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Assessing Service Quality of E-Waste Recycling: A Case Study from Putrajaya, Malaysia

[1]Nazatul Faizah Haron, [2]H.O. Mohd Shahwahid and [2]Shaufique F. Sidique

[1]Department of Economics, Faculty of Economics and Management Sciences,
Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300 Kuala Nerus,Terengganu Darul Iman, Malaysia
[2]Department of Economcis, Faculty of Economics and Management,
Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

Abstract: The quality of recycling services will reflect the effectiveness of recycling performancefurther improvements. Putrajaya residents were selected as a study site to evaluate the recycling services and assess the ability of the services provided. Data were collected using a stratified random sampling of the householdsusing the questionnaires that have been prior tested for reliability. Thecritical incident technique (CIT) was used to identify and analyse the satisfaction and dissatisfaction of recycling services. Five successful service constructsidentified were a good feeling, secured environment, facilities and efficiency, educational and peer pressure. The paper highlights the form of recovery strategiesundertaken by the authorities as perceived by the households.

Key words: Critical Incident Technique · Service Quality · Recovery Strategy · Recycling · Putrajaya

INTRODUCTION

Since attaining independence in 1957, Malaysia continues to progress and there has been a remarkable change in all sectors through national transformation. The earnest efforts of the government to stabilize the economy and develop the infrastructure towards the aspiration of Vision 2020 are without a catch. Environmental pollution is a problem that arises with rapid development. Rising consumption of electronic products will affect the environment if the electronic waste is not managed properly. The management guidelines provided by the Department of Environment (DOE) Malaysia defined e-waste as waste from the assembly of electrical and electronic appliances that consist of components such as mercury-switches, accumulators, glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors or contaminated with cadmium, lead, chromium, mercury, nickel, silver, copper, manganese or polychlorinated biphenyls. All of these materials may pose a lot of damage if disposed inefficiently.

The majority of households in Malaysia dispose of their solid waste into landfills and send their e-wastes to collection centers that are already available in Malaysia. For the industry players, they can send their e-wastes to the recovery facilities licensed by the DOE. Generally, the main sources of e-wastes are from the industries followed by the households which generate e-wastes from domestic dwellings. The huge amount of e-waste will worsen and be more harmful towards the environment if we disregard their management. Because of that, monitoring and improvement in services should be done so that the environment is protected. To best reflect the commitment towards e-waste recycling Putrajaya was selected for the study site. It is a model city planned towards the Green City development by the year 2025. Green City is an initiative that has been made with the conditional commitment of a reduction of carbon emission intensity. It has a specific aim to minimize negative environmental impacts and degradation. Besides that, the Green City might encourage people to build their interactions back with nature and reduce carbon emission from their daily activities.

Putrajaya is the new federal administration centre of Malaysia located 25km south of Kuala Lumpur. It was develop based on two underlying concepts, including sustainable development and as an intelligent city. And for those concepts, an integrated land was planned for

Corresponding Author: Nazatul Faizah Haron, Department of Economics, Faculty of Economics and Management Sciences, Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300 Kuala Nerus,Terengganu Darul Iman, Malaysia.

use with support by various guidelines covering all sectors such as environment, transportation, utilities, landscape, lake use and navigation, urban design and etcetera. The facilities of waste disposal are provided by the authorities to be used by the rising population from 67,964 in 2010 to 72,000 in 2013 in managing their wastes. These increasing numbers in terms of population has raised the quality services demanded by consumers. It is important to gauge the quality of e-wastes recycling services and to identify any service failure incidents occurring over a specific period of time. The authorised operators have to identify the quality of services which are not meeting the requirements demanded by the consumers and make remedial actions to ameliorate the problems. This study investigated the quality of e-waste recycling services in Putrajaya due to service quality issues. The communities have joined recycling activities in their area and the observations that they made can be taken and managed to gain feedback towards the services.

