DETERMINANTS OF E-WASTE RECYCLING IN PUTRAJAYA, MALAYSIA: AN APPLICATION OF AMOS GRAPHIC

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Abstract

The increasing volume of e-waste creates the potential for high level of hazardous materials posing a significant threat to public safety if electronic waste was improperly discarded. To overcome this problem, recycling is recognized as an effective way to reduce waste sent to landfills. This paper identifies the factors influencing household participation in e-waste recycling by using confirmation factor analysis using AMOS graphic. The findings of this study suggests that the participation of household influenced by socioeconomic factors such as age, education and income. Meanwhile attitudinal variables are also found as an influenced factors of recycling named ‘attitude’, ‘belief’, ‘convenience’ and ‘social pressure’.

Keywords: recycling, e-waste, factor analysis, amos

1. Introduction

In the new global economy, consumption of electrical and electronic equipment has become a central issue in economic development. The increase in consumption has brought huge impacts on the demand for electronic waste which is not limited to households, but across to the public sector and the government. The increase in the use of electronic equipment indicates that large amount of e-waste will be generated and this will cause widespread damage to the environment and human health because of the hazardous chemicals contained in electronic equipment.

As a developing country, Malaysia is also experiencing the same problems of huge dumping of e-waste because of the increasing consumption of electronic equipment in every sector. Increase in the use of electronic equipment will lead to the dumping of waste as a result of waste disposal. For example, the quantity of e-waste produced in the year 2009 was 134 thousand metric tons, 163 metric tons in 2010 and 152 metric tons in 2011. The increasing volume of e-waste creates the potential for high level of hazardous materials posing a significant threat to public safety if electronic waste was improperly discarded.

In Malaysia, the Environmental Quality (Scheduled Wastes) Regulations 2005 has replaced the 1989 regulation to enable Malaysia to control transboundary movement of e-waste and implement recycling programs to reduce the growing volume of e-waste. Recycling programs have been widely initiated since 1993, but unfortunately, the campaign has failed because of less commitment from top management and the lack of serious awareness programs. To date, the recycling rate in Malaysia is

1 Source: Department of Environment Malaysia (DOE)
reported to be only five percent. This is low compared to many developed countries with approximately 50% recycling rates. Thus, Malaysia has just started to implement and take these issues seriously since electronic devices and equipment has proliferated in recent decades. To achieve this mission requires full cooperation from all parties, including industries, the government and the consumers. However, recycling on its own is not enough to increase the recycling rate without the involvement and awareness from all members of society. Knowledge education is needed to educate people and to attract them to participate in recycling activities with emphasis on the importance of managing e-waste. The purpose of this education is to guide people to take this issue seriously and help them to deal with their electronic appliances as they reach their end-of-life.

According to previous studies, most researchers have investigated on the handling and management of solid waste. Normally they focus on municipal solid waste management and how to improve the solid waste management facilities (Manaf et al., 2009 and Afroz et al., 2011). To date, however, little is known about the preferences for e-waste recycling specially in Malaysia. Malaysia generates about 18,000 ton of waste daily with around 0.85 kg/cap/day of waste averaged over a population about 28 million. This study will fill the gaps by examining the factors that influence recycling activities and analyzing the attitude and behavior towards e-waste recycling activities. More specifically, this study will describe the profile of e-waste recyclers in Putrajaya, examine households attitudes and behavior towards e-waste recycling, and finally analyze the effects of households demographic, social, economic and attitudinal factors on e-waste recycling participation. The study will be conducted in Putrajaya that is located 25km south of Kuala Lumpur. As a planned city that serves as the federal administrative centre of Malaysia, Putrajaya has conducted several programs to increase recycling rates and implement current schemes to encourage recycling activities. Unfortunately, the level of recycling is not satisfactory and continuous effort to educate the community and promote recycling is needed to maintain a sustainable environment. This study will enable us to gain a better understanding of the antecedents of recycling behavior that will be extremely useful in designing public services and develop educational programs to increase recycling participation.

2. Literature review

The importance of what encourages people to recycle their electronic waste is crucial. In today's world, the importance of recycling is becoming a concern both for the general public and also to the economy. The projections made by the Department of Environment Malaysia indicate, Malaysia will generate approximately 1.17 million to 21.38 million tons of e-waste annually and will be increasing by an average of 14% by year 2020 (DOE, 2009). The disposal will come from residents, businesses, and institutions. Thus, having a good understanding of recycling behavior will help us to better design and implement recycling policies to further increase its effectiveness. The best alternative to treating the electrical and electronic equipment waste is recycling as suggested by previous researcher (Bereketli et al., 2011).

