recycling.

(8) *Knowledge of strategies and action skills*:
- I know what is good for recycling and what is not.
- I classify paper, plastic, metal and glass to recycle.

(9) *Satisfaction with service provided*:
- My council provides an adequate service with respect to collection of dry recyclables.
- My local council provides a sufficient number of bring-in-sites.
- I have plenty of opportunities to recycle my waste.

(10) *Scheme preferences*:
- I prefer Bring-in-Sites to door-to-door collection because I do not need to hold the waste for a week.
- I prefer Bring-in-Sites to door-to-door collection to avoid cross contamination; hence the recyclables earn a higher market value.
- I prefer door-to-door collection to Bring-in-Sites as I do not have enough time to visit Bring-In-Sites frequently.*
- I prefer door-to-door collection to Bring-in-Sites because the Bring-In-Sites are a bit far away from my house.*
- I prefer door-to-door collection to Bring-in-Sites because recyclables are collected in one bag only; therefore, one recycling bin is enough.*

(11) *Recycling participation*:
- I often separate household waste.
- I often participate in the door-to-door scheme (Irricikla t-Tlieta).
- I often use bring-in-sites.
- I am likely to separate waste in the next few weeks.

*Reversed scale.

Test-retest reliability

To assess the temporal stability of the instrument, the questionnaire was presented to 25 participants selected at random from the sampling frame and after two weeks, the same questionnaire was re-administered to the same participants. The responses on both administrations were used to assess the test-retest reliability of the instrument. In fact, all constructs produced a significant correlation coefficient ($p < 0.01$), thus confirming the temporal stability of the instrument. A summary of the results is presented in Table I.

Construct	Correlation coefficient
Knowledge of issues	0.743*
Awareness of consequences	0.616*
Social norms	0.654*
Personal attitudes and norms	0.812*
Inconveniences	0.674*
Motivating factors	0.709*
Intentions to act	0.705*
Knowledge of recycling skills	0.715*
Satisfaction with schemes	0.714*
Recycling preferences	0.737*
Recycling participation	0.904*

Note: $^{*}p < 0.01$

Table I. Test-retest reliability correlation coefficients (pilot study)

Sample size estimation

In order to determine the sample size required for the estimation of an arithmetic mean with a specified degree of confidence and margin of error, we used the formula:

$$\text{Sample size (SS)} = [\text{DC} \times \text{TV} / \text{DP}]^2$$

where "DC" (Degree of Confidence) is the number of standard errors for the degree of confidence specified for the research results, "TV" (True Variability) is the estimation of population standard deviation as extracted from pilot study and "DP" (Desired Precision) is the maximum accepted difference between the sample mean and the unknown mean of the population (see Hair *et al.*, 2007). After specifying that the DC = 2.06 (the critical value of the Student t distribution with 95 per cent confidence and $n - 1 (= 24)$ degrees of freedom), TV = 1.47 and DP = 0.2, the minimum sample size required with the preset criteria was 230. However, one of the intentions of the present study was to conduct exploratory Factor Analysis and so it was evident that a sample size of 230 was not sufficient. Comrey and Lee (1992) provide the following sample-size guidance for factor analysis: 100 = poor, 200 = fair, 300 = good, 500 = very good and $1,000+$ = excellent. Based on this, an attempt will be made to obtain a random sample size of at least 400 participants.

The procedure

The actual field study (Stage 3) was conducted during July 2009. With the help of a team of trained staff from WasteServ Malta Ltd, 700 residents were selected at random from the sampling frame and contacted by telephone. Those aged 18 to 64 were invited to participate in the survey and were given the option of either responding over the phone (either instantly or following an agreed appointment) or online via a link sent by e-mail. As an added incentive to participate, a weekend break for two persons in a local hotel was to be won by one of the participants. Some respondents still declined to participate while others opted to reply online but failed to submit their responses. Non-respondents were chased until 400 usable questionnaires were collected. The population and sample characteristics (by gender and age) are presented in Table II.

