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The proposed e-waste management model from the conviction of individual laptop disposal practices-An empirical study in Malaysia

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ABSTRACT

There is no formal system in place for household e-waste management although e-waste from the industries were controlled and regulated according to Natural Resources and Environment Ministry in Malaysia. In fact, e-wastes are collected by buyers, non-governmental organizations or collectors; but many are improperly dismantled which can cause environmental and health hazards. Malaysia was estimated to generate 53 million pieces of e-waste in the year 2020 and therefore a proper system is required to control hazardous substances such as cadmium, mercury, chromium, zinc, lead, silver and copper found in e-wastes which should not be released into the environment. The aim of the present study is to find out the individual conviction on laptop disposal practices. Data were obtained from 123 respondents through structured questionnaire and open-ended questions from individuals owning laptop. The findings highlight that individual awareness on laptop disposal practice and laptop usage are positively influencing on the conviction of laptop disposal practices. Knowledge on computer literacy moderates the relationship between social consequences and the conviction of laptop disposal practices. It is recommended in the present study an extensive e-waste management model that resolves some of the major challenges aroused due to e-waste crisis. In particular, the proposed model acts as a guide for upstream and downstream reduction of e-waste generation through green design and cleaner engenderment to succeed for e-waste environmentally sound management system.

1. Introduction

Electronics waste (e-waste) refers to the process that embraces various forms of electric and electronic equipment that have ceased to be of any value to their owners (Widmer et al., 2005). It also includes discarding mechanism of waste electrical components or sub-assemblies. Electronics device such as refrigerators, cell phones, air conditioners, consumers' electronics, cell phones and laptops are common components of e-wastage. Every electronic product has its life-span and after a certain period, it reaches to discard stage (Byster et al., 2002). E-waste also refers to the reverse manufacturing process by re-engineering and refurbishing the waste product to new finished goods for future use (Kumar et al., 2012). This refurbishment process also helps firm to control ecosystem. Uncontrollable and abandoned e-wastage severely affect the eco-system and human health (Widmer et al., 2005). Due to ongoing technological innovation, changing trends of consumer electronics, lesser lifespans of electronic products and increased demand of hi-tech products are escalating the e-wastage practices.

Awareness regarding the recycling process of e-wastage is one of the effective management processes to reduce the negative impact of e-wastage pollution on environment (Oguchi et al., 2013). The kohlberg's stage of moral development theory has highlighted three levels of moral development to create awareness of individual's convictions. These stages are pre-conventional, conventional, and post conventional moral developments. Subtle sense regarding the information of e-waste hazard improves knowledge about the disposal of hazardous electronics parts. Such learning on e-waste hazard also leads individual to have intention concerning proper disposal practices. It develops individual's awareness of the negative impact of improper e-wastage on health. High volume of e-wastes severally damage the environment because it contains

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toxic and complex design which are hard to disassemble. Financial limitation is another reason that individuals are not practicing in green disposal practices and lack of strict legislations lead to improper e-waste disposal in landfill (Kwatra et al., 2014). E-waste can be disposed in landfill through incineration process, but the practice is considered as conviction. Landfill leachate percolates toxic substances into groundwater. The consequence leads to the release of toxic gases into the atmosphere (Kiddee et al., 2013). Severe impact on atmosphere is also caused by the disposal of heavy metal in landfill (Pan and Li, 2016). Electric electronic gadgets such as laptops, calculators, components of personal computer are assembled together with plastic materials. The informal and open burnt recycle process of plastic e-waste releases harmful dioxins, brominated flame-retardants and furans. Information regarding this negative implication of informal disposal practice on the environment develops individual's awareness on ethical disposal practices of consumer electronic products. An attempt is made in this research to determine the reflections from the Malaysian respondents on the disposal practices of individual laptops.

2. Literature review

The importance of integrated approach to address challenges in e-waste management is very important in modern society (Ikhlayel, 2018). The awareness regarding the social consequences of e-waste results in minimizing the environmental pollution and the negative impacts on human health. Visual pollution can create mental and physical health by affecting quality of life in the community; well-being wellness of human being; reducing economic health; aesthetic appeal; and civic-sense. It happens due to unorganized dumping of the components of electronics such as cables, wires, billboards, worn-out of buildings during construction. This practice negatively affects individual's experiences of environment (Jana and De, 2015). The e-waste flow is higher in developing countries, following eighty percent of e-waste being exported to developing countries from developed countries. These e-wastes are appliances that less environment friendly, older and discharged appliances but still re-usable (Kiddee et al., 2013). Buying practices of cheaper and limited lifespan laptop in developing countries are increasing. It leads to higher amount of e-wastes, limited safeguard policy and the enforcement of safe environmental friendly disposal of imported electronic products. These are causing serious human and environmental problems in developing countries. Individual awareness regarding social consequences of e-wastes improves worker's life as well as economic development and reduce poverty (Ekener-Petersen and Finnveden, 2013). Social life cycle assessment (S-LCA) addresses the categories of social impact on environment and public health such as health and safety, human right, governance, cultural heritage, working condition and socio-economic consequences (Arcese et al., 2018). According to the products end-of-life cycle, it is important to focus on recycling, reuse, reassemble and proper disposal practice. Upstream and downstream reduction of e-waste generation through green design and cleaner engender is gaining interest and attention. However, there is a limited number of environmentally sound management system of e-wastes in developing countries. Trans-boundary kinetic is a major challenge throughout in this region. Dealing with improper or informal recycling practices have worsen the environmental issues. It's a huge challenge faced by these developing countries to succeed in e-waste environmentally sound management system (Herat and Agamuthu, 2012). Local and federal government also plays significant role in handling e-waste management by creating public awareness (Dias et al., 2018).

