

ATTRIBUTES FACILITATING SOLID WASTE SEPARATION AT SOURCE  
PRACTICE AMONG HOUSEHOLD.

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A project report submitted in partial fulfilment of the  
requirements for the award of the degree of  
Master of Asset and Facilities Management

Faculty of Geoinformation and Real Estate  
Universiti Teknologi Malaysia

JANUARY 2017

*Alhamdulillah, thank GOD for His blessing that had made this project a blissful success*

*Especially dedicated to my lovely family, my Supervisor, and friends....*

*“Thanks for All Support and Encouragement”*

## ACKNOWLEDGEMENT

In the name of Allah, the most Gracious, and the Most Merciful

*Alhamdulillah*, at last, I am very grateful to Him for giving me all the strength, blessing and guidance to finish this final year project successfully. I would like to express my sincere appreciation and special gratitude to my supervisor, Dr. Low Sheau Ting for the advice, guidance and support. Thank you for sharing the enthusiasm, knowledge, as well as the time spent. Without the patience and criticisms, the thesis would not have been the same as the one presented.

I am very grateful to all postgraduate students for serving advice and for their many helpful suggestions throughout my research. Not forgetting Hazwan Halimoon for all the helps he gave. I would also like to thank to my lab- mates for their friendship and concern during my throughout project's progress.

Thanks to my family for their never-ending support, to my parents who have always encouraged me to succeed academically. Thank you.

## ABSTRACT

This study aims to identify a set of attributes to facilitate source separation practice of solid waste among households. Solid waste management has approached major environmental challenges all around the world, particularly in developing countries. Municipal solid waste generation is expected increase up to 1.8 million tons of waste per day by year 2025 in Asia countries such as China, South Korea and Malaysia. Increasing trend of solid waste generation contributed by various factors including increase of population, urbanization process, changes in consumption patterns and improvement in lifestyle. To support a more sustainable solid waste management and resources use, one of the immediate paths is to reduce overall solid waste generation by increasing the recycling rate, through solid waste separation at source. This study is focusing on external factors that likely to facilitate solid waste separation at source.practice among the households in Langkawi Island, Malaysia. The PEST model is used as the fundamental basis in formulating the attributes to facilitate source separation practice in present context. There are four attributes identified: Regulation, Incentive, Information and Infrastructure and Support. Each attributes made up of two to three sub attributes. Questionnaire survey was conducted among households in Langkawi Island, Malaysia. A total of 472 convenience sample were accumulated from the household population. Raw data gathered was analyzed using Choice based conjoint analysis performed by Sawtooth Software. The results indicate that most preferred attribute is Infrastructure and Support. The set of attributes identified in this study may serve as a reference for governance consideration in formulating strategy to motivate source separation practice.

## ABSTRAK

Kajian ini bertujuan untuk mengenal pasti satu set atribut untuk memudahkan amalan pengasingan sisa pepejal di kalangan isi rumah. Pengurusan sisa pepejal telah menghadapi cabaran utama terhadap alam sekitar di seluruh dunia, terutamanya di negara-negara membangun. Penjana Sisa Pepejal Perbandaran dijangka meningkat sehingga 1.8 juta tan sampah sehari menjelang tahun 2025 di negara-negara Asia seperti China, Korea Selatan dan Malaysia. Trend peningkatan penghasilan sisa pepejal disumbangkan oleh pelbagai faktor termasuk pertambahan penduduk, proses perbandaran, perubahan dalam corak penggunaan dan peningkatan dalam gaya hidup. Untuk menyokong pengurusan sisa pepejal yang lebih mampan dan sumber digunakan, salah satu langkah segera adalah untuk mengurangkan penjana sisa pepejal keseluruhan dengan meningkatkan kadar kitar semula, melalui pengasingan pada sumber sisa pepejal. Kajian ini memberi tumpuan kepada faktor-faktor luaran yang cenderung untuk memudahkan amalan pengasingan pada sumber sisa pepejal di kalangan isi rumah di Pulau Langkawi, Malaysia. Model PEST digunakan sebagai asas utama dalam penentuan sifat-sifat bagi memudahkan amalan pengasingan pada sumber sisa pepejal dalam konteks ini. Terdapat empat atribut yang dikenal pasti: Peraturan, Insentif, Maklumat dan Infrastruktur dan Sokongan. Setiap atribut terdiri daripada dua tiga sub atribut. Soal selidik telah dijalankan di kalangan isi rumah di Pulau Langkawi, Malaysia. Sebanyak 472 sampel mudah telah terkumpul daripada penduduk isi rumah. Data kasar yang diperolehi dianalisis dengan menggunakan analisis gabungan berdasarkan pilihanyang dilakukan oleh Sawtooth Software. Keputusan menunjukkan bahawa atribut pilihan kebanyakan adalah Infrastruktur dan Sokongan. Set atribut yang dikenal pasti dalam kajian ini menjadi rujukan untuk pertimbangan tadbir urus dalam merangka strategi untuk memberi mendorong amalan pengasingan sumber.

