Factors and values of willingness to pay for improved construction waste management – A perspective of Malaysian contractors

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Abstract

Malaysia is facing an increase in the generation of waste and of accompanying problems related to its disposal. In the last two decades, extensive building and infrastructure development projects have led to an increase in the generation of construction waste material. The construction industry has a substantial impact on the environment, and its environmental effects are in direct relation to the quality and quantity of the waste it generates. This paper discusses general characteristics of the construction contractors, the contractors’ willingness to pay (WTP) for improved construction waste management, determining factors which affect the amount of their willingness to pay, and suggestions and policy implications in the perspective of construction waste management in Malaysia.

The data in this study is based on contractors registered with the construction industry development board (CIDB) of Malaysia. Employing the open ended contingent valuation method, the study assessed the contractors’ average maximum WTP for improved construction waste management to be RM69.88 (1 US$ = 3.6 RM) per tonne of waste. The result shows that the average maximum WTP is higher for large contractors than for medium and small contractors. The highest average maximum WTP value is RM88.00 for Group A (large contractors) RM78.25 for Group B (medium-size contractors) and RM55.80 for Group C (small contractors). One of the contributions of this study is to highlight the difference of CIDB registration grade in the WTP for improved construction waste management. It is found that contractors’ WTP for improved waste collection and disposal services increases with the increase in contractors’ current paid up capital. The identified factors and determinants of the WTP will assist the formulation of appropriate policies in addressing the construction waste problem in Malaysia and indirectly improve the quality of construction in the country.

1. Introduction

Malaysia is facing an increase in the generation of waste and accompanying problems related to its disposal. In the last two decades, extensive building and infrastructure development projects have led to an increase in the generation of construction waste material. In Malaysia, data is not readily available on the current structure of construction waste flows by the source of generation, type of waste, intermediate and final disposal and the amount of waste reduced at source, reused or recycled on-site or off-site. A study by Nasir et al. (1998) provides a breakdown by source of waste generation in the central and southern region of Malaysia: 36.73% from household waste, 28.34% from industrial and construction waste, and 34.93% from other sources (market and commercial waste, institutional waste, landscaping waste and street sweeping waste). This shows that in Malaysia construction waste forms a significant portion of wastes that is finally disposed of in landfills.

The construction industry has a substantial impact on the environment, and its environmental effects of this industry are in direct relation to the quality and quantity of the waste it generates. Despite the massive amount and complexity of waste produced, the standards of waste management in the country are still poor (Nasir et al., 1995). These include outdated and poor documentation...
of waste generation rates and its composition, inefficient storage and collection systems, disposal of municipal waste with toxic and hazardous waste, indiscriminate disposal or dumping of wastes and inefficient utilisation of disposal site space. In Malaysia, the literature on economic valuation or contractors’ willingness to pay (WTP) for improved construction waste management is limited. Most of the studies on solid waste management are descriptive in nature. To date there has been few studies conducted to estimate WTP for solid waste management activities (Mourato, 1999; Othman, 2002). According to the contingent valuation literature, WTP should reflect the value to the community of having improved environmental quality. From an economic perspective, the goal is to determine the value to the community of having such a management system and to use this value in the decision-making process so that the full cost of waste management is recovered. In the absence of a market for a service or goods, as with the environment, people are simply asked what they would do in a hypothetical situation. This method is known as contingent valuation (CV). CV involves obtaining direct information from individuals about their willingness to pay or accept money for changes in environmental quality. CV has been used in the valuation of public goods, mainly in the valuation of the environment (Krutilla, 1967; Boyle and Bishop, 1987; Mitchell and Carson, 1989). According to Kotchen (2000), the contingent valuation method (CVM) measures such values by employing survey questions to elicit people’s stated preferences for environmental intermediate goods, such as compost (Bandara and Tsidell, 2004). Recently, Danso et al. (2006) used CVM for the analysis of perceptions and willingness-to-pay (WTP) for composted municipal solid and faecal waste among urban and peri-urban farmers and other potential compost users. The most prominent research has been done in evaluating benefits of curbside recycling for households (Creel and Loomis, 1997; Caplan et al., 2002; Aadland and Caplan, 2003; Basili et al., 2006). The monetary valuation of an environmental good is usually based on the monetary value that individuals place on it. The maximum amount of money an individual is willing to pay for obtaining a benefit or avoiding a loss in most situations reflects the intensity of his preferences for such a benefit or loss (Markandya, 1998; Huhtala, 1999; Basili et al., 2006). His preferences in turn are based on the values he attaches to goods. The maximum WTP can be considered an expression of the individual’s values. Analogously, the minimum willingness to accept (WTA) is an amount of money considered as compensation for foregoing a benefit or for incurring a loss and this reflects the value of such a benefit or loss.