Shorten product lifespan is another key factor to increase e-wastes. Innovation, technological advancement, and new fashion and trends indirectly influence shorten product lifespan. Frequent changes of electronics products increase the disposal practice. In addition, shorter batteries life and the production mechanism of electronics item indirectly reduces the lifespan of these electrical products. Individual's concern regarding the lifespan and the quality of the products might improve the awareness on e-waste. It is very important as a consumer to consider and examine the lifespan of the products before proceed to the buying decision. It is also important for individuals to choose green and environmental friendly appliances for everyday needs. Life cycle assessment (LCA) is one of the most powerful processes to identify the environmental impacts of the disposal of electronic products and helps company to develop eco-design products (Kiddee et al., 2013). This process also helps to identify laptop usage experience and the results help to handle replacement claims (Hatcher et al., 2013). Remanufacturing of a product requires more work than reconditioning or rehabilitating. The resultant product will be better qualitied with elongated life in utilization. It also influences individual's attitude to consume the product until its lifespan ends (Kiddee et al., 2013). However, attitude towards upgrading new electronic products depends on financial situation of an individual. While in other situation, individuals have discharged their products by following improper disposal practices of consumer electronics such as laptop and other appliances. These electronic products are broken and unfixable or the lifespan has elapsed. Complex ecological system and poor recyclability causes severe threats to the environment through increasing amount of waste such as plastic e-waste (Kumar et al., 2018). Apparently, majority individual still maintains their laptop by continuous maintenance and upgrade some components of their laptop which can prolong the laptop's lifespan.

Individual behavior of disposal practice is certainly associated with the e-waste management. Multiple disposal practices are such as: send e-waste to junk shop, give to scrap collector, street buyer, use drop box that is provided by the appliance producer (for example Dell provides drop-box for Dell laptop), formal sector or municipal facilities of e-waste management which dispose e-waste in landfills. However, study has shown that people from less developing countries are reluctant to practice ethical e-waste disposal and retrieved e-waste at small family workshops or follow primitive recycling process (Awasthi et al., 2016). Individual e-waste disposal practice is a resource efficiency strategy for municipalities and industrial development processes. This recycling policy plays a consequential role to increase resource efficiency, curb the incrementing environmental process, gregarious and financial encumbrance of waste management (Oguchi et al., 2013). Other benefits include greenhouse gas (GHG) reduction, energy and material preserving, lower impacts on human health and to generate job (Hotta et al., 2016). In Malaysia, there are no direct regulations of e-waste. It is controlled by the department of environment (DOE) who issued guidelines for the relegation of used electrical and electronic equipment. However, these guidelines do not provide any information on how to manage e-waste (Kalana, 2010). In addition, the existing nature of the technological waste, practices, and economic conditions are very much responsible to have effects on the recycling potential of e-waste (Zeng et al., 2017).

There is a concern that e-waste generated in developed countries are ended up in developing countries, including in Malaysia (Pariatamby and Victor, 2013). The e-waste management system of Malaysia was not well developed back in the year 2010 (Kalana, 2010). The country is expecting to be a developed country by 2020 and an effective e-waste management system is a key requisite to achieve vision 2020, but still in its early stage to deal with e-waste management system (Shumon et al., 2014). Furthermore, Malaysia has lack of hazardous waste management system, including, transportation and disposal of waste and enforcement

(Nnorom and Osibanjo, 2008). Overall, it is the individual conviction, which is responsible for disposal practice. This study argued that knowledge on e-waste hazards, social consequences, electronic uses and its disposal practices influence individual conviction on laptop disposal practice. Conviction is defined as the degree of belief and understanding on specific practice (Anderson, 2012). It is an attitude or belief system towards the behavior of an individual, whether it is right or wrong, or guilty or not. Usually, conviction is on certain conflict of moral dilemma which values that, there are more alternative decisions on the right and wrong, which the individual believes (Kvalnes, 2015). Individual's responsibilities are mainly ranged of actions which focus on the understanding of certain attitudes. Thus, allocation of certain decision with a single motive is highly arbitrary. Individuals can successfully assess his or her action on environmental consequences (Spangenberg, 2014). Availability of appropriate information to individuals facilitate them to purchase green products and make sure of effective disposal practices to confirm green environment (Lojacono and Zaccai, 2004). Therefore, the buying decision, usability, and the disposal practices always remain with the end user consumers (Zaccaï, 2008). The present research focuses on the conviction of laptop disposal practices with five possible predictors namely e-waste hazards, social consequences, laptop usage, disposal practices and computer literacy which are discussed below.