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**LIST OF ABBREVIATIONS**

<i>STEEPLED</i>	-	<i>Social, Technology, Economic, Environment, Political, Legal, Ethical</i>
<i>MSW</i>	-	<i>Municipal Solid Waste</i>
<i>OECD</i>	-	<i>Organisation for Economic Co-operation and Development</i>
<i>PEST</i>	-	<i>Political Economic Social and Technological</i>
<i>UNESCO</i>	-	<i>United Nations Educational Scientific and Cultural Organisation</i>
<i>RSW</i>	-	<i>Rural Solid Waste</i>
<i>HSW</i>	-	<i>Household Solid Waste</i>
<i>PAYT</i>	-	<i>Pay-as-You-Throw</i>

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Solid waste management is crucially challenging due to multiple waste stream appeared in landfill and least to recycle , mainly in developing countries including Malaysia (EU-SWMC, 2009; Moh and Abd Manaf, 2014). Recently, source separation had been implemented in Malaysian government in order to achieve sustainable waste management (Moh and Abd Manaf, 2014). Generally, to determine the attributes influencing source separation of solid waste is crucial since different needs perceived by different individuals (Saladié and Santos-Lacueva, 2016) and (Sukholthaman and Sharp, 2016). For example, availability of specific container for each type of waste and collection system provided are remarkable but inefficiently, regardless preferred attributes that influence separation at source practice (Saladié and Santos-Lacueva, 2016). Consequently, no improvement in recycling rate unless people find proper container to dispose their wastes (Saladié and Santos-Lacueva, 2016). Therefore, attributes of source separation should be identified as may vary across the local context. This study aims to identify the preferred attributes of source separation practice among households in Malaysia so that it can support the objective targeted by Malaysia government in achieving recycling rate of 22 percent by 2020.

## 1.2 Problem Statement

Presently, the solid waste is becoming a part of an upfront issue been discussed by government due to the increasing of world population and waste generation (Tan *et al.*, 2015). The increasing rate of population growth will increase the solid waste generated (Hoornweg *et.al.*, 2013). According to What a Waste, (2012), East Asia and Pacific Region such as Malaysia, Singapore and Indonesia are generating approximately 270 million tons of solid waste per year.

Typically, the solid waste management is dominated of landfilling up to date (OECD, 2008). Nevertheless, the waste generated is excessive than the contented landfill space. Simultaneously, that will expose the waste to threat other resourceful such as river, flora and fauna habitat, and mangroves. In addition, the amount of waste generated was increasing tremendously. In United States of America, MSW increased of 200 to 400 million tonnes each year dramatically (Tonjes and Greene, 2012). According to Hoornweg (2012), 1.3 billion tonnes of MSW a year and is expected to increase to 2.2 billion tonnes by 2025 generated all around the world (Sukholthaman and Sharp, 2016). Such scenario could affect health problems to human in any ways. Generally, the Organisation for Economic Co-operation and Development (OECD) claimed that external affects may include dust, odour, noise, pests, accident risks, air and climate emissions (notably methane) (Briguglio, 2016).

