

A 'Symbiosis Effect' Perspective to Understand Reverse Logistics and Household Recycling Waste Systems

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INTRODUCTION

The essence of the problem with waste is that it is by definition something that is not wanted. We argue here that achieving a sustainable solution requires consideration of both regulatory responsibilities and social norms (Deutz and Frostick, 2009). Landfill costs levy a high financial impact on municipalities due to the environmental directives that compel them to collect and recycle household waste. More efficient and effective systems are therefore crucial for municipalities from both a financial and environmental perspective. Thus, householders and municipalities "symbiotically" working together in a natural system could enhance sustainable living (Fennell and Weaver, 2005; Ehrenreich, 2002). This paper reports on the first two stages of a PhD research study project conducted within the two municipalities in the North of England. This research investigates the relationship between the sustainability and effectiveness of household recycling systems and household recycling behavior, reveals how factors associated with household recycling systems affect household recycling behaviour, and how household recycling behaviour affect the provision of household recycling systems by the local authorities. The main objective is to reveal and explain the interaction and symbiosis. In fact, this study has found that a 'symbiosis effect' perspective appears to be a robust framework to bring together effective household waste recycling systems and sustainable development considerations to enhance both sustainability and the economy. Further, the study provides empirical evidence examining both situational and personal factors of households and their interactions, which were previously not well-understood. This study has incorporated behavioural aspects in the reverse logistics process that should help improve the municipalities' planning processes. Also, municipalities may be more adaptive to the changing behaviour of their constituents and more willing to change their waste and recycling strategies to more sustainable methods. The paper is structured as follows. The literature reviews from multiple lenses of multiple disciplines and research design that accessible for interdisciplinary study and the current findings with discussion as well as conclusion that explain and encapsulate symbiosis effect perspective in understanding reverse logistics and household waste recycling system (HRWS).

LITERATURE REVIEW

The waste movement and diversion is closely related to HRWS activities (Deutz and Frostick, 2009; Fuller, 1978) as well as processes that related to reverse logistics (de Brito and Dekker, 2009; Jahre, 1995). Prior studies have ascertained that reverse logistic factors (situational) such as convenience, improved recycling facilities and communication from municipalities tend to lead to higher household recycling levels (Keramitsoglou and Tsagarakis, 2013). Thus, these reverse logistics factors closely refers to accessibility and availability of the situational factors within the HRWS were considered strong predictors (Woodard et al., 2006; Bhate, 2005). However, the studies relatively excluded the potential of "interaction" from the relationship between householders and HRWS. A proposition in this study is that in reality, "interaction" contains as symbiosis effect and is a pre-condition of the actual behavioral change in household recycling patterns. A Municipality's engagement (with) has an effect in household recycling behaviour (HRB) that applies on the accessibility and availability as well as convenience of HRWS at that particular area (Bhate, 2005). There was improvement in many municipalities' HRWS across regions in Great Britain (CIWM, 2013) nevertheless, the recycling rates across the UK municipalities are varied and still below average compare to some our EU counterparts (EUROSTAT, 2013). This quandary

cannot be resolved by focusing solely on the technical issues of HRWS (situational factors) but there is a need proper understanding of HRB in the system. HRB depends not only on situational factors but also the householders' personal capabilities and attitudinal factors, which could be referred to as "personal factors" (Barr et al., 2005). Therefore, the study has incorporated multiple theories and frameworks (Carter and Ellram, 1998; Stock, 1997) in understanding two major factors (situational and personal) and formed conceptual framework (Fig. 1).

The preliminary conceptual framework (Fig. 1) was developed to guide this study and is derived from three existing theories: Theory of Planned Behaviour (Ajzen, 1991), Norm Activation Model (Biel and Thøgersen, 2007) and Environmental Significant Behaviour (Thøgersen, 2006). The dotted arrow in Figure 1 suggests a symbiosis effect emerges when there are interactions between situational and personal factors.