2.1. E-waste hazard

E-waste containing chemical concern is hazardous to environment and human health. Batteries contain mercury, lithium and lead, printed circuit board contain cadmium, lead, antimony and beryllium (Tsydenova and Bengtsson, 2011), Laptop or monitor with LCD screens, which contain a coalescence of 10–20 substances in each liquid crystal are suspected to be very hazardous (Prakash et al., 2010). Awareness on hazardous material in laptop and the impact to environment and human health will encourage individual to be convinced and proceed with correct disposal practice. According to Herat and Agamuthu (2012), laptop containing high level of heavy metals like silver, antimony, chromium and zinc. The chemical hazard will impact the surrounding living being (Kwatra et al., 2014). Individuals, who have enough awareness on laptop, particularly concerned on the hazardous materials, positively favor on the conviction towards laptop disposal practices.

2.2. Social consequences

Social consequences elaborate impact towards individuals, family and community. Visual pollution happens due to unorganized dumping of cables, wires, billboards, worn-out buildings, heaped construction materials that affect individual vision (Jana and De, 2015). According to Ekener-Petersen and Finnveden (2013), working condition at China was partly identified as an area with social impact hotspot particularly high impact to workers and community, but indirectly playing role for economic development as providing employment and reduce poverty. Social consequences will be an impact from improper recycling (Jayaraman et al., 2011). Long working hours with no proper safety equipment when performing recycling will not only impact the workers but also the community in the surrounding areas which will actually lead individual to convince the laptop disposal practices (Ekener-Petersen and Finnveden, 2013).

2.3. Laptop usage

E-waste becomes an even more crucial issue when a product considers the lifespan reduction due to continued innovation to new products and upgrades. As an example, Apple's iPods, I Phones, batteries'life span are only for certain years. The product was designed to fail over the years and ultimately reduces the product life span. Whereas, it will be a choice for an individual to use LCA (life cycle assessment) as one of the most powerful tools that can identify environmental impacts to develop eco-design products and can further improve on laptop usage (Kiddee et al., 2013). Apart from the laptop design, knowledge on how to use and maintain laptop usage will be another factor that prolongs the life span of the laptop.

2.4. Laptop disposal practices

There are several types on laptop disposal practices such as give it to friends or relatives, sold as second hand, donate to charity, discarded item to retailer to get some voucher to buy new, or even keep at home. According to Tiep et al. (2015), individual will stockpile e-waste at home, while others may discard to get some voucher to buy new. As per update by Babayemi et al. (2017), some individuals inclined to keep their non-useable mobile phones for long time and later dump them with the general household wastes; while few disposes in drop box provided by laptop producer such as Dell.

2.5. Computer literacy

Computer knowledge or literacy can be defined as knowing some basic details on how to use computer. Thus, computer literacy or computer knowledge can be defined as a sort of comfortable level when using the computer (Patrick and Benwari, 2014).

3. Conceptual research framework and hypotheses development

Drawing on kohlberg's stage of moral development theory, this study argues causal relationship between e-wastage awareness and conviction on laptop disposal practice. Four factors have been discussed as e-wastage awareness. These factors are e-waste hazard, social consequences, laptop usage and Laptop disposal practice. This article considered computer literacy has potential moderating effect on the relationship between e-wastage awareness and the conviction on laptop disposal practices. Fig. 1 displays the conceptual research framework of the present study.

The awareness of hazardous material of laptop and the consecutive impacts to the environment and human health encourage individual to practice accurate disposal process. Hazardous materials of laptop include high level of heavy metal such as silver, chromium, antimony, and zinc (Herat and Agamuthu, 2012). These chemical contaminate the environment that creates severe threats for living being (Kwatra et al., 2014). Higher level of awareness in concerning the ethical disposal practice minimizes

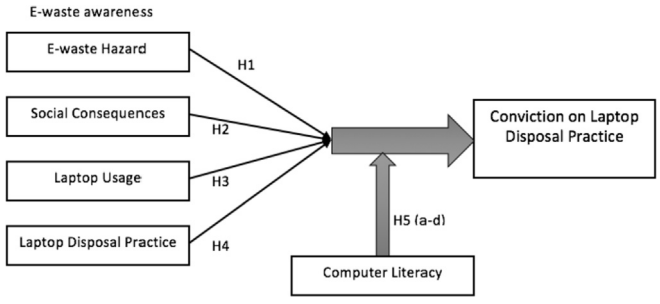

Fig. 1. Conceptual research framework.

negative hazardous effects. These behaviors of individuals will not only help them but also create awareness in the whole society (Nwagwu and Okuneye, 2016). Awareness of disposing locations that are far from household area will help individuals to minimize pollution in the locality. The awareness on the grounds that an outlined reusing system can viably decrease the negative effect of the disposal activities on environment and can satisfactorily expel potential health hazard resulted from e-waste management practices (Pinto, 2008). Inhalation because of vicinity to unsafe disposal can make serious harm to the health and mental comprehensions, thus increase the needs of awareness to control the maintenance of hazardous e-waste disposal (Adediran and Abdulkarim, 2012).