A chi-squared test confirmed that the way the characteristics (by age and gender) of the sample are distributed does not differ significantly from the way they are

distributed in the population ($\chi^2 = 7.89$, df = 5, $p = 0.163$) and this will permit us to make generalizations from the sample to the population without the need to apply weights to adjust for differing probabilities. Educational level was excluded from the contingency table since the Demographic Review 2008, published by the National Statistics Office (NSO, 2009) does not provide any information about the educational level of Maltese residents. The sample used in this study consists of 103 persons (25.75 per cent) with secondary education (note: in Malta, school is compulsory till age 16), 178 persons (44.5 per cent) with post-secondary education and 119 persons with at least tertiary education (29.75 per cent).

Internal consistency reliability and construct validity

A pre-requisite for validity is reliability. After confirming the temporal stability of the instrument in the pilot study, the next step was to confirm the internal consistency reliability of the instrument. Table III reveals that the Cronbach alpha coefficients obtained for each construct were greater than 0.6, thus confirming the internal consistency of the instrument (Robinson *et al.*, 1991).

To assess the construct validity of the instrument, exploratory factor analysis was used. Factor Analysis can identify the structure of a set of variables and provides a process for data reduction (Hair *et al.*, 1998). All the questionnaire items excluding the recycling participation were used. This is because recycling participation will be used as the dependent variable in the regression analysis.

The first step was to assess the assumptions in Factor Analysis. The Bartlett test of Sphericity (approx. chi−square = 4404.99, df = 406, $p < 0.001$) confirmed the presence of correlations among variables while the Kaiser-Meyer-Olkin statistic (KMO = 0.793) supported the continuance of factor analysis (Hair *et al.*, 1998).

The next step was to determine the number of components to be retained for further analysis. Using the latent root criterion, there were nine eigenvalues greater than one and so nine factors were retained. A VARIMAX rotation (one of the most popular orthogonal factor rotation methods) was obtained and these nine factors represented 68.48 per cent of the variance of the 29 variables. This rotation converged after six iterations.

A summary of the items loading on each of the nine factors together with the eigenvalues, the variance explained by the factors and the Cronbach alpha coefficients for each factor are presented in Table III.

Table II.
Population and sample characteristics

Gender and age groups	Population		Sample	
	n	Proportion (%)	*n*	Proportion (%)
Male; age 18-29	35,476	13.64	42	10.50
Female; age 18-29	33,630	12.93	52	13.00
Male; age 30-44	39,308	15.10	60	15.00
Female; age 30-44	37,401	14.38	70	17.50
Male; age 45-64	57,159	21.97	98	24.50
Female; age 45-64	57,187	21.98	78	19.50
Total	260,161	100	400	100.00

Table III.
VARIMAX with Kaiser normalization rotation loadings

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Eigenvalues (rotated)	3.246	3.108	2.441	2.204	1.946	1.923	1.915	1.609	1.468
% Variance (cumulative)	11.193	21.911	30.327	37.929	44.637	51.269	57.872	63.421	68.482
Item									
1A									0.795
1B									0.857
2A								0.848	
2B								0.847	
3A					0.764				
3B					0.759				
3C					0.775				
4A	0.821								
4B	0.725								
4C	0.817								
5A				0.845					
5B				0.838					
5C				0.692					
6A							0.775		
6B							0.646		
6C							0.740		
7A			0.813						
7B			0.876						
7C			0.922						
8A	0.587								
8B	0.753								
9A		0.793							
9B		0.689							
9C		0.832							
9D		0.745							
9E		0.737							
10A						0.810			
10B						0.840			
10C						0.598			
Reliability – Cronbach α	0.83	0.82	0.85	0.83	0.70	0.68	0.61	0.70	0.61

The pattern of items loading onto factors was clear and interpretable. The rotated factor solution was mostly consistent with the components of the constructs. The factors that emerged are as follows:

(1) Personal recycling attitudes, norms and skills.
(2) Scheme preference.
(3) Intentions to act.
(4) Inconveniences.
(5) Social recycling attitudes and norms.
(6) Satisfaction with service provided.
(7) Motivating factors.
(8) Awareness of the consequences.
(9) Knowledge of issues.