Presently, most of the developing countries and urban cities such as India, China, Vietnam, Thailand and Indonesia are heavily rely on landfill due to the cost-effective and simple method compared to other disposal method such as incineration which requires higher costs and expertise (Moh and Abd Manaf, 2014). Regretably, landfill method is not sustainable method for recovering the useful components from waste consisting of value and can be reused (Bag, *et al.*, 2016).

Globally, the progress made to recycle MSW among developed and developing countries is varying. In United States about 34 percent of MSW were recycled in 2010, including 71.6 percent of waste paper (U.S. Environmental Protection Agency, 2011). In United Kingdom, about 30 percent of MSW has been recycled in 2004 (Tonglet *et al.*, 2004 and S. Zhang *et al.*, 2016). In contrast, about less than 2 percent of MSW is sorted and recycled in China (Chen *et al.*, 2015 and Zhang *et al.*, 2016). While in Thailand, only 26 percent of 3.9 million tons of MSW is being recycled over 16 million tons of annual generated waste (Achapan, 2012). In Malaysia, the recycling rate is only 10.5 percent for whole waste generated currently (SWC, 2015). This is indicating that more aggressive efforts should be in placed for Malaysia to achieve higher recycling rate.

Malaysian government focused on waste management since 1995 to present. To the extent of that, Figure 1.1 shows the national development plans and solid waste management plans in Malaysia. In the 8<sup>th</sup> Malaysian Plan, the government focus on waste 3Rs (reduce, reuse and recycle) form of studies and projects on recycling. In 9<sup>th</sup> and 10<sup>th</sup> Malaysian Plan, the government addressed on waste reduction issue. Obviously, these plans are looking to something that relating to develop sustainability in solid waste management.

National Development Plan				SWM Plan	
1988	Vision 2020			ABC Plan	
1993				First recycling campaign	
2000				NSP	National Recycling Programme (NRP)
2005		OPP3	RM-8		Waste Minimization Master Plan (WM-MP)
2010			RM-9		Solid Waste and Public Cleansing Management (SWPCM) Act 2007
2015			RM-10		
2020		OPP4			

**Figure 1.1** National development plans and solid waste management plans in Malaysia (MHLG, 2006).

To further, source separation has been launched on 1<sup>st</sup> September 2015 as aligned to 11<sup>th</sup> Malaysian Plan of managing waste holistically. Generally, Malaysian source separation program is alleviating the wastes management to increase recycling as well recovery rate of waste and improve management of landfills to reduce the amount of waste and pollution (Economic Planning Unit, 2015). According to SWCorp (2105), this program considered two main categories of wastes such are residual and recyclable. The public need to sort out all their wastes as referring to type recycle bin served and residual waste, households are advised to pack all wastes in one plastic and put inside trash bin. It also served on collection system so that the wastes are transfer off to the right place after been sorted (Ministry of Urban, Wellbeing, Housing and Local government, 2015).



The source separation program has been launched in whole Malaysia. At the initial stage it is launched at few states such as Kuala Lumpur, Putrajaya, Johor, Melaka, Negeri Sembilan, Pahang, Kedah and Perlis since 1<sup>st</sup> September 2015, it is effective throughout the Malaysia. Separation of waste at source is a critical first step in reducing mingled waste, which is a waste of resource. Literally, Malaysia is 100% dependent on landfills, however, only 10% of landfills are sanitised. The issues facing on Malaysia waste management included rapid increase in population along with massive movements of rubbish from densely populated township that is still ill-equipped to meet even its basic waste management needs and requirements, economic growth among townships, factories and super departmental stores decorating the skylines of many townships turn to have handover issues and private waste disposal contractors playing truant and not collecting waste regularly, as well as, a lack of proper infrastructure like incinerators, sanitised landfills, composting stations, recycling centers, transfer stations and proper waste separation centres. Recently, Malaysia is concerning about incinerators in waste management in resort islands such as Langkawi, Pangkor and Tioman. Unfortunately, failed and there are no success stories to learn from. Besides that, no enforcement on fine for waste disposal, Malaysian attitude of, “I don’t care what happens to my waste, as long as it is out of my sight” and least education programs to waste management from the responsible parties to the ground that attach directly.