Practices of improper recycling also lead to severe social consequences. Individuals with higher level of morality have better awareness in concerning to social consequences. On this note, individuals working longer hours for disposing electrical equipment are responsible for the negative impact on environment. Following proper guidelines of disposal practices can minimize individual harm and the negative impact on the community in the surroundings (Ekener-Petersen and Finnveden, 2013). Although individuals are aware of social consequences, however lack of practices of proper disposal cause negative consequences (Kalana, 2010). Minimum level of knowledge on social impact of e-waste disposal practices cause severe negative environmental footprints as exist in China, Pakistan, Ghana, and Nigeria (Moran et al., 2014; Puckett et al., 2002, 2005; Luo et al., 2011). Pervious study also investigated the impact of social consequences of e-waste on cultures, individual's health, and economies in different context (Bridgens et al., 2017). Higher level of knowledge on the consequences of improper disposal of laptop can improve individual conviction for disposal practices.

Knowledge regarding the product life cycle also influences on individual conviction and disposal practices. Big firms like Apple, Samsung, HP, and Dell manufacture products and the components of products have limited lifespan. Some of the products are failed to fulfil the required lifespan as promised. As a consumer, it is important for them to acquire proper knowledge on the usage of the products before proceed with the final buying decision. Knowledge on the usage of the product improves individual's ethics on purchasing decision. It is also important to buy green and environmental friendly appliances because the disposal of green and environmental friendly appliances have less harm to the environment. Firms are developing eco-design products through LCA assessments and improving the laptop usage experiences (Kiddee et al., 2013). In fact, firms like universities where students are more focused on digital education system rather than reading from textbook also learn the efficient usage of digital device to enhance the user experience. This culture of using laptops in educational institutes is widespread. Hence, creating awareness on efficient laptop usage is important (Duncan Selby et al., 2014). This usage experience also develops individual's mindset to consume laptops until its lifespan ends. Longer period of laptop usages can minimize the quantity of disposal units.

Knowledge on the ways of disposal can improve individual's choice of disposal practices. There are several types of laptop disposal practices, such as give the old laptop to friends, sold at the refurbished shop, donate to charity, exchange with a new one, or keep it at home. Some retailers also give cash vouchers for trade-in old laptop (Tiep et al., 2015). Evidence has shown that, individuals are inclined to keep their used mobile phone after the end of lifespan and habituated to disposed the e-waste with regular household (Babayemi et al., 2017). Sufficient knowledge on e-waste disposal practice plays a crucial role in maintaining natural resources, handle irreparable drastic damage to the environment and individual's health (Duraisamy et al., 2017). Adequate knowledge on disposal practice advocates green e-waste disposal practice to achieve natural sustainability (Mejabi, 2014). In developed countries like USA, UK and other European countries, big firm like Dell or HP offers drop box for used electrical items to dispose. Based on the above discussion, this study poses the following hypotheses:

H1. There is a positive relationship between individual awareness on e-waste hazard and Individual conviction on laptop disposal practice.

H2. There is a positive relationship between individual awareness on social consequences and Individual conviction on laptop disposal practice.

H3. There is a positive relationship between individual awareness on laptop usage and Individual conviction on laptop disposal practice.

H4. There is a positive relationship between individual awareness on laptop disposal practice and Individual conviction on laptop disposal practice.

3.1. Moderating role of computer literacy between e-waste awareness and conviction on laptop disposal practice

The features, user manual, and guidelines of the electronic products often help individuals to be literate on its usage. The information of the materials and components of the electric products literate individual by providing the disposal guidelines. However, the choice of disposal practices of the laptop ends with individual's choice. Computer literacy also improves user experiences of the specific product (Akuoma, 2012). Yet remarkably, computer literacy of users also facilitates firms to maintain necessary supply chain when it comes to disposal practices and period (Streicher-Portea et al., 2009). It is a pre-requisite for information literacy to broaden and make effective user experience of a laptop in many ways from the time that laptops are used and not used; such as, keep the laptop in sleep-mode is not good for its battery health (Kurbanoğlu and Boustany, 2014). It will help individuals to know about the lifespan of the product, potential methods of maintenance and upgrades of detachable components of the laptop.