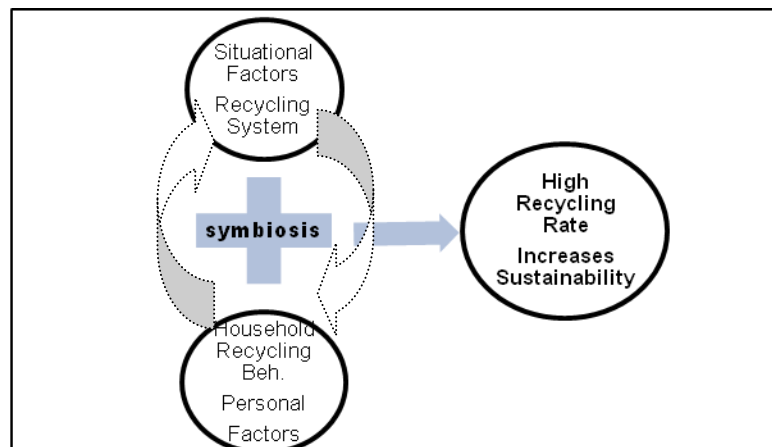


Figure 1: Proposed theoretical framework based on three theories

Furthermore, this theoretical framework has to be accessible in the research design which in this case is the application of mixed-methodology approach was chosen for the whole research framework (Creswell, 2008). The methodological approach for accomplishing the research objectives requires a cross-examination of two data sources (qualitative interviews and quantitative questionnaires) because the recycling systems and household recycling behaviour that can be quantified and observed directly are viewed as reality without the need for subjective interpretation (positivist) (Schrag, 1992). However, this reality is governed by the different attitudes, perceptions and interpretation of the reality by different individuals (interpretive) (Guba and Lincoln, 1994).

RESEARCH DESIGN

The basis of the study design is a sequential exploratory design known as Qual-Quan-Qual (Creswell, 2008; Clark, et al., 2008). Two councils were chosen from the North of England (the East Riding of Yorkshire and the City of Hull). A total of fourteen respondents participated in the first stage of data collection (n=14): two of those were council officers – one each from the East Riding of Yorkshire and the City of Hull. The remaining twelve respondents were demographically diverse and lived or used to live in the East Riding of Yorkshire and the City of Hull. The second stage was a quantitative approach (n=412) which a postal-survey questionnaire was sent to 500 households from each area. In addition to reduce the impact of the low response rate normally associated with postal surveys, an online survey was published via the University of Hull's social media platforms, the local councils' affiliated community networks, public community online news network (e.g. 'this is Hull and East Riding') and under the discretion of selected companies within the population parameters (e.g. Kingston Communications, East Yorkshire Motor Services, and Jackson's Bakery). Table 1 provides a socio-demographic profile of respondents.

Item	N	%
Age		
20 or under	21	5.1
21-30	85	20.6
31-40	96	23.3
41-50	59	14.3
51 or older	151	36.7
Gender		
Male	157	38.1
Female	255	61.9
Recycling Experience (years)		
More than 4 yrs	307	74.5
Less than 4 yrs	105	25.5
Living in current property (years)		
More than 4 yrs	286	69.4
Less than 4 yrs	126	30.6

Table 1: Demographic Background (n=412)

The sample was slightly dominated by female respondents (61.9 percent) and the majority of respondents fell in the 51 or older age group. Most respondents have more than four years of recycling experience (74.5 percent) and were living in the same property for more than four years (69.4 percent). Then the final stage of the research design in data collection was a focus group developed to cross validates the subjectivity and objectivity in the foregoing stages. Seven respondents were randomly recruited with a small token for participation (n=7).

RESULTS

Qualitative Finding: Stage 1

Using thematic analysis (Braun and Clarke, 2006) network as mean of interpretation helped to map the main themes emerged from the first stage (Fig. 2). The key themes as emerged in the study were categorized to situational and personnel factors and enablers for the existence of symbiosis effect. Nevertheless, the richness of the qualitative findings led to extending the thematic analysis in using ethnographic analysis: semantic relationship between themes (Roulston, 2010; Aronson, 1994); helped to explain the existence of symbiosis effect between councils and households.

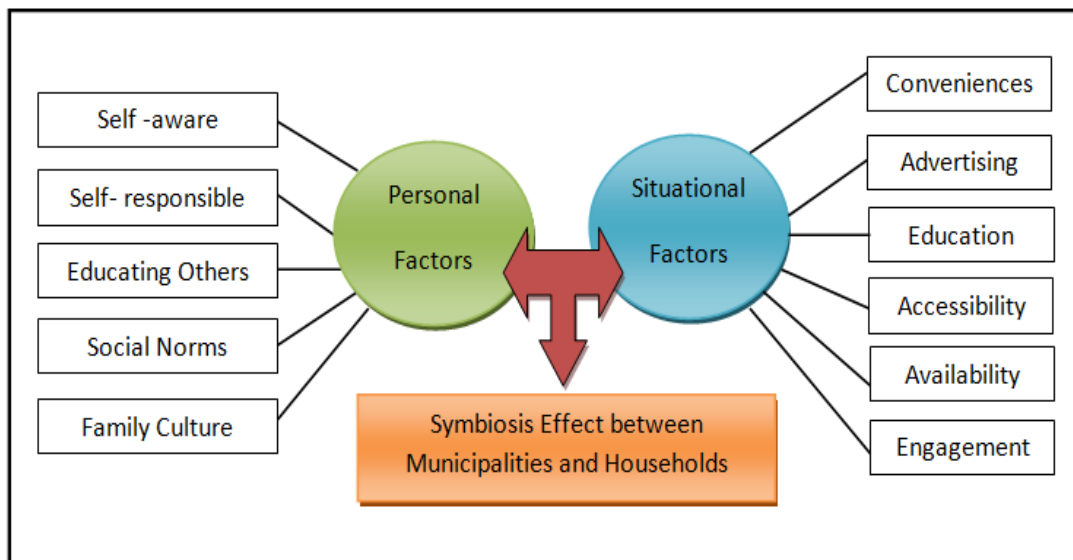


Figure 2: Thematic analysis network of Conceptualization on *Symbiosis Effect* between Municipalities and Households ($n=14$)