The most important element in recycling is the attitude of humans itself. In order to encourage them to recycle all of their electronic waste requires investigations on what are the factors that influence it. Several attempts have been made to examine the household recycling behavior and attitudes towards the disposal of small electrical and electronic equipment. The results indicate the lack of awareness and lack of recycling attitude are the main sources of these problems (Darby and Obara, 2005). Tonglet, et al., (2004) reported that recycling attitude is the major determinant in recycling behavior. Meanwhile, demographic factors such as age, education, income and household size and other attitudinal factors influenced the usage of drop-off recycling sites (Sidique et al., 2010).

Concern for the environment is perceived to be encouraging researchers to investigate the status of electronic waste and the potential of recyclable components especially in developing countries, such
as Malaysian. The determinants of recycling factors have been discussed, but empirical studies have shown mixed results. Saphores et al., (2009) found that gender, education, convenience, and environmental beliefs are key factors explaining the willingness to drop off e-waste at recycling centers. Wang et al., (2011) study the large proportion of residents in Beijing are still not very willing to participate in e-waste recycling, and report that convenience of recycling facilities and service, residential conditions, recycling habits and economic benefits are four determinants of Beijing resident’s willingness and behavior in e-waste recycling.

3. Methodology

1. Research design

The data for this study were collected in Putrajaya, Malaysia during the period August 2012 to December 2012. The questionnaire was designed based on previous study related to recycling behavior.

2. Research sample

The population of this study is from households that residing in Putrajaya and have experienced in recycling activities. For this study, the sample consists of 600 respondents. Based on Joseph et al. (2010), the recommended sample size is at least 200 per group and minimum sample size is 50 of respondents. Therefore, the sample size is reliable enough to meet the objective of the study. This study covers nine (9) residential areas in Putrajaya where the respondents is randomly selected by using stratified random sampling technique by the total population since every members is given equal opportunity of being selected.

3. Research instrument

The statistical package Analysis of Moment Structures (AMOS) is used to analyze the structural equation modelling. In this study there were six independent variables consisting of six latent variables. They are: attitudes, belief, convenience, knowledge, situational and social pressure. Total of these research instruments is 33 where ten indicator items were designed for attitude variable, eight items for belief, four items for convenience, five items for knowledge, three items for situational and three items for social pressure. The reliability of the instrument is based on Cronbach Alpha value which is 0.7.

4. Data Analysis

Data were analyze by using factor analysis and performed AMOS graphic as a confirmatory factor analysis. The step is to test the relation between e-waste recycling practices and latent variables.

4. Findings and Discussion

Based on the figure 1, the hierarchical CFA (second order) analysis was performed and the analysis was conducted with ERP being measured as a second order. In a second-order, the results of CFA analysis, showed the statistical requirements to determine the adequacy of the model and multiple fit indexes, such as chi-square, goodness-of-fit index, comparative fit index, incremental fit index and root mean square error of approximation were also reported. The strength of the relationships among latent variables as specified by the paths and higher order factor of ERP was evaluated. As illustrated in figure 1, the regression paths between latent variables and higher order factors are indicated by solid arrows.
Based on the results of second order CFA analysis, items d17 (“I have particular spaces to stored my e-waste before sending it to recycle”), d36 (“Cost and time constraints is one of the problem to send my e-waste to recycling centre”) and d32 (“I prefer to sell my e-waste to private collectors rather than collected by the local municipal council”) were dropped due to their low value of factor loadings and as most of the indices were not within acceptable levels. The results suggest a good fit for the second-order CFA model with $X^2 = 1468.896 (p = 0.000, df = 489)$. The GFI was 0.860, CFI = 0.905, IFI = 0.905 and RMSEA = 0.058. Therefore, “Knowledge” was found to be the strongest factor to explain e-waste recycling practices and contributed about 89%. This result confirms previous findings that a person’s knowledge of how to recycle and the types of materials eligible for recycling is an important factor influencing recycling participation (Vining and Ebreo, 1990; Simmons and Widmar, 1990; and Lansana, 1993). This suggests that people will recycle their e-waste for reasons, such as “I know how to sort recycling wastes”, “I think e-waste recycling is important”, “I think all campaigns influenced me to recycle”, “I know how to appreciate natural resources” and “Reduce the waste sent to
landfill sites”. These are primary reasons that motivate them toward recycling. Besides that, “Belief” and “Situational” were identified as factors that influenced households to recycle. This suggests that although households are motivated by their “Knowledge”, they may also be expect to recycle with other determinants with 83% and 73%, respectively. Meanwhile, 63% and 62% of ERP is explained by “Attitude” and “Convenience”, followed by 50% by “Social Pressure” which was identified as the lowest determinant to influence e-waste recycling practices.

5. Conclusion

The primary purpose of this research was to determine the antecedents of determinants or e-waste recycling among households in Putrajaya, Malaysia. The strongest predictors of determinants of recycle is “knowledge”, “belief” is the second strongest and the lowest determinant was “social pressure”. As a conclusion, the important elements that can effectively inculcate a pro-environmental should been focused in order to encourage people to recycle.

References