Higher level of computer literacy helps the consumer to handle the laptop in a proper manner (Raut et al., 2015). Based on the above discussion we propose the following hypothesis:

H5. Computer literacy positively moderates the relationship between e-waste awareness (e-waste hazard, social consequences, laptop usage, and laptop disposal practice) and Individual conviction on laptop disposal practice.

4. Research methodology

The empirical research setting of the study consists one of the emerging economies in Asia, particularly Malaysia. The samples of this study were collected from individual who owns laptop. The sample consists of the respondents from students of colleges, universities, working people and retired persons. Cross-sectional study has been conducted to collect the respondent's feedback. Data have been gathered in two months period. Due to the nature of the population, the sampling frame was not available. Therefore, non-probability convenience sampling method was used to perform data collection. About 500 questionnaires were administered to the individuals in different parts of Malaysia. About 142 respondents positively responded to our primary survey questionnaire (Appendix 1). About 19 responses were incomplete, excluded from the analysis, hence, 123 samples were used for analysis and hypotheses testing. With regard to the socio-demographic and economic variables of the sample, the respondents are Malaysians citizens and no expatriates are considered in this study. About 46% were male while 54% were female respondents. Majority falls under the age group of 31–40 years old with 53%, followed by age group between 21 and 30 years with 31%, while 12% were under age group of 41–50 years. Only 2% of the respondents were below 21 years and above 51 years. About 63% of the respondents have bachelor degree or professional qualification, followed with master degree 22%. About 11% of the respondents were diploma/advanced diploma holders while 2% of the respondents have completed secondary schooling. The race distribution of the respondents is almost uniform with Chinese 34%, Indians 33%, Malaysian 32%, and others 1%. For the statistical analysis of the collected data, Smart PLS was used primarily due to non-parametric nature and the measurements of the study constructs are subjective. Conceptually PLS-SEM can be viewed as similar to multiple regression analysis to examine the possible relationships with less emphasis on the measurement model (Hair et al., 2013). According to Götz, Liehr-Gobbers and Krafft, PLS method demands categorically fewer requirements compared to that of covariance based structure analysis, hence delivers consistent estimation results. This character makes PLS a valuable tool for testing theories. Another advantage of PLS-SEM is its ability to deal with formative as well as reflective indicators, even within one structural equation model. These arguments lead PLS approach to be appropriate for explorative analysis of structural equation model, thus offering a significant contribution to theory development.

4.1. Dependent variable

Conviction on laptop disposal practice is the dependent variable in this research model. This variable reflects on individual awareness towards need to dispose laptop in proper manner. The operationalization of the variables concerning on environment issue, social issue, laptop usage and laptop disposal practice are addressed. The items to measure these variable includes I am fully convinced on my laptop disposal practice; there is guilty feeling when doing the disposal practice. These items were adopted from the study of Kalana (2010).

4.2. Independent variables

Four items were used to measure *E-waste hazard* which were adapted from Kalana (2010) and Kwatra et al. (2014). These items are such as I have intention to know on how laptop parts are disposed; I am aware of improper disposal method that leads to pollution. *Social consequences* were measured based on four items such as I am aware that e-waste increase the price of raw materials due to scarce of new products; I give importance to visual pollution (dirty environment). The items of social consequences were adapted from Kalana (2010) and Ekener-Petersen and Finnveden (2013). *Laptop disposal practice* was also measured based on four items such as I would like to take the internal component of the laptop that can still be reused when I dispose the laptop; I carry the discarded item to retailer to get some voucher to buy new. Laptop disposal practice was adapted from Tiep et al. (2015). *Laptop usages* was were measured based on seven items such as I change my laptop even its still in good working condition; I only discarded my laptop when it is broken and unfixable. The measurement items of laptop usage were adapted from Kalana (2010).

4.3. Moderating variable

Computer literacy was measured based on four items such as I update knowledge periodically in computer literacy; I am learning when using laptop. The measurement items of computer literacy were adapted from Akuoma (2012). All the question items in this study were measured based on five point Likert scale (Allen and Seaman, 2007).

4.4. Significant findings and results from data analysis

The output of the Smart PLS reveals that the indicators included in Fig. 2 have main loadings above 0.7 that fulfil the thumb rule of Hair et al. (2013). The average variance extracted (AVE) is the mean variance extracted for the items loading on a construct, which were above the suggested value of 0.5 or greater. The composite reliability (CR) values were found to be within the range of 0.707–0.838 fulfilling the consistency of data. The explainable variation of the data R^2 is 0.301 and the predictive relevance of Q^2 is well above zero. Fig. 2 shows the results of the measurement model of the conceptual framework on conviction of laptop disposal practice.