The first type semantic relationship existed in this study was the cause and effect (X is a result of Y, X is a cause of Y: X is HRB and Y is engagement of the recycling services by councils). Most respondents had knowledge of recycling, were fully aware of their consumption patterns, and also what they placed in their bins. Those who had experienced the transition from the one bin scheme to a new three bin scheme introduced by the local authorities were initially reluctant to participate due to a perceived lack of effort to engage residents by their local authority. However, over time councils did improve their engagement and communication that lead to HRB increases.

The second type of semantic relationship was rationale (X is a reason for doing Y: X is marketing and logistics initiatives by the councils and Y is recycling). This scenario supported the symbiosis or interdependencies between systems and behaviour. Some of the respondents were from Germany, which has a very systematic waste and recycling management system, and they expressed an affective/emotional motivation that (Burgess, et al.,1998) defined as "guilt" for not recycling as much as they would in their home country . This may be due to the fact that stimuli for recycling behaviour from current local authorities' logistics and marketing initiatives were not as aggressive as they had experienced before.

Quantitative Finding: Stage 2

The frequency analyses showed more than 90 percent of households were clearly aware of why they recycled; the majority of households recycled because they believed recycling improved the environment and a feeling that they should live in an environmentally- conscious society. The study also looked for any differences between the municipalities regarding their reasons for recycling. It found the number of principal reasons (environmentally- concerned) for City of Hull residents was somewhat higher than for those living in the East Riding of Yorkshire (Fig. 3). In the 'others' option City of Hull residents were inclined towards 'up-cycling' such as reusing most of the recyclable items or giving those items to extended families or friends. The East Riding of Yorkshire households were more likely to send their reusable items to various charities.

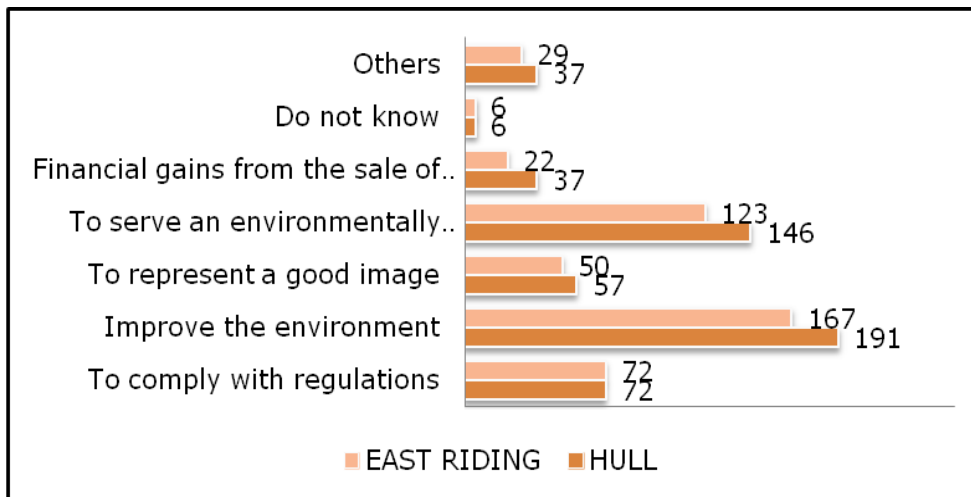


Figure 3: "I recycle because _____" based on municipality (n=412)

This study seeks the reasons behind the householders' recycling initiative by examining confounding variables (demographic factors). Logistic regression was used to test the full model against a constant model. The results from the full model indicate that householders' reasoning for HRB depends on changes in some demographic factors (one unit increase); they are likely to change their reasoning for HRB based on regulation if they are (double occupants: $Wald = 4.48, p < 0.05$ with $df = 1$, or a student: $Wald = 7.76, p < 0.01$ with $df = 1$); as well as reasoning based on environment if they are (living in current address more than 4 years: $Wald = 4.44, p < 0.05$ with $df = 1$, or they started recycling as the scheme was introduced: $Wald = 4.47, p < 0.05$ with $df = 1$) and their reasoning based on self-image if they are (working: $Wald = 4.49, p < 0.05$ with $df = 1$, or unemployed/on benefit: $Wald = 3.99, p < 0.05$ with $df = 1$). The overall model is significant at the 0.05 level according to the Model chi-square statistic. The model predicts reasoning for regulation (65%), environment (86.9%) and image (74.3%) of the responses correctly. The Nagelkerke's for regulation ($R^2 = 0.12$), environment ($R^2 = 0.13$) and image ($R^2 = 0.09$) implied the model is a moderate improvement over the null model with no predictors even though Nagelkerke's Pseudo R^2 is skewed to zero than one.