This paper discusses general characteristics of the contractors, contractors’ WTP for improved construction waste management, determining factors which affect the amount of their willingness to pay, and suggestions and policy implications in the perspective of construction waste management in Malaysia.

2. Survey design, data collection and analytical model

Data was collected through interviews with contractors registered with the CIDB of Malaysia (registration with CIDB is obligatory for all contractors) from October 2003 to March 2004 in the Klang Valley, specifically in Kajang, Petaling Jaya, Subang Jaya and Seri Kembangan. In the construction industry, there are seven categories such as G1, G2, G3, G4, G5, G6 and G7 of local contractors in which a total of 5696 contractors have been registered in the Selangor (CIDB, 2003). In this study, the “purposive stratified random sampling” method was used focusing on three major groups of contractors. These are: Group A comprised of G6 and G7 contractors, Group B comprised of G4 and G5 contractors, and Group C for G1, G2 and G3 contractors. The final survey was based on 130 samples of contractors: 35 from Group A, 35 from Group B and 60 from Group C. The sample represents 2% of the total registered contractors in Selangor. Interviews were based on a set of questionnaires that was pre-tested and modified before being used in the survey. The study was based on the open ended CVM in the survey for collecting information about the willingness to pay of contractors (Begum, 2005). In addition, the contractors were provided with a scenario for improved waste collection and disposal services proposed by a private waste collection and disposal servicing agency (details of scenario in Appendix I). Based on this scenario, the contractors were free to decide their WTP.

To determine the factors that affect the willingness of contractors to pay for improved construction waste management, this study followed a multiple regression model. The ordinary least square (OLS) method was used to estimate the parameters in multiple regression models. The significant relationships between dependent and independent variables was examined by the value of the correlation coefficient (R) in two variable cases and for the multivariate case, t-values, $R^2$, adjusted $R^2$ and F-values was estimated. As such, the model assesses the relationship between various factors and the contractors’ willingness to pay. In this regression analysis, the maximum amount of contractors’ WTP is regressed due to its quantitative nature by several independent variables. The model is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + e$$

(1)

where, $\beta_0$ is constant term, $\beta_1$-$\beta_8$ are the coefficients of independent variables and $e$ is the error/disturbance term. $Y$ is the dependent variable, (maximum amount of contractor’s WTP in RM).

In the interview process, at first contractors were asked whether they were willing to pay (or not) for improved construction waste management services, specifically waste collection and disposal services. If yes, contractors were asked how much they would be willing to pay (by the open ended
contingent valuation questionnaire). Additional questions related to the contractors general characteristics, waste collection systems and other related issues were considered to obtain the estimates for the explanatory variables in the multiple regression model. Most of the variables derived from the survey and which have been considered relevant from theoretical point of view were included as explanatory variables. Table 1 provides a summary of the explanatory variables used in the multiple regression model of the study.

3. Results and discussion

3.1. General characteristics of the sample

Table 2 summarises the general characteristics of the respondents. The category distribution in the samples is 26.9% for Group A (G6 and G7), 26.9% for Group B (G4 and G5) and 46.2% for Group C (G1, G2 and G3). The selected samples are quite representative of the general building and construction contractors of the Klang Valley. In this survey, 19.2% of the respondents are public companies and 80.8% are private limited companies.

3.2. WTP responses of the contractors

Table 3 summarises the responses of the contractors according to their willingness to pay. This study found that 68.5% of the contractors showed a positive WTP response for improved construction waste collection and disposal services in their construction sites and 31.5% of the contractors were not willing to pay. Views on willingness to pay were different among the groups, with the highest number of contractors that are willing to pay reported in Group C (73.3%), followed by 71.4% in Group A and 57.1% in Group B.