Table 1 gives the results of the structural model along with the predictive inference results. Unfortunately, E-waste hazard (EH) is not significantly related to the conviction of disposal practice ($\beta = 0.016$, $t = 0.092$, $p > 0.05$). It indicates that the respondents

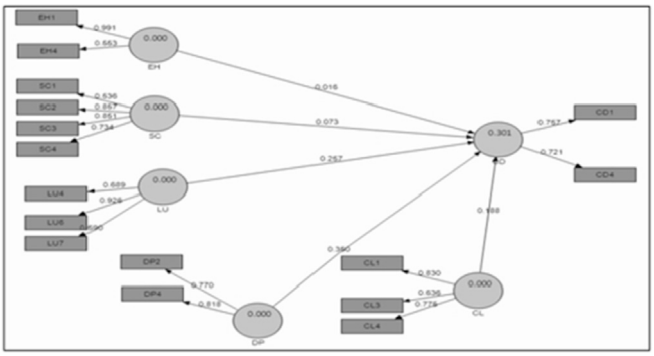

Fig. 2. Results of the measurement model. Note: CD = Convinced Disposal Practice, CL = Computer Literacy, DP = Disposal Practice, EH = E-waste Hazard, LU = Laptop Usage, SC = Social Consequence.

Table 1
Summary of the path coefficients and Hypotheses testing for direct effects.

Hypothesis	Path	Std. Beta	Std. error	t-value	p-value	Supported
H1	EH -> CD	0.016	0.178	0.092	$p > 0.05$	No
H2	SC -> CD	0.073	0.118	0.615	$p > 0.05$	No
H3	LU -> CD	0.257	0.095	2.698**	$p < 0.01$	Yes
H4	DP -> CD	0.350	0.110	3.184**	$p < 0.01$	Yes
H5	CI -> CD	0.188	0.087	2.158*	$p < 0.05$	Yes

Table 2
Results of moderating effect.

Hypothesis	Path Relation	Significance
H5a	EH * CL-> CD	Not Supported
H5b	SC * CL -> CD	Supported
H5c	LU * CL -> CD	Supported
H5d	DP * CL -> CD	Supported

have less knowledge on e-wastage implications and they are not considering it as a serious issue. Further, Table 1 indicates that the social consequences (SC) is also not significantly influencing to the conviction of disposal practice ($\beta = 0.073$, $t = 0.615$, $p > 0.05$). It shows that there is less reaction to the social consequences while disposing individual laptops. More usage of laptop (LU) has significant positive relationship on the conviction of disposal practice ($\beta = 0.257$, $t = 2.698$, $p < 0.01$). Interestingly, the awareness on disposal practice (DP) significantly influences on the conviction on Disposal practice ($\beta = 0.350$, $t = 3.184$, $p < 0.01$). The moderator variable namely computer literacy (CI) has positive and significant effect on the conviction of disposal practice ($\beta = 0.188$, $t = 2.158$, $p < 0.05$).

When it comes to the moderation effect on the relationship between independent variables and dependent variable, it should be noted in Table 2 and Fig. 3 that computer literacy significantly moderates the relationship between social consequences and individual laptop disposal practice. Also, computer literacy has significant moderation effect between laptop usage and the conviction of laptop disposal practice. Further, computer literacy significantly moderates the awareness of disposal practice on the conviction of laptop disposal practice. However, computer literacy has no moderation effect between e-waste hazard and on the conviction of laptop disposal practice.

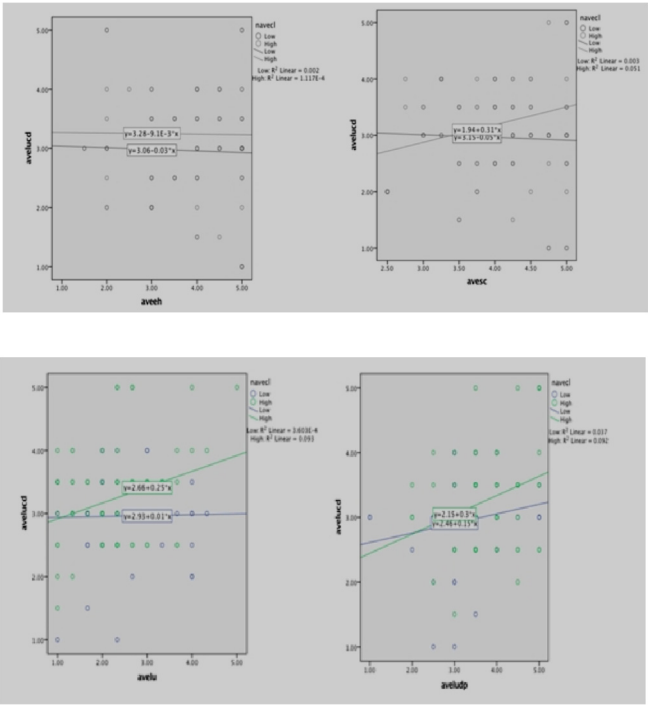

Fig. 3. Moderating effects.