Admittedly, several researches explored massively in fillings the gaps within waste management in consecutive years. Source separation is supporting the collection of cleaner recyclables conserving material quality and improving their value for the recycling industry mainly concerned to food wastes (Miliute-Plepiene and Plepys, 2015). Nevertheless, source separation is relating to behaviour of human’s efforts which considerable to be complicate and several factors identified to influence the decision (Karim Ghani *et al.*, 2013). According to W. Zhang (2012), personal environmental beliefs are causing an individual to source separation. Consequently, the stakeholders less focusing on the rightly targeted attributes and spent more on to implement the separation at source schemes.

Undoubtedly, several studies have discovered the attributes of source separation or recycling among households all over the world. According to Matsumoto (2011), socio-demographic variables, pro-environmental attitude, opportunity cost, recycling knowledge and social norms are influenced in doing source separation of household solid waste (HSW). Efficient, correct and active technical systems for source separation are contributed to higher participation rates at the household level (Rousta *et al.*, 2015). Providing the drop-off recycling facilities, the nationwide campaign provides recycling centres (RC) or buy back (BBC) with monetary incentives for recyclable items (Zen and Siwar, 2015). Still, recycling activity consumes individual investment of time, space, money and effort (Zen and Siwar, 2015). The constraints in recycling formed of external factors such as too few drop-off sites and inaccessibility recycling locations or individual barriers include not enough time, lack of space to store the recyclables (Chenayah *et al.*, 2007; Ibrahim *et al.*, 2000; Zen *et al.*, 2014; Zen and Siwar, 2015). Hence, source separation system reproducible caused by lack of related knowledge, inefficient policies, insufficient education and facilities, and poor maintenance by the community, mainly focused developing countries (Xu *et al.*, 2015).

Moreover, several economic instruments have been implemented in the past that consisted of money incentive which costs and benefits perceived to individual in performing behaviour is significant (Kirakozian, 2015). Regardless, information and infrastructure policies contribute great success to individuals participation in recycling as resulting from an accurate of information about how to sort waste as well suitable infrastructure to support recycling, eventually sorting will increase (Kirakozian, 2015). However, kerbside collection impressed households to practice of source separation in constantly since notified that supportive initiatives are implemented (Kirakozian, 2015). Hence, in previous study found that behavioural factors associated with external condition influence behaviour (Kirakozian, 2015). Presently, varies attentions in source separation practices.

Additionally, an incentive-based that concepts of rewarding household for sorting organic waste influenced of economic benefits (Xu *et al.*, 2015). Legislative Decree is regulation of Italy's provinces used to influence separate waste collection rate (Agovino *et al.*, 2016). Accessibility to recycling opportunities and corresponding knowledge towards source separation and recycling were influence the citizen's attitudes and practice (Refsgaard and Magnussen, 2009; Keramit and Tsagarakis, 2013). Moreover, a waste charge paid by residents of the communities (Slavik and Pavel, 2013). Door-step collection of recyclables (Schwebel, 2012). Furthermore, previous study investigated on socio-demographic, economic, and situational factors either stimulate or restrain recycling involvement of people directly (Ittiravivongs, 2012). Socioeconomic factors found integrated with the source separation schemes (Getahun *et al.*, 2012). However, in recycling, socio-demographic influenced is still under argument (Rousta *et al.*, 2015). In a study conducted, found of inefficiency of MSW recycling when the recycling and separate collection of waste are excluded from municipalities responsibilities and no strict rule or established system to collect recyclable waste materials indeed (Mian *et al.*, 2016).

