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Abstract

The aim of this article is to estimate the perception, knowledge and attitude of the respondents towards electrical and electronic equipment waste (e-waste) management. It also tried to identify current e-waste management practiced by households in Kuala Lumpur. In order to ensure a higher response rate, face-to-face survey was employed. In this study, it has been found that 69 per cent of the respondents were satisfied with Kuala Lumpur's environmental quality, while 31 per cent were not satisfied. More than one third of the respondents informed that they send their electric and electronic equipment (EEE) to charity or transfer the EEE to relatives if they cannot repair them. Only a small fraction of the used EEE finds its way to recycling facilities and manufacturer as there is no efficient take back scheme for consumers. It has also been found in this study that more than 81 per cent of the respondents are unenthusiastic to pay for the recycling of their e-waste. It is interesting to find that much of the EEE was updated within two thirds of their designed lifetime.

Keywords

Perception and attitudes, electronic waste, environmental quality, recycling, Kuala Lumpur

Introduction

Electrical and electronic equipment waste (e-waste) is said to be the fastest growing waste stream in the world (Cui and Forssberg, 2003; Jain, 2008; Nnorom and Osibanjo, 2008), with the growth rate at 3 per cent to 5 per cent per year (Mohan et al., 2008), which is three times faster than the general waste (Pucket et al., 2002), thus creating a great management challenge to most countries worldwide. Managing e-waste is a challenging task, not only due to its rapidly increasing volume, but more importantly because of its hazardous nature. E-waste contains numerous hazardous substances which may pose a threat to the environment and human health if they are not disposed of in the correct manner. On an average, 9 per cent of the weight of e-waste is made of hazardous substances such as lead,

cadmium, mercury (heavy metals) and other toxic chemicals (Umweltbundesamt 2006, in Sarkar 2008).

Malaysia plays a dual role in e-waste trading—as an importer and exporter of e-waste. The geographic location of Malaysia, which lies in the middle of international e-waste trade route (Figure 1) makes it an attractive target for e-waste smugglers. According to (Pucket et al., 2002), Malaysia is one of the countries which receive the e-waste from the USA other than China, India, Pakistan, Vietnam, the Philippines, Nigeria and Ghana (Pucket et al., 2002), Brazil and Mexico. Malaysia is also facing problems with rapid growth of domestic e-waste volume. With the increasing number of Malaysia's population living in urban areas and adopting modern lifestyles (due to economic transformation from agricultural-based to industrial-based socio-economies in the 1980s), the generation of domestic e-waste is expected to grow (Figure 2).



Figure 1. The Main E-waste Recycling Countries, Main E-waste Receiving Ports and the Movement of E-waste

Source: Rekacewicz (2002). Retrieved from <http://maps.grida.no/go/graphic/who-gets-the-trash>.

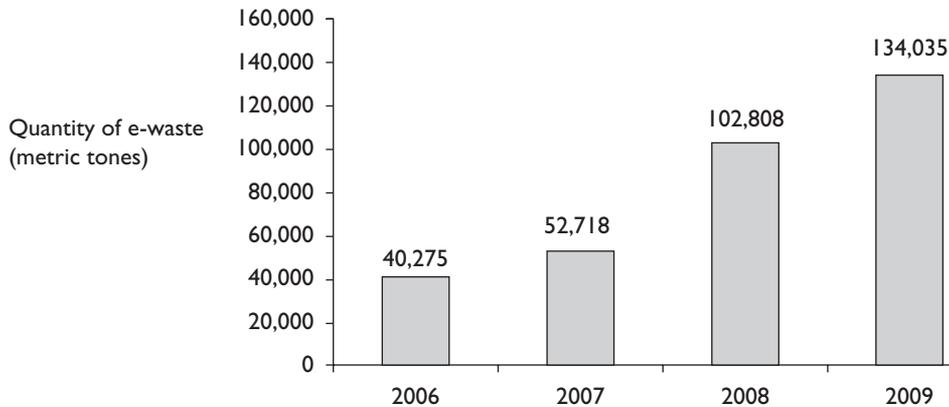


Figure 2. Quantity of E-waste Generated in the Year 2006–2009

Source: E-waste Inventory Project in Malaysia Report, 2009.