A Pearson's correlation was used to analyse the relationship between situational and personal factors. Firstly, all items that constituted personal or situational factors were formed into relevant composite factors, and then a statistical correlation was tested between these composite factors including all demographic items. Those representing a more than a 0.05 significance level were omitted from further analysis. Table 2 demonstrates the correlation between these two composite factors. It shows that personal factors have a significant relation to situational factors ($p < 0.01$) and vice versa; with positive correlation ($r(412) = +0.41$). Four demographic items (Table 2) were also found to have positive relation with both factors ($r(412) > +0.07$) and correlation between personal factors with those four demographic items has significant relation ($p < 0.01$). However, household employment has significant influence at ($p < 0.01$) on situational factors, thus households' age and marital status were at ($p < 0.05$) significant level and recycling experiences had no significant correlation with situational factors. The analyses indicate that a socio-demographic profile of a municipal resident has a positive correlation with factors contributing to HRB.

Factors	PEARSON CORRELATION					Sig. (2-tailed)
	Situational	Age	Marital Status	Employment	Number of Year Recycling	
Personal*	0.41	0.24	0.20	0.23	0.15	0.00
Situational*	1	0.10	0.12	0.17	n.s	0.01

*Both factors are formed into composite factors (i.e. Item1 + item2+....)

Table 2: Correlation Table (n=412)

Additionally, the study correlated composite personal factors with individual items of situational factors. The results show that the personal factors have significant relation with engagement ($p < 0.01$) with positive correlation ($r(412) = +0.71$); as well as convenience ($p < 0.01$) with positive correlation ($r(412) = +0.44$) and accessibility and availability ($p < 0.01$) with positive correlation ($r(412) = +0.27$). In order to examine whether personal factors interacted with situational factors (engagement, availability and accessibility), the study applied multiple regression analysis to question these assumptions. This analysis is relevant as it addresses assessment of various relationships, using the information from independent variables to improve the accuracy in predicting values for the dependent variable as recommended by Greene and Field (Green, 1991; Field, 2005). These analyses also reveal the existence of confounding variables (demographic items) in association with either personal or situational factors (engagement, accessibility and availability). Thus, when personal factors were predicted; it was found that engagement ($\beta = +0.36$, $p < 0.01$), convenience ($\beta = +0.11$, $p < 0.01$), and accessibility and availability ($\beta = -0.13$, $p < 0.01$) were significant predictors of recycling behaviour (Table 3).

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	15.093	1.851		8.154	0.000
Engagement	0.316	0.032	0.359	9.890	0.000
Convenience	0.156	0.048	0.106	3.225	0.001

Table 3: Coefficients Table (n=412)

DISCUSSION AND CONCLUSIONS

The first two stages of this study demonstrate that personal and situational factors interact in promoting HRB. Specifically, the reasoning for HRB indicated that changes in demographic profiles have an effect on householders' intention of recycling. The inference statistical model significantly was the existence of interaction between accessibility and availability as well as convenience and awareness with personal factors were the main predictors. This (what) is consistent with Bhate (2005) in juxtaposing the existence of situational factors to enable HRB and Woodard et al. (2001) to imply that the existence of situational factors without abandonment of the personal factors reflected positive HRB (Barr et al., 2005; Timlett and Williams, 2008). To project or manifest HRB, households must be motivated by the right stimuli such as the availability, accessibility, awareness/engagement and convenience of HRWS in order to increase household recycling rates (Keramitsoglou and Tsagarakis, 2013). In addition, households' knowledge of recycling and how long they have been recycling positively interacted with situational factors and contributed to an improvement in HRB per Thorgesen (1994). The study has shown that symbiosis effect perspective explained vis-a-vis the "hygiene" factors conveying HRB. This means the two factors investigated have to be interaction. In conclusion, this paper has reported on qualitative and quantitative study examining the relationship between householders' behaviour and local authority recycling practices.

The findings indicate that a symbiosis effect exists between the two major factors driving councils' household recycling behaviour. The quantitative analysis demonstrates and validates the first stage finding (i) the higher interactions and engagement will result in increases of HRB; (ii) higher spatial coverage of service provision and availability of recycling facilities will increase the councils' performance in waste and recycling initiatives. Thus, this study was embryonic in nature to investigate this "symbiosis effect" perspective; further investigations should be done in different geographical settings (other municipalities and countries) for the benefit of future research.

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