Recycling services in Putrajaya is fully managed by Alam Flora and controlled by Perbadanan Putrajaya in terms of operational matters. The existing practice is for the operator to provide recycling centres for use by society and to collect the wastes deposited. However, the effectiveness of these services has not yet been measured in terms of the quality of services offered. The failure of services can be considered through the negative statements from consumers. When a service failure occurs, the management needs to recover it quickly. The purpose of this study was to evaluate the quality of recycling services and to gauge the services recovery strategies. This study also investigates the presence of quality characteristics that could constrain the success of services which depends on the participation from communities and the ability of the service provider.

MATERIALS AND METHODS

To address this research topic, the CIT method will be used to elicit the perceptions from respondents. Specifically, it is aimed to collect information on incidents occurring over a specific period of time. The critical incident technique (CIT) originally established by Flanagan in [1], broadly explains the development of the CIT method and their usefulness in solving practical problems. The definition of CIT stems from the work of Flanagan who defines the technique as procedures used to collect information about human behavior and it is an analytical method that uses narratives and self-reported stories to classify specific events or phenomena. Within the CIT method, data can be gathered in several ways, generally, through surveys, personal interviews, focus group interviews and observations [2]. In this study, a survey was conducted to elicit and explore the failure of recycling activities. Critical incidents were collected from respondents who live in Putrajaya by using the structured interview in which the residents were required to provide vivid details of their perceptions about recycling services in their area.

Following the Flanagan studies that were first presented in a paper in the *Psychological Bulletin*, in which he describes the five steps of CIT as illustrated in Figure 4 for data collection. This method has been extensively used in the study of various disciplines for example in hospitality and travel, education and human resource. The essential of CIT technique is that observation can only be made on the good or bad performance by asking respondents to express their special needs and expectations. Prior to this study, several researchers have used this method to elicit a wealth of data. This method can facilitate a high level of ecological validity as claimed by Narayanasamy *et al*., [3] since it gets the feedback from respondents based on real accounts from experience. According to previous works, CIT is an ideal approach to identify dissatisfaction of related issues such as techniques that are currently being used for areas which are not widely explored.

After recognizing the critical events from these responses, the next procedure is to classify them into groups or magnitudes based on their resemblances. Each category would be given a name and percentage (based on the number of responses in each category) which is calculated as the influencing causes (positive and negative) in the failure of recycling activities. The CIT method has it's strengths and advantages depending on the experience of the researchers. First, this technique is inexpensive and provides strong reliability since it is collected from the respondent's perspective and they give their statements in his or her own words (Edvardsson, 1992). The CIT method also provides rich information by allowing respondents to ponder and determine which incidents are most relevant to them. By doing that, CIT is one of the flexible methods that allow respondents a wide range to respond to the overall research [4]. Second, the technique is appropriate especially for unusual events, which may not be picked up by other techniques and it is an attractive method of investigation since it does not restrict observation to a limited set of a variables or activities [5]. Recent CIT study was used as an example in conducting a CIT study. Five steps in critical incidents can be followed as illustrated in the diagram below:

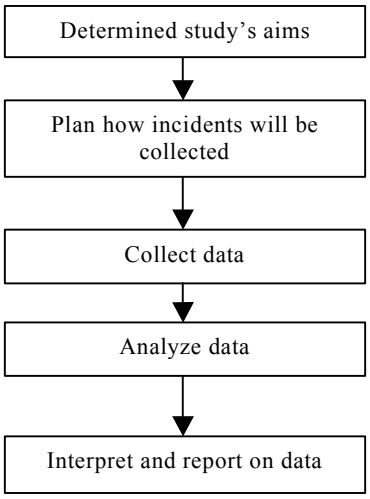

Fig. 1: Five steps in critical incident technique [6]