5. Discussion on the findings of the study

Out of four direct hypotheses, only two hypotheses (H3 and H4 are supported) have positive relationship. on the conviction of individual laptop disposal practice. When individuals are using laptop more often, they get to know about various functionalities of laptop and therefore they have clear-cut idea on disposal practice. In addition, individuals opt for upgradation, latest design and newer version while they dispose the used laptop. Also, when the individuals know about the method of laptop disposal which benefits the environment, they strictly adhere to that method. In fact, smart individuals even take the internal components of the laptop which can still be reused and carry the discarded items to retailer to get some voucher to buy a new laptop. Surprisingly, awareness on e-waste hazard has no significant influence on the conviction of laptop disposal practice (H1 is not supported). Since, the e-waste concepts particularly individual laptop disposal practice is in the primitive stage, the respondents have less knowledge on laptop parts which are hazardous to environment like lead, cadmium and mercury. Although, some respondents opined that they know that e-waste will definitely cause health implications and improper disposal of laptops lead to pollution, it was not found to be significant. Similarly, social consequence has no effect on the conviction of individual laptop disposal (H2 is not supported). The respondents recognize that the discarded laptop can increase the amount of waste and might result in the increased price of raw materials due to scarce of new products. Again, computer literacy is significantly related to the conviction of laptop disposal. Majority of the respondents, for example, more than 83% of them update the usage of laptop and of the opinion that it will update computer literacy. Thus, computer literacy actually helps to moderate well and significantly influence to have better relationship among individual awareness (social consequence, laptop usage and laptop disposal practice) towards conviction on laptop disposal. It is worthwhile to mention that the computer literacy moderates the relationship between social consequence and the conviction of laptop disposal practice. Therefore, without moderator, social consequence is not influencing the conviction on laptop disposal practice. With high knowledge in computers, the respondents realize the importance of e-wastage and practice appropriate measures of disposal of laptops.

6. Novelty of the current research

Based on the empirical study discussed in sections 1–5 and from the reflections of the study from respondents, it is time to propose an e-waste management model which can be used not only for Malaysia but also can be customized for any other nation. The proposed E-Waste Management Model (EWMM) is supported by two developmental theories particularly Theory of moral reasoning by Kohlberg (1973) and Theory of cognition by Piaget (1977). The Developmental Theories focus on how behavior changes throughout the life time. In the present study, once the awareness and knowledge on individual laptop disposal practices are completely realized in the society, this behavior change stays throughout the life time. Kohlberg (1973) constructed theory of moral reasoning which mainly highlights on accepting 'what the world says is right', the voice of the people is to decrease drastically

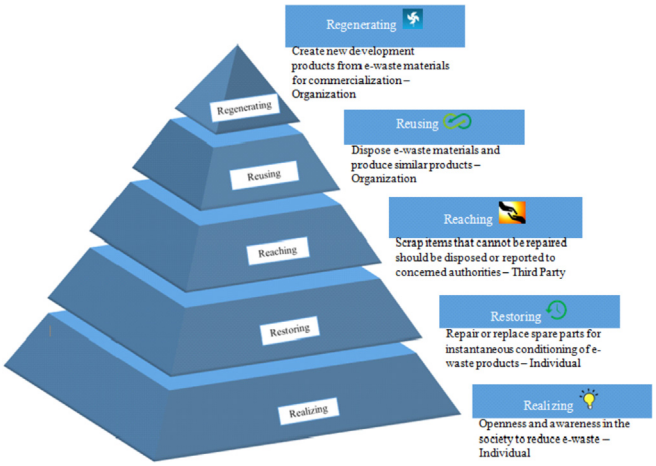

Fig. 4. E-Waste management model.

the pollution challenges and thereby the reduction of e-waste is to be considered by each and every one for environmental safety. On the other hand, Theory of cognition (Piaget, 1977) states that an individual becomes capable to solve real and hypothetical problems using abstract concepts. In fact, E-waste disposal practices for laptops is currently at primitive stage or abstract in nature and to be tested for its applications in reality. Thus, the proposed E-Waste Management Model (EWMM) can be directly applied in the society to resolve the e-waste crisis. Fig. 4 displayed below gives a pyramid which has five dimensions of EWMM namely, Realizing, Restoring, Reaching, Reusing and Regenerating (5Rs) and these dimensions are discussed in detail.

6.1. Realizing

The lack of knowledge and awareness in managing the electronic garbage effectively holds cause for contaminating the air, water and soil. Moreover, human negligence while discarding software or hardware wastes may lead to data and security breaches. It is important that every user be cautious about this critical issue and work towards resolving it. The Communications and Technology Industry has to be revamped in such a way that the key focus lies on reducing materialistic products and advancing virtualization.

6.2. Restoring

Electronic gadgets like PCs, laptops, printers, tapes, TVs, monitors, VCRs, Stereos, Fax machines, mobile phones and tablets that are damaged or considered outdated can be put to effective use rather than disposing it as trash. This can be done by simply making use of the working parts from a device and replacing the defective parts with working ones from any other device that is considered obsolete. For example, a mobile phone that has a damaged display screen can be refurbished by replacing it with a display screen taken from any other unproductive mobile device. In this way, the usage and lifetime of electronic products will be increased, thus providing temporary solutions to avoid generating e-waste.