3.3. Willingness to pay values of the contractors

Table 4 summarises the maximum WTP values (RM per tonne) and their respective frequencies among contractors from the three groups. The results show that 24% of the Group A contractors reported RM100 WTP per tonne of construction waste collection and disposal services, and 20% reported RM150 and RM50 per tonne. For Group B, 20% of contractors reported RM100 and RM70 WTP per tonne of waste, and 15% expressed a WTP value of
In the case of Group C, around 23% of contractors reported their maximum WTP value as RM50 and 11% reported RM70 and RM40 per tonne. However, the willingness to pay values of RM40 is the lowest and RM150 is the highest in Group A. The lowest WTP value is RM20 for Group B and RM 5 for Group C, and the highest WTP value is RM200 for Group B and Group C. It is found that none of the contractors are willing to pay more than RM200 (Begum, 2005).

The result shows the average maximum willingness to pay value of the contractors in the three groups. The average maximum amount that the 89 respondents reported being willing to pay for collection and disposal services is RM69.88 per tonne. The study also shows that the highest average maximum WTP value is RM88.00 for Group A, RM78.25 for Group B and RM55.80 for Group C contractors. However, the results indicate that the average maximum willingness to pay values tend to be higher for the larger contractors such as Group A (G6 and G7), compared to the medium-size contractors such as Group B (G4 and G5) and the small contractors as Group C (G1, G2 and G3).

3.4. Relationship between maximum amount of WTP and category of contractors and paid up capital

The study shows that the relationship between the maximum WTP value and the category of contractors is positive (Pearson correlation 0.183) and statistically significant at the 0.05 level ($P < 0.05$). This means that the maximum amount of WTP increases with the higher category of contractors; for example the Group A maximum WTP is higher than that for Group B. On the other hand, the Group B maximum WTP is higher than that of Group C.

In addition, the results also show a positive and direct (Pearson correlation 0.170) relationship between the maximum WTP value for improved waste management services and contractors’ paid up capital, and is statistically significant at the 0.05 level ($P < 0.05$). This explains that for contractors whose paid up capital is higher, their maximum
WTP is also higher; and, conversely, those contractors with lower paid up capital have a lower maximum WTP. The reason behind this is that the contractors with higher paid up capital are larger contractors than the contractors with lower paid up capital, and larger contractors can afford more money for improved waste management.

3.5. Estimated multiple regression model for determining factors of the contractor’s willingness to pay

It is noted that there are seven categories of local contractors (G1, G2, G3, G4, G5, G6 and G7) in the construction industry of Malaysia. As described previously, the study samples were divided into three groups – Group A (G6 and G7), Group B (G4 and G5), and Group C (G1, G2 and G3) – based on their paid up capital, tendering capacity and minimum personnel resources requirement. The results of the study show that Group A contractors generally engage private waste collectors and they are willing to pay RM88.00 per tonne for waste collection and disposal services. Contractors in other categories tend to practise self disposal. Group B is willing to pay RM78.25 and Group C RM55.80 per tonne for waste collection and disposal services. However, the study applied a multiple regression model to explain the factors affecting contractors’ WTP for improved waste management services. The estimated results of the multiple regression model on the contractors’ willingness to pay are summarised in Table 5.

Most of the explanatory variables are significantly related to the contractors’ willingness to pay, which is discussed below:

- The coefficient value of the variable, contractor’s type of company, indicates that contractors that are public companies are more willing to pay than contractors that are private limited companies. It shows that public construction companies are potentially inclined to contribute to environment by improving construction waste collection and disposal services. In line with this study, Basili et al. (2006) also showed that commercial firms have a negative relation to the WTP.
- The negative coefficient of the variable, experience in construction works, indicates that contractors with less experience are more willing to pay for the improved construction waste management services assuming other factors are constant. In the survey, most of the contractors (about 72%) have 2–10 years experience while almost 28% of the contractors have experience ranging from 11–13 years. In fact, newly established contractors are more conscious about waste collection and disposal services, and that they are willing to pay for these services.
- The positive coefficient of the variable, contractors’ paid up capital, shows that the higher the paid up capital, the higher the WTP value, compared to those contractors who reported lower levels of paid up capital.
- When the other factors are constant, this finding indicates that contractors who collect their waste frequently are more willing to pay than the contractors who do not collect waste frequently. It seems reasonable since the contractors who collect waste frequently could have a better understanding of the improved waste collection and disposal services.
- The result shows that contractors who practice source reduction, such as buying repairable, refillable and durable materials, are more willing to pay than those who do not practice source reduction.
- The positive coefficient of the variable, WTP more for improved waste collection and disposal services, indicates that for contractors who agree to pay more for these services, their maximum WTP value is higher than those contractors who do not agree. This is expected if other variables remain constant.