Data Collection: To address the problem in this study, a questionnaire was developed which comprises a series of questions asked for respondents to response. The interview session requires respondents to give their statement regarding the predetermined questions. The objectives of the research and the importance of truthful answers from respondents are clearly emphasized in the introduction in order to reduce hypothetical market bias in the questionnaire. Besides that information about e-waste is also mentioned to avoid confusion of scope of e-waste during the interview session. The formulation of questions is based on literature review with the contents covering six main sections that requests information on general social and environmental attitudes, awareness of current e-waste disposal options, willingness to participate in recycling scheme, preferences for that scheme, evaluation of the Putrajaya's recycling facilities and householder's current disposal practices and the last section enquires about socio-economic and demographic details [7]. Likert Scales will be used to measure the environmental attitudes that typically ranged from 1 to 5 and respondents need to choose a number to indicate the degree of agreement or disagreement with a given statement such as: 1 = strongly disagree and 5 = strongly agree. Factor analysis with principle component analysis was used to group Likert-scale variables into a small number of interpretable factors. The reliability analysis of the questionnaires responses provided a value of Kaiser-Mayer Olkin's measure of sampling adequacy (KMO) test and Barlett's test of sphericity to assess the suitability of the survey data for factor analysis and as an important role for accepting the sample adequacy [8]. The results indicate the proportion of variance in the variables which is common variance, while the Barlett's test is a statistical test for the presence of correlations among the variables as reported in Table 1. The KMO index ranges from 0 to 1 and produces the sampling adequacy is 0.943 which is larger than 0.6. On the other hand, a significant Barlett's test for sphericity results with Chi-square = 10721.387 which further supports the factorability of the correlation matrix. The KMO and Bartlett's test show the suitability of the data and meet the fundamental requirements for factor analysis.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.943
Bartlett's Test of Sphericity	Approx. Chi-Square	10721.387
	df	630
	Sig.	.000

Data Analysis: In this method, the analytical framework is based on the following model. The dependent variable construct being a successful performance in e-waste recycling and its determinant constructs are the critical incidents obtained from data analyses.

In the analysis seeking the intensity of the service quality all the data generated are based on information provided by the respondents. In the earlier stage, the data was analyzed to obtain the list of successful performance incidents, thus reducing the number of incidents categories. These categories were further sorted into small groups or constructs of incidents. Before that, the frequency of the occurrence of the group of successful performance incidents was done by applying factor analysis that would provide information on what are the critical incidents of recycling service performance in Putrajaya. The following stage in the analysis was to determine the magnitude of each successful performance. To access the intensities of critical incidents, the Likert scale ranging from 1 (not very serious) to 5 (very serious) as reported by respondents is taken to evaluate their dissatisfaction for the particular service. Meanwhile, the respondents who are not facing a particular service quality incident would score 0 for that service. After that, the study will continue to obtain the mean score for each service quality that reflected the perspective of all respondents. The statements or responses with none having problems in service quality was included as a part of the whole sample and used in the analysis.

RESULTS AND DISCUSSIONS

Respondent's Profile: The proportion of the survey was 48% for male and 52% of female respondents within the age group between 31-40 years old (43%). The highest income range was RM4001-RM6000 per month and about 51% of the respondents are degree holders, followed by 34% of respondents are diploma holders. From the above figures, it could be concluded that the most of the interviewed respondents were young and well educated with a good income. The majority (44%) of the respondents think that the e-waste generated from the society is important and the majority of them (48%) will get involved in recycling. Meanwhile, 91% of the respondents had recycling experiences. This profiling together with further findings from this investigation provides information for management or any shortcomings that may need more attention.

From the survey, 35 service incidents were identified that generate the perception towards the recycling services among respondents. All collected feedbacks were from their experiences through practicing the recycling activities. The high number of incidents portrays that most factors influence their perceptions on recycling services and showed their opinions regarding these matters.

Critical Incidents: A total of 35 incidents of satisfaction in recycling services were identified (Table: 2).