In Malaysia, the volume of e-waste in the waste stream is a combination of those generated by the local industries and households, and also imported from other countries. As Malaysia is a large manufacturer and consumer of electronic appliances, the Malaysian government has made efforts to tackle the problem caused by the recycling and disposal of e-waste since 2001. The driving forces come from both outside and inside the country. The regulations on electronic products and e-waste recycling management in other countries/regions (especially in the European Union [EU] and its member countries) put great pressure on exports of Malaysian electronic products and suitable responses need to be found. Meanwhile, Malaysian domestic e-waste stockpiles are approaching a peak. The development of small-scale and informal recycling processes has had serious adverse impacts on the environment and human health in some regions. These informal processes attract material from most of the e-waste generated and thereby become a barrier to the formal recycling businesses. The importance of establishing a regulated e-waste management framework has been widely recognized but progress with regard to legislation, the collecting system and the construction of formal recycling facilities is slow. The aim of this paper is to estimate the perception, knowledge and attitude of the respondents towards e-waste management. It also tried to identify current e-waste management practiced by households in Kuala Lumpur.

Methodology

A random sample was taken in the residential areas in Kuala Lumpur such as Selayang, Cheras, Ampang, Taman Jaya and Kuala Lumpur. All of the residents were Malaysian citizens. The questionnaires were distributed to 350 respondents and then collected. Of the 350, there were 330 who acceptably completed the questionnaire. Public environment awareness is one of the most important indicators for displaying many aspects of environmental status, such as peoples' knowledge, personal consideration and behaviour and the local citizen's attitudes towards sustainable society as a whole. All of the information is useful for decision makers, environmentalists, educators and businessmen in planning for

social sustainable development. In the survey, 69 per cent of the respondents were satisfied with Kuala Lumpur's environmental quality, while 31 per cent were not satisfied.

Electrical and Electronic Equipment have Caused Problems in the Environment

Due to rapid growth of advanced technology and sharp decline in the price of electronic goods, people are using more electrical and electronic equipment that has created dangerous environmental problems. Based on our survey, 96 per cent of the respondents know that the electrical and electronic equipment have created problems in the environment as well as human health. This is because they are very much conscious about their environment and the future generation. Only 4 per cent of the respondents replied that they do not know about the environmental problem that can be created by electrical and electronic equipment. An analysis on future management of hazardous household waste in Petaling Jaya, Malaysia has shown that most people were aware of the hazardous materials present in electronic products but only a few actually knew the practices adopted to recycle their waste (Gatke, 2003). In actual fact, many electrical and electronic products can be reused, recycled and refurbished.

Consideration of the Environmental Element during Buying

In modern era, people want to buy new technological and environmental friendly product in order to protect their environment. Nowadays, people are more conscious when they buy electrical and electronic equipment for their household. The respondents were asked whether they consider the environmental elements when they buy the electrical and electronic equipment for their household. In response to this question, 65 per cent of the respondents answered 'Yes', while 35 per cent of the respondents answered 'No'. This means that people are aware about the dangerous effects of electronic equipment.

Household Usage and Management of Electronic Product

Presently, there are no household that they do not use any electronic product. Almost all of the respondents use the electronic product. With the development of new technology, the electronic products are becoming cheaper, swifter, faster and easier to use. However, they also become obsolete very fast. Consumers sometimes find it comparatively cheaper and more convenient to buy new products rather than repairing the old ones. When the electronic product becomes outdated and cannot be repaired, 34 per cent of the respondents mentioned that they re-use their electronic product, while 30 per cent of the respondents mentioned that they throw them to the waste bins and 27 per cent of the respondents said they kept it in the house. On the other hand, only 3 per cent and 2 per cent of the respondents returned them to the manufacturer and recycling centre respectively (Figure 3). Actually in Malaysia, there is no efficient take-back scheme for consumers. Currently, there is also no structured mechanism to handle e-waste from households (Kalana, 2010). Extensive literature has proven that most consumers store their