There is minimal research in proposing set of attributes to facilitate the source separation practice among the local community. Separation at source practice is looking forwards on individuals commitment in collecting recyclable or composable materials from commingle and placing them at the disposal location at their household for collection (Sukholthaman and Sharp, 2016). Therefore, separation at source practice is involving processes that need public participation in order to simplify the processes taken such as collection, transportation, treatment, and disposal (Sukholthaman and Sharp, 2016). However, different people acquired different point of views that resist them to do separation at source practice. As such, recycling rate was low even separate of colour recycle bins provided in developing countries mostly. The identification of the right attributes are contributing to desired behaviour will foster sustainable behaviour change, thus, a set of attributes that preferred by the local community should be identified as human natures are favour to reflect with preferred attributes to sustain in source separation practice. According to Low (2012), the right determinants that formulate the specific behaviour able to

improve or change the human behaviour to act in favour accordingly. In a nutshell, the principal aim of this study is to identify the preferred attributes influence source separation practice of solid wastes among households in Malaysia.

### **1.3 Research Questions**

The research questions of the study are:

1. What are the attributes facilitating source separation practices among households?
2. What are the preferred attributes facilitating source separation practices among households in Langkawi Island, Malaysia?

### **1.4 Objectives of Study**

The objectives of the study are:

1. To identify the attributes facilitating source separation practices among households.
2. To identify the preferred attributes facilitating source separation practices among households in Langkawi Island, Malaysia.

## **1.5 Scope of Study**

The scope of this study is households in Langkawi Island, Malaysia that practice source separation of wastes. These respondents are considered main contributor to waste production in community areas and conform to initiatives waste management covered by local authorities of Langkawi.

## **1.6 Significance of Study**

The identification of a set of attributes facilitating source separation practices among households will contribute to encourage recycling and rates in effectively. The study will serve as reference guide for the future research as there is limited study on source separation in Malaysia and it can also be used by the government as a waste management strategy to encourage Malaysian participation in source separation program.

## **1.7 Research Methodology**

This research consists of five stages which are literature review, design survey instrument, data collection, data analysis and conclusion and recommendation. Figure 1.2 shows the flow chart of research methodology. The details of research methodology are as follows:

### **1.7.1 Stage One: Literature Review**

At this stage, the preferred attributes of source separation practices are being proposed. Suits with objective one, a comprehensive theoretical review is being captured through relevant scope theories and models directly. Literature review done by collecting published literatures formed of journals, articles and websites relating to minimisation of waste, characterisation of solid waste management, source separation of solid waste and attributes on source separation practices to external factors among households. At the end of this stage, researcher proposes the preferred attributes of source separation practices through PEST analysis (political, economic, social and technological).

### **1.7.2 Stage Two: Survey Instrument Establishment**

The second stage is to produce the survey instrument. By using theoretical structure found in literature review, the researcher need to produce relevant survey instrument in order to verify all respective elements in local context. This study use questionnaire survey in achieving the objectives. A suitable sampling strategy is used to ensure sufficient sample for this study. The questionnaire is generated using Sawtooth Software. Pre-test for the questionnaire will be done before distribute to the respondents in order perceived understanding and reliability implications according to study aimed.

### **1.7.3 Stage Three: Data Collection**

The questionnaire final version revised will distribute among households that perceived source separation practiced in Langkawi, Malaysia. The approached is face-to-face or single communication design. The data collection gathered is needed to identify the preferred attributes of source separation practices among households in Langkawi, Malaysia contexts.