Initially, "personal recycling attitudes and norms" and "knowledge of recycling skills" were intended to be two separate constructs. However, this was not supported by Factor Analysis and so they were grouped into a single factor – personal recycling attitudes, norms and skills. This could be attributed to the fact that when attitudes studied are social in nature, they generally tend to overlap with subjective norms (Sun, 2000). Additionally, it is generally acknowledged that without knowledge of recycling skills, recycling attitudes and norms are inhibited and this leads to poor recycling performance (Tucker, 2001).

Finally, no variable loaded significantly on more than one factor or else loaded on the wrong factor to produce an unstable factor structure.

Results

Characteristics of recycling behaviour

In this section, we will identify the recycling behaviour characteristics of Maltese residents. On a scale from 1 (lowest) to 5 (highest), summary statistics (based on the mean and the standard error of the mean (SEM)) of 400 participants across the nine factors revealed that Maltese residents:

(1) Have a positive recycling attitude, a relatively high perceived moral obligation to recycle and a good knowledge of the strategies required to separate waste (overall mean = 4.18, SEM = 0.03).
(2) Prefer the door-to-door scheme (mean = 3.45, SEM = 0.98) to bring-in-sites (mean = 3.01, SEM = 1.06) as they find the former more convenient. The difference in means is also statistically significant (paired $t = -4.84$, df = 399, $p < 0.01$).
(3) Neither agree nor disagree that society is doing its part to address the issue of recycling and waste management (mean = 3.06, SEM = 0.04).
(4) Are neither satisfied nor dissatisfied with the current recycling schemes (mean = 3.23, SEM = 0.05).
(5) Are willing to act to increase recycling participation rates (mean = 3.59, SEM = 0.06).

(6) Neither agree nor disagree that they would recycle more with the introduction of the reward technique such as lottery prices for the random recycler (mean = 3.07, SEM = 0.07) or PAYT (mean = 3.02, SEM = 0.06). However they agree that the local council should provide the grey bag free of charge (mean = 4.05, SEM = 0.06).

(7) Claim to be knowledgeable about waste management issues (mean = 3.98, SEM = 0.04).

(8) Claim to be highly aware of the consequences if we do not recycle waste (mean = 4.55, SEM = 0.03).

(9) Do not envisage recycling as an inconvenience (mean = 2.41, SEM = 0.05) and seem capable to tolerate the difficulties often reported as barriers to recycling.

Other important considerations that emerge are as follows:

- Analysis of variance (ANOVA) revealed no significant differences by age or educational level in each of the nine recycling behaviour constructs. As for gender, the only difference occurred in construct 2 (i.e. "scheme preference"). In fact, women have a preference for the door-to-door collection scheme (mean diff = -0.41, df = 398, $t = -3.93$, $p < 0.01$) while men have a preference for bring-in-sites (mean diff = 0.39, df = 398, $t = 3.91$, $p < 0.01$). This pattern is probably related to the fact that women in Malta are more likely to be at home during the day and less likely to drive and so they find the door-to-door scheme more convenient. In fact, published statistics by the NSO (2009) show that from the male population, 62.6 per cent are employed and 77.9 per cent hold a driver's licence while from the female population, 30.5 per cent are employed and 47 per cent hold a driver's licence. However, there is a need for more research in the area before any strong conclusions can be drawn.
- An analysis of the responses to the individual questionnaire items revealed that while residents generally claim that they know what is good for recycling and what is not (mean = 3.97, SEM = 0.04), and also know how to separate paper, plastic, glass and metal (mean = 4.11, SEM = 0.05), at the same time they are not sensitive to the fact that if the recyclables are not contaminated they earn a higher market value (mean = 3.20, SEM = 0.05). No wonder that a recent unpublished paper by Agius *et al.* (2008) reported that the paper collected in the grey bags is losing its market value as it ends up being contaminated through contact with other streams and that 38.2 per cent of the total operating time at the MRF plant during four weeks of observation was dedicated to pre-sort material from grey bags that was not good for sale. Thus, the Maltese public needs to understand that the success of recycling schemes is not based only on the number of households that participate but also on how constantly and effectively they do it (see Thomas, 2001).
- Although it is clear through this survey that the door-to-door scheme is helping to increase recycling rates, we still recommend that a feasibility study including a cost benefit analysis be conducted to investigate and justify its operating expenditure. One must not forget that when the material recovery facility at Sant'Antnin was developed, it was not envisaged that a bag opener would be necessary. Currently, a manual sorting process is being used, resulting in double

handling, inefficient sorting and laborious operational hours (see Agius *et al.* 2008). After all, recycling schemes tend to be more successful if they are operator and user friendly (see Read, 1997).