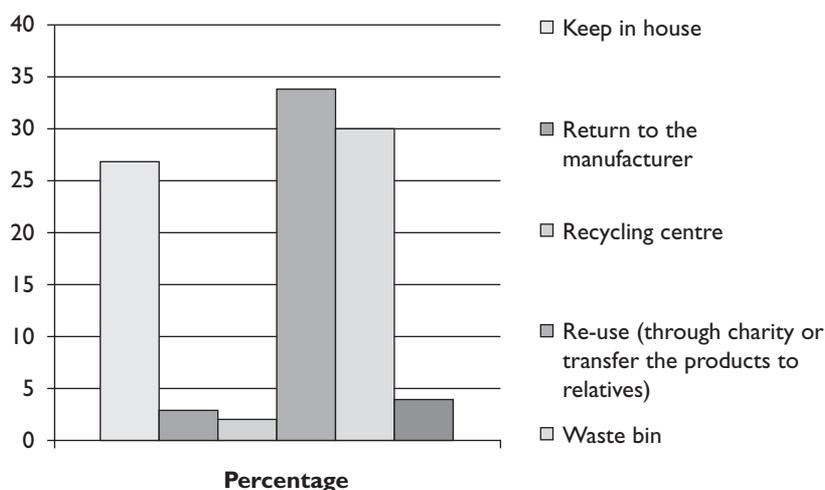


Figure 3. Electronic Product becomes Obsolete and Can't Be Repaired, What Do You Do With it?

Source: Field survey, 2010.

unused or broken electrical and electronic equipment for years before the equipment is resold or otherwise disposed of (Williams, 2005).

Environmental Consciousness during Purchasing

Table 1 focuses on the lists of the environmental elements considered by the respondents during individual purchasing of electrical and electronic equipment. Obviously, a higher percentage of the respondents gave their priority to the environmental elements related to saving energy in case of all electrical and electronic products, and therefore, gaining some economic benefit, such as reducing electricity consumption. In addition, most respondents consider noise pollution in case of all electrical and electronic products except the refrigerator. Indoor air quality is considered by the majority of the respondents only for air conditioner. Ozone depletion is given less priority. This is because of lack of knowledge of the respondents about ozone depletion.

Table 1. Environmental Elements Considered during Purchasing (%)

Items	Refrigerator	Air conditioner	TV set	Personal computer
Energy saving	56	98	72	65
Noise	18	61	62	52
Indoor air quality	23	65	10	7
Ozone depleting substances	19	17	24	43

Source: Field study, 2010.

In this survey, environmental labeled products, famous brands and lower prices are given priority by majority of the respondents when they buy electrical and electronic equipment (Table 2). This is probably majority (73 per cent) of the respondents mentioned that they have knowledge on environmental labeling. In fact, the respondents choose the environmental friendly electrical and electronic equipment because they consider the personal health safety.

Table 2. Priority Choice for Purchasing Computer and Refrigerator (%)

Items	Environmental Labeled Products	Lower Price	Famous Brand	Recommended by Friends	Promoted by the Store	Others
Personal computer	20	27	30	17	4	2
Refrigerator	28	27	36	2	3	4

Source: Field study, 2010.

Consideration of the Environmental Element during Buying

In modern era, people want to buy new technological and environmental friendly products in order to protect their environment. Nowadays, people are more conscious when they buy electrical and electronic equipment for their household. The respondents were asked whether they consider the environmental elements when they buy the electrical and electronic equipment for their household. In response to this question, 65 per cent of the respondents answered 'Yes', while 35 per cent of the respondents answered 'No'. This means that people are aware about the dangerous effects of electronic equipment.

Attitude of the Respondents Towards Household Waste Sorting at Source

The respondents were asked about their attitude towards solid waste sorting at source. It is interesting to find that 61 per cent of the respondents are willing to sort their household waste into separate containers. Among them, 27 per cent of the respondents stated that it is impossible to sort the household waste because of the lack of public environmental awareness (Table 3). Similar survey was conducted in Kuala Lumpur, Malaysia. In Kuala Lumpur, the majority of the households (54 per cent) were dissatisfied with the quality of the current waste collection services (Afroz and Masud, 2010).