### **1.7.4 Stage Four: Analysis of Data**

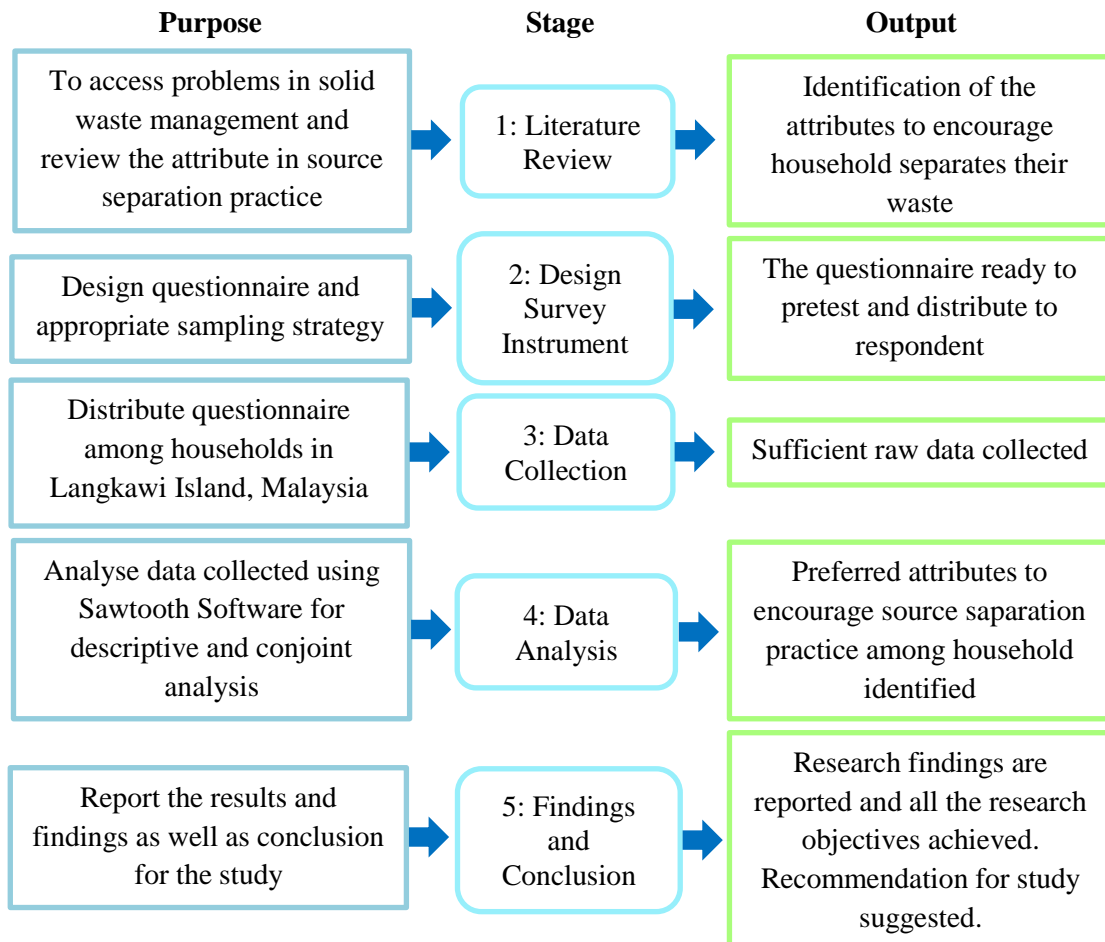
Raw data gathered from the field will be compiled and analysed to answer the research objectives. CBC analysis (choice based conjoint) will be used and assisted by Sawtooth Software to perform the analysis. Lastly, the preferred attributes of source separation practices will be identified.

### **1.7.5 Stage Five: Conclusion and Recommendation**

This is the final stage in this research. At this stage, researcher will conclude based on findings of the study in following literature reviews. Then, some recommendations for future research are presented.

### 1.7.6 Research Flow Chart

In order to achieve research output, some stages needed to be fulfilled as shown below in Figure 1.2.



**Figure 1.2** Research Methodology Flow Chart



## **1.8 Summary**

In conclusion, this chapter is reviewing the overall framework that inclusive in the present study of attributes facilitating solid waste separation at source practice among household in Langkawi Island, Malaysia. Literally, the gaps of the present study have been identified in this chapter through previous research study that related to area of source separation, recycling and waste segregation. The research procedure did mention in briefly which consists of five stages with data analysis performed by Sawtooth Software.

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