These points highlight the need for more dialogue and communication to better inform and educate the end user thereby enhancing the overall process.

Recycling participation

On a scale ranging from "1" (lowest) to "5" (highest), the average recycling rate of Maltese residents is 3.45 (SEM = 0.05).

Figure 4 exhibits the distribution of the recycling participation scores. The box-plot indicates that although there are residents that recycle on a regular basis, there are others who do not recycle at all. Before making any additional comments, we will first determine which of recycling behaviour factors emerge as significant predictors of recycling participation.

In preliminary analysis, zero-order correlations between recycling participation and each of the recycling behaviour factors were obtained. In fact, we can conclude that a strong, positive and linear relationship exists between recycling participation and "personal recycling attitudes, norms and skills" ($r = 0.655$, $N = 400$, $p < 0.01$), a modest, negative and linear relationship exists between recycling participation and "inconveniences" ($r = -0.468$, $N = 400$, $p < 0.01$), while small but significant relationships exist between recycling participation and "satisfaction with service provided" ($r = 0.311, N = 400, p < 0.01$), "motivating factors" ($r = -0.241, N = 400$, $p < 0.01$) and "social recycling attitudes and norms" ($r = 0.243, N = 400, p < 0.01$). All the other factors produced a negligible relationship with recycling participation.

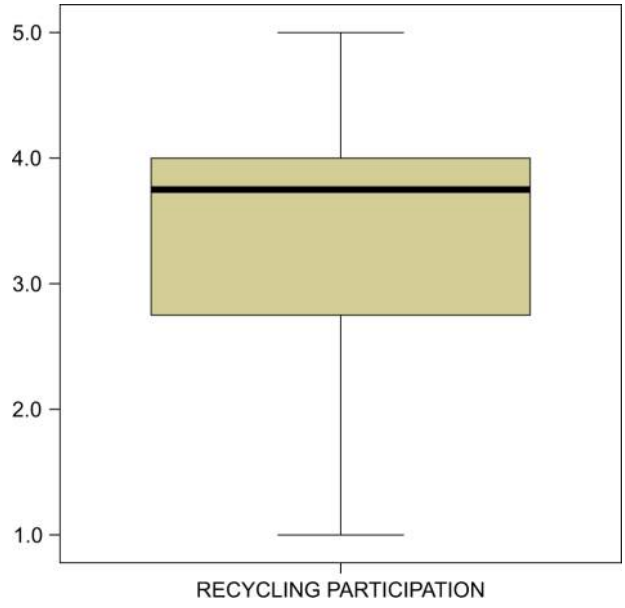


Figure 4.
Box-plot for recycling participation scores

Stepwise Multiple Regression was then used to determine which of the nine factors identified by Factor Analysis and three demographic factors (gender, age, educational level) can be used to predict recycling participation (dependent variable). The regression model summary table is exhibited in Table IV.

The two principal assumptions that must be met in a multiple regression analysis are the assumption of independent error and the assumption of no collinearity in the data. The Durbin-Watson statistic (presented in Table IV) tells us that the assumption of independent errors is tenable. This is because as a conservative rule, values less than 1 or greater than 3 should raise alarm bells while the closer to 2 this statistic is, the better (see Field, 2009). For our data, this statistic is 1.876, which is so close to 2 that the assumption has almost certainly been met. The next assumption to be met is that there is no collinearity in the data. Collinearity is a problem if the largest variance inflation factor (VIF) is greater than 10 or the tolerance statistics are below 0.2 (see Field, 2009). Table V reveals that all models have VIF values below 10 and all tolerance statistics above 0.2. Hence, we can safely conclude that there is no collinearity in the data.