Deposit and Disposal of Waste Electrical and Electronic Equipment

With the enhancement of living values, blown up production capacity and a quick decrease in product cost, electrical and electronic equipment have steadily become every day necessity. Now it is very straightforward for many families to buy these cheap and necessary electrical and electronic

Table 3. Attitude Towards Household Waste Sorting at the Source

Items	Frequency	Percentage
I'm willing to sort house hold waste into separate containers	200	61
I will sort my household waste if the government requires me to do it	23	7
It is not a proper time since there is no sorting and collecting system	16	5
It is impossible because of the lack of public environmental awareness even if there is a sorting and collecting system	89	27
Total	330	100

Source: Field study, 2010.

equipment. Thus, the waste electrical and electronic equipment are demonstrating an increasing trend of municipal solid waste. The increasing trend causes not only a huge amount, but also causes a serious harmful impact on the environment due to their composite components with toxic and hazardous material. Therefore, to find out the real lifetime of electrical and electronic equipment, the reason for updating electrical and electronic equipment and the methods to deposit and dispose of electronic and electrical waste is fundamental for the government to implement an effective e-waste management system.

Product Lifetime

The rapid growth of electronic industries and the consumer culture which encourages consumption of electronic products have led to the increase in the rate of e-wastes (United Nations Environment Programme [UNEP], 2008). Increase in consumption patterns leads to an increase in product obsolescence which will result in higher generation of e-waste (Campbell and Hassan, 2003). However, the updating rate is associated with the designed lifetime of the product. According to commonly adopted international criteria, the product lifetimes are 8–10 years for colour TVs, 13–16 years for refrigerators, 8–10 years for general air conditioners and six years for personal computers. In this survey, it has been found that most electrical and electronic equipment are phased out within their product lifetime. For example, the percentage of refrigerators phased out in more than 10 years reaches 73 per cent and the figure for washing machine is 74 per cent. It has also been found in this study that much of the electrical and electronic equipment were updated within two thirds of their designed lifetime such as 62 per cent of TV sets and 80 per cent of the computers (Table 4).

With the increasing popularity of personal computers, TV and mobile phone in Malaysia and their rapid updating, the amount of waste computers is increasing sharply. So, the factor that is contributing to the rapid increase in the volume of e-waste worldwide is innovations in televisions, such as the migration from analogue to digital and from CRT to flat-screen technologies. Television owners are discarding their old device for new flat screen digital sets to keep up with the advanced technology. Another factor which contributes to the trend is the wide usage of mobile phones as communication via satellites was made easier in the 1990s. Tremendous technology revolutions in the communication industry, and its rapid advancement (where mobile phones are not just connecting people, but are also multi-functioning

Table 4. Updating Time for Electronic and Electric Products

Television	%	Refrigerator	%	Washing Machine	%	Computer	%	Mobile Phone	%	Camera	%
1 to 2	1	1 to 2	0	1 to 2	0	1 to 2	2	1 to 2	37	1 to 2	0
2 to 4	25	2 to 4	3	2 to 4	1	2 to 4	40	2 to 4	48	2 to 4	6
4 to 6	35	4 to 6	24	4 to 6	25	4 to 6	38	4 to 6	11	4 to 6	19
Above 6	39	Above 6	73	Above 6	74	Above 6	20	Above 6	4	Above 6	75
Total	100	Total	100	Total	100	Total	100	Total	100	Total	100

Source: Field study, 2010.

as camera, audio-visual recorder and player and much more), have resulted in the increase in e-waste volume as people frequently opt for the latest version of devices with upgraded features. In this study, it has been found that the updating time of mobile phones within four years is about 85 per cent. A large number of waste mobile phones result in a much heavier burden on the government to deal with the waste electrical and electronic equipment issue.