The variables that show expected coefficient signs but that are insignificant are explained below:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimated coefficient (β)</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>52.511 (2.023)b</td>
<td>25.953</td>
</tr>
<tr>
<td>Type of company (X1)</td>
<td>−15.873 (−1.985)b</td>
<td>7.997</td>
</tr>
<tr>
<td>Experience in construction works (in years) (X2)</td>
<td>−1.163 (−2.408)b</td>
<td>0.483</td>
</tr>
<tr>
<td>Group A (G6 and G7) contractors (X3)</td>
<td>2.638 (0.396)c</td>
<td>6.662</td>
</tr>
<tr>
<td>Paid up capital (X6)</td>
<td>0.00009 (0.000)b</td>
<td>0.000</td>
</tr>
<tr>
<td>Frequency rate of waste collection in the construction site (X5)</td>
<td>4.299 (2.144)b</td>
<td>2.005</td>
</tr>
<tr>
<td>Buying repairable, refillable and durable materials (X6)</td>
<td>13.378 (1.985)b</td>
<td>6.738</td>
</tr>
<tr>
<td>Willing to pay more for improved waste collection and disposal services (X7)</td>
<td>68.447 (10.842)a</td>
<td>6.313</td>
</tr>
<tr>
<td>Satisfaction level of the existing waste collection and disposal Services in construction site’s (X8)</td>
<td>−6.288 (−1.276)c</td>
<td>4.929</td>
</tr>
</tbody>
</table>

Y is the maximum amount of contractors’ willingness to pay. Figures in parentheses denote the t-values for the regression coefficients.

- a Indicate significant at 0.01 level.
- b Indicate significant at 0.05 level.
- c NS: Indicates not significant at 0.10 levels.
• Group A shows a positive relation with WTP. The positive coefficient shows that the larger the contractor, the higher the WTP amount compared to the medium and small categories of contractors. This result seems reasonable since Group A contractors are the largest contractors in the construction industry and also have higher paid up capital, which has a positive and significant effect on the willingness to pay for improved waste collection and disposal services.

• The variable, satisfaction levels of the existing waste collection and disposal services, seems to be negatively correlated to WTP. The reasoning behind this correlation is, if the contractors' satisfaction level about the present waste collection and disposal services is higher, it can be expected that they would not be willing to pay more money for the improved waste collection and disposal services. Similarly, the negative coefficient shows that contractors who have a lower level of satisfaction with the present services are willing to pay more for improved waste collection and disposal services. This result is supported by the findings of Huhtala (1999), which showed that those who stated they had problems with their current garbage disposal service were often dissatisfied; these respondents tend to be more likely to favour recycling.

The explanatory factors that have a positive effect on the contractors' WTP are Group A contractors; current paid up capital; frequent rate of waste collection in the construction site; buying repairable, refillable and durable materials; and willingness to pay more for improved waste collection and disposal services. On the other hand, factors such as type of company, experience in construction, and satisfaction level with existing waste collection and disposal services have a negative effect on the willingness to pay. The factors determined in this study are not directly comparable to those reported in the literature (Huhtala, 1999; Caplan et al., 2002; Aadland and Caplan, 2003; Danso et al., 2006; Basili et al., 2006) because the features of the contractors' WTP and the factors that affect it are not same as those related to households or residents. However, the positive relation obtained could be compared with WTP found in the literature. As can be seen from the literature, income has a positive effect on WTP (Viniegra et al., 2001; Caplan et al., 2002; Danso et al., 2006; Basili et al., 2006); experience has a negative relation with WTP (Danso et al., 2006) and the negative relationship between age and WTP (Viniegra et al., 2001; Caplan et al., 2002; Basili et al., 2006). These literature can be indirectly supported to the findings of this study.