Table 2: Service Quality Performance

	Successful construct (factor) [sub-variables]	*Sub-variables loading*	*Variance (% of explained) [eigenvalues]*
a	**Good feeling**		
	Feels happy involved in recycling	0.784	31.638 [11.390]
	Feels great when do recycling	0.782	
	Feels committed	0.764	
	Feels better when to recycle	0.759	
	Satisfied in life	0.752	
	Feels happy to be involved	0.733	
	Can explore new things in recycling	0.706	
	The World become better	0.687	
	Feels comfortable around recyclers	0.686	
	Feels the quality of life in recycling	0.655	
b	**Secured Environment**		
	There is hazardous waste in electronic wastes	0.759	3.660 [10.166]
	E-waste recycling is important	0.745	
	Conserved resources through recycling	0.742	
	Suffered pollution problem in future	0.714	
	Pollution is in critical level	0.700	
	E-wastes gives negative impacts on human health	0.685	
	Increase the quality of environmental	0.678	
	Better environment promotes better living	0.607	
c	**Facilities and Efficiency**		
	Campaign and programmed has successful launched	0.742	6.976 [2.512]
	Good services in recycling centre	0.727	
	Recycling facilities was provided	0.699	
	Most of the family members involve in recycling	0.651	
	Selling e-wastes to private company	0.641	
	Encouragement from neighbours	0.574	
	Enough space to store the materials	0.542	
	Recycling centre is available in residential areas	0.509	
	Belief in local authorities to handle	0.495	
	Time and cost constraint to recycle	0.491	
d	**Educational**		
	Separation between recycling and non-recycle materials	0.669	
	E-waste recycling is important because it's contained hazardous materials	0.645	3.640 [1.311]
	Appreciate resources through recycling activities	0.644	
	All campaign influenced me to recycle	0.577	
	Reducing consumption of landfill areas through recycling	0.554	
e	**Peer Pressure**		
	I will do the recycling when I see others do that	0.617	3.497 [1.259]
	Most of the family members think that I should do recycling activities	0.486	
Total of variance explained			55.918

A total of 35 categories of successful performance were identified (Table 4.9). The results were gained through the extraction from factor analysis. The first factor that had the strongest variation explanation level (31.64%) is the 'Good Feeling'. The factors include ten items, namely happy involve in recycling (0.784), feels great (0.782), committed (0.764), feels better (0.759), satisfaction (0.752), happy to be involved (0.733), explore the new things (0.706), world becomes better (0.687), comfortable around recyclers (0.686) and the quality of life. The result indicates that the successful performance of recycling services could occur when related to the sense of responsibility and good citizenship of respondents. An illustration is provided below:

"I feel committed and very responsible when I take part in recycling activities. I would feel guilty if I did not recycle my e-waste and contribute something that can reduce the amount of wastes that goes to landfill. I know when I am doing a good deed it makes me feel happy and satisfied." [From a 40-year-old Malaysian Female]

The second factor is termed 'secured environment', which accounted for 3.66% of the total variance. This factor includes eight items explaining the assessment of respondents on recycling services, which are the existence of hazardous waste in electronic wastes (0.759), e-waste recycling is important (0.745), conserved resources through recycling (0.742), pollution problem in future (0.714), critical level in pollution (0.7), negative impacts on human health (0.685), increased the quality of environment (0.678) and promotes better living in a good environmental (0.607). This satisfaction performance was related to the circumstances where the respondents' were aware of a clean environment and feel secured if living in a high-quality environment that is free from toxicity or any hazardous threats. Below is an illustration of a concern about the environment:

"As far as I know, there are hazardous materials contained in electronic equipment. Because of that, we need to take a step further to preserve our environment to avoid or at least to decrease the pollution in the future. In my mind, recycling is the one of the best solution to prevent these things to happen besides we can keep our environment in a good condition without giving any hazardous threats to nature and to human health especially." [From a 35-year-old Malaysian Female]