Waste computers will be generated in large scale in future. E-waste Inventory Project in Malaysia Report, 2009 predicted that the volume of e-waste is expected to reach up to 1.1 million metric tons in 2020. With computer manufacturers competing intensely in terms of innovation, the raw processing power of computers is rapidly increasing, resulting in a large number of machines becoming obsolete in increasingly short periods of time (Babu et al., 2007) and subsequently contributing to the increase in the amount of e-waste production. Moreover, as more computers are manufactured, economies of scale have given way to much lower prices for computers, thus increasing the global demand (and contributing to more e-waste generation). While the increasing sales of computers in the less economically developed countries is due to the success of penetration market, the increase in the more economically developed countries is due to the replacement market. In the USA for example, the life span of computers was four to six years in 1997, but by 2005 it had drastically reduced to less than two years (Tengku, 2011). As such, one study suggests that the driving force behind e-waste production is the rapid growth of computers and computing systems (Umweltbundesamt, 2006).

Reasons for Updating

The reasons why the respondents in this study update electrical and electronic equipment are shown in Table 5. In this study, 24.55 per cent of the respondents mentioned that the main reason for updating their electronic product was that the new items had additional and technologically more advanced features. About, 22.12 per cent of the respondents informed the reason of updating as the previous product was damaged or not functioning anymore. Another reason which is stated by 11.21 per cent of the respondents is the launching of new products with more powerful designs and extended capacity into the market. It is also found that 17.58 per cent of the respondents updated their electric and electronic products because their disposable income level has increased which indicates the increasing purchasing power of the citizens as the standards of living continues to improve.

Table 5. Reasons for Updating Household Electrical and Electronic Equipment

Items	Frequency	Percentage
Keep in house	88	26.67
Return to the manufacturer	10	3.03
Recycling centre	6	1.82
Give to charity or transfer the products to relatives	114	34.55
Waste bin	98	29.70
Others	14	4.24
Total	330	100

Source: Field study, 2010.

Methods for Deposit and Disposal of Electrical and Electronic Equipment

According to the questionnaire, when asked to find out how the citizens managed their e-waste, the following points were highlighted: Keep in the house, return it to the manufacturer, send it to recycling centre, reuse it and throw it to waste bin (Table 6). More than one-third of the respondents informed that they send to charity or transfer the products to relatives. Another two preferred methods of e-waste disposal by the respondents shown in Table 4 are ‘Keep in house’ and ‘throw in the dustbin’ and their percentage is about 26.67 per cent and 29.7 per cent, respectively. Only a small fraction of e-waste (1.82 per cent and 4.24 per cent) finds its way to recycling facilities and manufacturers respectively as there is no efficient take back scheme for consumers. It has also been found in this study that more than 81 per cent of the respondents are unenthusiastic to pay for the recycling of their e-waste.

Table 6. Methods for Deposit and Disposal of Electrical and Electronic Equipment

Items	Frequency	Percentage
Previous product damaged or not functioning anymore	73	22.12
Not powerful/not enough capacity	37	11.21
New items have additional and more advance technological features	81	24.55
Increase in disposable income level	58	17.58
Influences by others (e.g., through advertisement, friends and trend)	62	18.79
Other reasons	19	5.76
Total	330	100

Source: Field study, 2010.

Conclusion

Malaysia plays a dual role in e-waste trading—as an importer and exporter of e-waste. The geographic location of Malaysia, which lies in the middle of international e-waste trade route makes it an attractive

target for e-waste smugglers. Malaysia is also facing problems with rapid growth of domestic e-waste volume. With the increasing number of Malaysia's population living in urban areas and accepting modern lifestyles (due to economic transformation from agricultural-based to industrial-based socio-economies in the 1980s), the generation of domestic e-waste is expected to grow (Williams et al., 2008). Another issue concerning e-waste in Malaysia is unacceptable disposal of e-waste and unlawful e-waste recycling. These activities have the possibility to contaminate the environment and create significant health risks for the society.

In this study, it has been found that 69 per cent of the respondents were satisfied with Kuala Lumpur's environmental quality, while 31 per cent were not satisfied. As the economy expands with strong support from local environmental policy, more attention should be paid to environmental protection. The Government of Malaysia and the related organizations are suggested to improve their environmental performance to improve local environmental quality. It is interesting to find that 61 per cent of the respondents are willing to sort their household waste into separate containers. Among them, 27 per cent of the respondents stated that it is impossible to sort the household waste because of the lack of public environmental awareness. This can be the basic problem to improve the waste management system in Kuala Lumpur. (Genandrialine and Psyche, 2006).