6.3. Reaching

Individuals who are unable to find a way out of the e-waste crisis could take help from expert groups. Handling e-wastes improperly may result in hazardous circumstances. Sometimes, it is observed that people tend to assume the wrong as the right thing to do. Therefore, it is highly recommended to always consult the appropriate authorities and stakeholders while handling electronic appliances that are considered junk. Certified third party teams address such issues with caution and help in providing optimized solutions.

6.4. Reusing

When an electronic appliance is considered to have reached the end of its consumption period and cannot be retracted back to a functional state, the product has to be disposed to legitimate professionals for recycling. Similar electronic devices are produced from these disposed products. For example, old computer drives can be handed out to organizations or directly to its manufacturer for recycle and reuse. Often, the electronic garbage is recycled under controlled environments in order to reduce hazardous substances from getting emitted while processing. By recycling electronic scrap materials the right way, permanent solutions are obtained to address the e-waste crisis.

6.5. Regenerating

A novel way to put e-waste into good use is by innovating new products from the discarded gadgets. The value of wastes generated from electronic goods is substantial. Ability to think differently helps eradicate critical situations of e-waste propagation. Developing a wallet from floppy disks, a key chain from keys of old keyboards and a cellphone holder or card holder from discarded mother boards helps to remodel the e-waste and gives it a totally different outlook.

7. Conclusions

E-waste is a crisis for both local and global scales. The volume of e-waste is growing drastically without control as consumer technology continues to increase in obsolescence of manufactured products. E-waste has been contaminated with many hazardous materials and chemical particles and therefore without proper control will impact negatively on environment. Many case studies have been done previously on the impact of e-waste according to literature review cited in this article. However, still needs higher individual participation on e-waste management especially in the usage of electric and electronic products and to practice proper channel to dispose the e-waste. There are some good approaches that Malaysia has implemented in the past to tackle the e-waste management issue. Firstly, to get individual awareness, proper green Malaysia advertisement was placed on the disposal practices of e-waste in social media networks (Facebook, Tweeter. WhatsApp), television and radio. Secondly, steps have been taken to recommend to the companies to update their manual operation book which is provided to the customers on hazarded materials of electric and electronic goods and the approach that consumer can take during the disposal practices. Due to these measures, there are manual books attached with laptop and provide details on hazardous materials and also the ways and means of disposing practices. Thirdly, the Department of Environment in Malaysia provides guidelines for Industrial e-waste but still needs some more updates on how a household in Malaysia can proceed on with the issue of e-waste disposal practice. For instance, Japan has designed two laws on e-waste practices which are named as Law for Promotion of Effective Utilization of Resources (LPUR) which periodically review and control the disposal of personal computers and other smaller electric and electronic appliances. The second law is designed as Law or R e-cycling Specified Kinds of Home Appliance (LRHA)

which is for bigger electronic and electrical appliances. These laws mainly ensure on the households to pay the cost for recycling and for transportation of their electric and electronic products to the recycling centers. The e-waste management model proposed in this study will solve some of the issues and challenges aroused on the current e-waste crisis for individual electric and electronic disposal practices.

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Appendix 1. Indicators of the primary survey questionnaire, measured on a 5-point Likert scale

Items/Constructs
E-Waste Hazard (EH)
I have ideas on laptop parts which are hazardous to environment (lead, cadmium, mercury)
I have intention to know on how laptop parts are disposed
I aware improper disposal method leads to pollution
I aware on health implications due to e-waste
Social Consequences (SC)
I aware discarded laptop can increase the amount of waste
I give important to visual pollution (dirty environment)
I aware e-waste increase price of raw materials due to scarce of new products
I aware that laptop that I discarded increased benefits for recyclers
Laptop Disposal Practice (DP)
I do not know how to dispose the laptop safely and conveniently
I know that Government burdened with high cost of disposing e- waste
I would like to take the internal component of the laptop that can still be reused when I dispose the lap top
I carry the discarded item to retailer to get some voucher to buy new
Laptop Usage (LU)
I only discarded my laptop when its broken and unfixable
I maintain and upgrade my laptop
I change my laptop when its broken but costly to fix
I change my laptop even its still in good working condition
I discharged my laptop as the lifespan elapsed
I discarded my outdated laptop to get latest design
I do change my laptop to new version within 2 years
Computer Literacy
I am expert in using laptop
I am learning when using laptop
I need less training when using laptop
I update knowledge periodically in computer literacy
Conviction of Disposal Practice
I am fully convinced on my laptop disposal practice
I am partially convinced on my laptop disposal practice
I have no regrets on my laptop disposal practice
I am partially regrets on my laptop disposal practice

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