The third factor had 6.98% of the total variance and is termed 'facilities and efficiency'. This factor contains ten items: campaign and program of recycling (0.742), good services in recycling centre (0.727), recycling facilities (0.699), most of the family members involve in recycling (0.651), selling e-wastes to private company (0.641), encouragement from neighbours (0.574), enough space to store the materials (0.542), availability the recycling centre (0.509), belief in local authorities (0.495) and time constraint (0.491). The satisfaction performance in the construct (c) was concerned with the facilities provided by the authorities and the efficiency of handling wastes. Respondents will respond through their feelings about the facilities that they are using and the easiness for them to doing it. Two illustrations are provided:

(1)"I recognised that recycling facilities are provided and I satisfied with it. It makes me easier to sending my e-waste to the recycling centre."[From a 30-year-old Malaysian Female]

(2)"I have experienced a great feeling whenever I dealing in recycling centre because they served me good services."[From a 40-year-old Malaysian Male]

The satisfaction here indicates the 'well performances' in facilities services that make respondents much affected to do recycling practice. The campaign by the authorities will raise the potential of respondents' involvement in recycling.

Satisfaction with performance in the construct (d) is termed 'educational' and was related to the level of understanding on this issues that can teach us to be more educated on how to manage and handle wastes. This factor included five variables contained with the good practices in separation recycle or non-recycle materials (0.669), well informed of the important of recycling (0.645), appreciate resources through recycling (0.644), recycling campaign (0.577) and reducing the consumption of landfill area (0.5554). All of these positive perceptions indicate the encouragement in recycling activities and ensuring the recycling service to be a success. An illustration of the educational interpretations is provided:

"I can feel that I become a grateful person to more appreciate the nature and resources. Through recycling, I can train myself to increase my awareness about the important of recycling and contribute something to preserve our environment." [From a 45-year-old Malaysian Male]

The last factor (peer pressure), which had a total variance of 3.497%, includes two items: influence from other members (0.617) and encouragement from family members (0.486). The illustration of these conditions is shown by the example given by the respondents:

"Most of my family members think that I should join the recycling activities. They always give me beneficial advice about the environment and showed me the good example in handling wastes. When I see them sending their wastes to the recycling centre, automatically I will do the same." [From 26-year-old Malaysian Male]

Recovery Strategies: In the assessing recycling services, the recovery strategies were framed by following the categories adopted by Hoffman *et al*. (2003). All the recovery strategies suggested recovering of any dissatisfaction from respondents. According to the feedback that was received from respondents, it was suggested that authority response was perceived as the most common strategy adopted (37.17%) by respondents and the participating community. This response falls into the category of the actions that would be taken after receiving any reports from the participant community. The second most frequent recovery strategy was excellent responses (29.67%) followed by apologetic responses (25.33%) that fall into the category in which the authorities understand the weaknesses in services quality but there is no action taken. The lowest recovery strategy was taking no action (7.83%) whereby the authorities and the management did not admit or just ignored the presence of a problem. They provided excuses and delayed taking any actions. All of these percentages are gathered from the analyses in a survey where the respondents were asked their opinion regarding the recycling service performance in Putrajaya.

CONCLUSION

The objectives of this study are to assess the quality of services in the recycling centre provided. By using the factor analysis, five successful categories can be obtained which are the good feeling, secured environment, facilities and efficiency, educational and peer pressure. All of these items indicate the successful construct from the analysis result. The response on recovery strategies provides a clue in that the authorities should take more actions on checking all the recycling facilities frequently. Therefore, the results of the study shown that CIT can be applied in environmental economics to provide feedback on service quality gained from the respondents and imply on the recovery strategies taken by the community and management. This method provided insight on the respondents' perspective of satisfaction of services and recovery strategies adopted. All of the incidents were taken from the community that had knowledge and experience on recycling and specific expectations of the services offered. For continued assessment, it could be more interesting if we take the service quality perspectives from the other side, such as top management, employees and other consumers that probably use the services so that other view of the effectiveness of their actions in improving the quality of services recycling in the future can be known.

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