The amount of electrical and electronic equipment held by the city and township inhabitants has increased dramatically and most of them are phased out within product lifetime. The main reason for them to update their products are that the new items have additional and technologically more advanced features and previous product has been damaged or not functioning anymore. Electronic products have very often retired early even though they still work perfectly because new products offer more or better features or have more fashionable designs (Williams et al., 2008). However, it has been reported that normally the purchase of new equipment is driven by the desire to update new Software or other functionality (Herat, 2007), not due to breakage of the machine (Williams, 2005) and at the same time, it is due to the decreasing lifespan of all consumer electronic products (Williams et al., 2008). If returning to the manufacturer, sending it to recycling centres and giving to charity or relatives are grouped and considered as reuse and recycling of e-waste, then 39.4 per cent of the respondents chose to reuse and recycle and almost one third of the respondents chose to throw them away. Currently, no structured mechanism is in place to handle e-waste from households compared to e-waste generated from industries as the management was in accordance with Environmental Quality Scheduled Wastes Regulations (EQSWR, 2005). Extensive literature has proven that most consumers store their unused or broken electrical and electronic equipment for years before the equipment is resold or otherwise disposed of (Hischier et al., 2005). It has been also found in this study that more than 81 per cent of respondents are unenthusiastic to pay for the recycling of their e-waste. This is due to their conventional understanding that there remained value in these end-of-life products.

Currently, there is no mechanism on a proper segregation or disposal system to encourage the public to recycle and discard e-waste. Continued generation of e-waste over time, together with lack of structured mechanisms of institutional framework and inadequate infrastructure, results in improper e-waste management. Even though at present, electrical or electronic appliances are rarely disposed of indiscriminately, with little regulation in place this has created hazards for the local population as well as the environment.

As mentioned in our above discussion, the main issues relating to adoption of this waste management option in Malaysia includes illegal import or smuggling of e-waste, rapid growth of locally generated e-waste, indiscriminate dumping and improper disposal of e-waste, tracking down illegal e-waste recycling

operators, low public perception about the adverse impacts of e-waste and low willingness to pay for recycling of e-waste. These call for a strong cooperation of government and non-governmental stakeholders to govern this environmental issue together, as traditional governing by the government alone has proved to be too challenging for the government (Williams et al., 2008). Recycling practices in Asian and African countries are mainly based on economic potential. In these countries, e-waste is treated as just another type of recyclable item and the process is characteristically undertaken without proper environmental procedures, often by illegal recycling operators who operate informally outside of the main business circle. This has brought many consequences such as high occupational health risks to the workers due to the exposure to hazardous materials, and negative impact on the environment and the society at large as a result of the inappropriate disposal of hazardous materials from the recycling and material recovery processes (Williams et al., 2008). From the resource conservation perspective, such informal practices are ineffective as the percentage of recovery is low and many of the valuable materials are lost during the inefficient recovery processes. It is thus obvious that leaving the recycling of e-waste to the informal sector is not a sustainable option, both environmentally and economically. Although e-waste recycling practices in the more economically developed countries appear to be more technologically advanced and environmentally sound compared to those in the less economically developed countries, they still pose environmental and health threats as it is impossible to recycle e-waste without any environmental impacts (Robinson, 2009). Recycling process may remove some contaminants, but some amount of hazardous substances may still be concentrated at e-waste recycling centres (Awang, 2010). However, e-waste recycling and material recovery management strategy have a relatively lower environmental impact compared to disposal (through landfill or incinerator) management option (Robinson, 2009). However, all stakeholders of e-waste management, from the government and non-governmental sectors should consider shifting the management options towards the top of the waste management hierarchy (prevention and waste minimization) by substituting the hazardous materials in e-waste and encouraging redesign of equipment (which facilitates replacements of parts of equipment to cope with technological advancement instead of disposing items in whole) for a better control of the negative impacts of e-waste.

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