In the stepwise regression, factor 1 (personal recycling attitudes, norms and skills) was entered first and this explained 43.00 per cent of the variance in recycling participation. When factor 5 (satisfaction with service provided) and factor 9 (inconveniences) were entered, the percentage of variance explained increased to 46.3 per cent and 48.5 per cent respectively. The Model that uses these three predictors simultaneously is Model 3 (see Table V). Table VI contains an ANOVA that tests whether this model is significantly better at predicting the outcome than using the mean as a "best guess" (see Field, 2009). The ANOVA table reveals that our model significantly improved our ability to predict recycling participation ($F_{3,396} = 124.43$, $p < 0.01$).

It is important to note that, although "satisfaction with service provided" and "inconveniences" increased the variance explained and produced partial regression coefficients that were statistically significant, they were dwarfed by "personal recycling attitudes, norms and skills". All the remaining factors and demographic variables used in this study did not emerge as significant predictors of recycling participation.

Based on the above, the following is the regression equation that emerges:

$$\text{Recycling Participation in Malta} = 0.762 \times (\text{Personal Recycling Attitudes, Norms and Skills}) + 0.179 \times (\text{Satisfaction with Service provided}) - 0.166 \times (\text{Inconveniences})$$

Model	*R*	*R* square	Adjusted *R* square	Std error of the estimate	Durbin-Watson
1	0.655	0.430	0.428	0.7483	1.876
2	0.680	0.463	0.460	0.7272	
3	0.697	0.485	0.481	0.7127	

Notes: Model 1 Predictors: (Constant), Construct 1; Model 2 Predictors: (Constant), Construct 1, Construct 6; Model 3 Predictors: (Constant), Construct 1, Construct 6, Construct 4

Table IV.
Regression – model summary for recycling participation

Table V.
Regression coefficients, correlations and collinearity statistics for recycling participation

Model		Unstandardized coefficients		Standardized coefficients			Correlations			Collinearity statistics	
		B	Std error	Beta	*T*	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	−0.451	0.229		−1.971	0.049					
	Construct1	0.933	0.054	0.655	17.313	<0.01	0.655	0.655	0.655	1.000	1.000
2	(Constant)	−0.855	0.237		−3.612	<0.01					
	Construct1	0.880	0.053	0.618	16.441	<0.01	0.655	0.636	0.605	0.959	1.043
	Construct6	0.195	0.039	0.186	4.943	<0.01	0.311	0.241	0.182	0.959	1.043
3	(Constant)	0.088	0.324		0.270	0.787					
	Construct1	0.762	0.059	0.535	12.819	<0.01	0.655	0.542	0.462	0.745	1.342
	Construct6	0.179	0.039	0.171	4.609	<0.01	0.311	0.226	0.166	0.949	1.053
	Construct4	−0.166	0.040	−0.173	−4.168	<0.01	−0.468	−0.205	−0.150	0.751	1.332

Model		Sum of squares	Degrees of freedom	Mean square	F	Sig.
1	Regression	167.851	1	167.851	299.734	<0.01[a]
	Residual	222.879	398	0.560		
	Total	390.730	399			
2	Regression	180.772	2	90.386	170.908	<0.01[b]
	Residual	209.957	397	0.529		
	Total	390.730	399			
3	Regression	189.597	3	63.199	124.429	<0.01[c]
	Residual	201.133	396	0.508		
	Total	390.730	399			

Notes: [a]Predictors: (Constant), Construct 1; [b]Predictors: (Constant), Construct 1, Construct 6; [c]Predictors: (Constant), Construct 1, Construct 6, Construct 4

Table VI.
ANOVA for recycling participation

Summary of major findings and limitations of study

This study has shown that nine factors – "personal recycling attitudes, norms and skills", "satisfaction with service provided", "inconveniences", "awareness of consequences", "knowledge of issues", "social recycling attitudes and norms", "motivating factors", "intentions to act" and "scheme preferences" – account for 68.5 per cent of the recycling behaviour of Maltese households. Regression analysis revealed that "personal recycling attitudes, norms and skills", "satisfaction with service provided", and "inconveniences" are significant predictors of recycling participation and account for 48.5 per cent of the variability in the dependent variable. All other factors as well as the demographic variables used had no significant effect on the recycling participation of Maltese residents.