3.5.1. Goodness of fit of the model

We test goodness of fit for the model with some diagnostic tests which fulfil the following criteria of good results. First, the adjusted $R^2$ value (which is a measure of goodness of fit of the estimated regression model) of 0.532 depicts a good fitting of the model, which defines that 53% of the variation in change of the contractors' willingness to pay could be explained by the independent variables in the model. In this model, the observed $R$-value of 0.749, $R^2$-value of 0.561, and the $F$-test shows that the estimated regression is quite meaningful in the sense that the dependent variable is related to each of the specified explanatory variables. The linear relation of the model is highly significant (the $p$ value for the $F$-test is less than 0.0001). Second, the signs for the estimated coefficients are consistent with the theoretical or prior expectations. Third, most of the estimated coefficients are statistically significant at the 0.01 and 0.05 level, which is significantly different from zero. To identify the occurrence of multicollinearity, the correlation matrix of the explanatory variables is studied. The results of this multiple regression model show the best in the sense of involving no multicollinearity, that is, ensuring no two independent variables have a correlation in excess of 0.70. This means that the independent variables are not too highly related to each other. Moreover, the study employed the technique of collinearity diagnostics to eliminate the problem of multicollinearity. The eigenvalues of the explanatory variables are also studied by factoring the scaled (diagonal elements are 1’s), uncentered cross products matrix of the explanatory variables. Eigenvalue provides an indication of how many distinct dimensions are among the explanatory variables. In this model, several eigenvalues of the explanatory variables are not close to 0, thus the variables are expressed to not be intercorrelated, and the matrix is showed to be efficiently conditioned.

4. Conclusions and policy implication

The study showed that 68% of the surveyed contractors reported a positive willingness to pay for improved construction waste collection and disposal services while the rest were not willing. Contractors reported that they are willing to pay a maximum of RM69.88 per tonne on average for waste collection and disposal services, but none were willing to pay more than RM200 per tonne. The result indicates that the average maximum willingness to pay for the large contractors is higher than for the medium and small contractors. One of the contributions of this study is to highlight the difference of CIDB registration grade in the WTP for improved construction waste management. During the survey, the cost for waste collection and disposal services was on the order of RM50.00 per tonne. The costs are expected to rise due to the closure of dumping sites in the Klang Valley. Increasing costs make it more important for source reduction, reuse and recycling practices to come into play; it is expected that the construction industry will intensify efforts on source reduction, reuse and recycling.

The findings of the model conclude that the factors affecting contractors' willingness to pay are: type of com-
pany, years of experience in construction, contractors size category, paid up capital, frequency of existing waste collection, source reduction practices and satisfaction levels towards the existing waste collection and disposal services. Contractors’ willingness to pay for improved waste collection and disposal services increases with the increase in company size category and paid up capital. The identified factors and determinants of the WTP will assist in the formulation of appropriate policies in addressing the construction waste problem in Malaysia and indirectly improving the quality of construction in the country.

The result of the study suggests that government can intervene to improve waste collection and disposal services driven by the private sector. For example, by gradually increasing the landfill charges to RM200 per tonne of waste and beyond, government can ensure that contractors will immediately take measures to recycle their waste materials. The government can also provide incentives for initiation of downstream industries for construction waste recycling. By making these policies, the government can ensure that construction waste is reduced, reused, recycled and properly disposed.

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I. Scenario for the respondent

If any private waste collection and disposal servicing agency provides improved waste collection and disposal services for the construction contractors (those contractors are already disposing their waste by the private contractors, for them, this private agency will provide improved waste collection and disposal services rather than existing services), in that case this study wants to see your willingness and capacity. The agency’s goal will be reduced, reused and recycled of construction waste materials and then proper disposal. It is assumed that the contractors will get the following benefits from the private agency’s improved waste collection and disposal services.

At first, the collected waste will be brought in the agency’s recycling centre for recycling and composting of waste materials. After recycling, some waste (those that are suitable) will be sent to the incineration plant for energy recovery. The rest will be properly disposed at construction and demolition landfill or Govt. designated land.

In this research, the contractor or representative of the company will be asked to make a payment per tonne of waste for this improved waste collection and disposal service. For this, some contractors may be willing to pay more and others may be less. As regards their willingness to pay, they are completely independent to make decision how much they willing to pay.

References


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