Although this study provides useful information about the determinants of recycling behaviour and the predictors of recycling participation, there are some limitations to the approach taken:

- The sample used in this study consists of 400 persons that were included in the most recent ER (April, 2009) and who were also enlisted in the local telephone e-directories. This means that the sampling frame used excluded persons that might not be in the ER since they did not have a permanent residence at time of compilation as well as other persons who are listed in the ER but are not listed in the local telephone directories.
- The survey was based entirely on responses from a self-completed questionnaire. So, we assumed that respondents are capable of an acceptable degree of rating with precision and objectivity.
- Recycling participation was based on residents' reports of their own perceived recycling participation and not on direct observation. So, it is possible that some residents might have presented themselves in what they consider to be a positive manner and so we cannot be sure that residents actually recycle as much as they reported.

Recommendations and conclusions

Successful waste management requires concrete and effective solutions. The pattern of results obtained in this study suggests that Malta would benefit from a highly

co-ordinated and strong information campaign in an attempt to influence recycling behaviours and recycling rates. More specifically, we recommend that the authorities concerned adopt a corporate communications programme similar to the one successfully implemented by the Rushcliffe Borough Council (see Mee and Clewes, 2004). The new improved scheme included separate collection of green garden waste and paper/card and well as mini bring-in-sites to encourage residents to take recyclable items not collected from the kerbside. To counteract the anticipated resistance to change and to increase acceptance to the new system, the council adopted an integrated approach to marketing communications around the "recycling2go" branding concept. The scope was to raise awareness of the need to cut waste and recycle more, to add value to the service and to link with the current throw-away, fast-moving society. The Council also monitored recycling rates regularly, opened an open dialogue with residents via a multi-channel approach and used marketing research to shape the service and to strengthen communication. Mee and Clewes (2004) stated that attitudes and recycling behaviour were changed in Rushcliffe and when a recycling rate of 50 per cent was achieved in the pilot area, this exceeded statutory targets set by the government of Rushcliffe or any council.

By adopting a similar corporate communication programme, Malta would be targeting all the three significant predictors of recycling participation that emerged from this study – "satisfaction with service provided", "inconveniences" and most importantly, "personal recycling attitudes, norms and skills". More specifically, this programme should attempt to increase recycling rates by:

- reinforcing the attitudes of the recyclers and changing the attitudes of the non-recyclers;
- designing recycling schemes with convenience in mind – schemes that are operator and user friendly (not complicated) and do not take too much space or time;
- implementing more effective waste separation schemes so that householders would be more satisfied with the service and exert a greater perceived control over the recycling behaviour;
- educating children (the future recycling market) and raising public awareness about recycling issues by keeping public well-informed about recycling issues as well as the commitment of the local council towards waste management; and
- consulting with all the stakeholders involved (including the general public). This should start from the planning stage and continue throughout the implementation stage, so as to ensure that the change is accepted and implemented by all those involved in the change.

Finally, a pre-requisite for all this is a proper waste management infrastructure. As Obeng *et al.* (2009, pp. 106-7) put it:

> It is a common perception that improving solid waste management (SWM) means making waste collection and disposal systems more efficient, raising public awareness and enforcing environmental SWM laws. However, according to Antipolis (2000) a prerequisite for all these factors is a well-planned management, operating within an enabling institutional framework, and capable of generating the financial resources required to meet operating, maintenance and investment costs.

Further and more focused research that builds up on specific aspects of this study will show how the public reacts and responds to any management intervention which is necessary for efficient planning and management of waste separation schemes. Additionally, feasibility studies including cost benefit analyses on the adopted recycling schemes is recommended in order to determine how well the operating schemes are working. With access to such detailed information, waste management practitioners should adopt a bottom-up approach to waste management issues (see Tucker, 2001) in an attempt to put waste separation back on track.

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