

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

JAYARAMAN, Krishnaswamy, VEJAYON, Seela, RAMAN, Shruthi and MOSTAFIZ, Imtiaz <<http://orcid.org/0000-0002-4362-4521>>

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The proposed E-Waste Management Model from the Conviction of Individual Laptop Disposal Practices-An Empirical Study in Malaysia

Abstract

Electronic waste is sprawling around in many parts of the world including Malaysia, leading to high pollution rates. Electronic products are considered obsolete within a few years of usage and are disposed. Massive quantities of these disposed products are often dumped into landfills, incinerated or recycled under disorganized, unethical and unchecked environments. According to Natural Resources and Environment Ministry in Malaysia, 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 (NGOs) 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 correlated with 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.

Keywords: E-waste practice, Laptop disposal, environmental hazard, health hazard, recycling.

1.0 Introduction

Electronics waste (e-waste) refers to the process that embrace 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 phone, and laptops are common components of e-wastages. Every electronic product has its life-span and after a certain period, its reaches to discard stage (Byster et al., 2002). E-waste also refers to the reverse manufacturing process by reengineering and refurbishing the waste product to new finished good for future use (Kumar, Teichman & Timpernagel, 2012). This refurbishment process also helps firm to control eco-system. Uncontrollable and abandoned e-wastages severely affect the eco-system and human health (Widmer et al., 2005). Due to on-going technological innovation, changing trends of consumer electronics, lesser lifespans of electronics products and increased demand of hi-tech products are escalating the e-wastage practices.

Awareness regarding the recycling process of e-wastages is one of the effective management processes to reduce the negative impact of e-wastages pollution on environment (Oguchi, Sakanakura, & Terazono, 2013). The Kohlberg's stage of moral development theory has highlighted three levels of moral development to create awareness of individual's convictions (Kohlberg, 1964). 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-wattages on health. High volume of e-wastes severally damage the environment because it contains 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 leads to improper e-waste disposal in landfill (Kwarta, Pandey, & Sharma, 2014). E-waste can be disposed in landfill through incineration process, but the practice is considered as conviction. Landfill leachates toxic substances into groundwater. The consequence leads to the release of toxic gases into the atmosphere (Kidee, Naidu, & Wong, 2012). Severe impact on atmosphere also caused by the disposal of heavy metal in landfill (Pan & Li, 2016). Electric 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 electronics products. An attempt is made in this research to determine the reflections from the Malaysian respondents on the disposal practices of individual laptops.

2.0 Literature Review

The importance of integrated approach to address challenges in e-waste management are very important in modern society (Ikhlayel, 2018). The awareness regarding the social consequences of e-waste is minimizing the environmental pollution and negative impacts on human health. Visual pollution can create mental and physical health by affecting quality of life of the community; well-being of human being; reduce 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 affect individual's experiences of environment (Jana & De, 2015). The e-waste flow is higher in developing countries following eighty percent of e-waste been export to developing countries from developed countries. These e-wastes are appliances that less environment friendly, older and discharged appliances but still re-usable (Kidee, Naidu, & Wong, 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 electric products. These are causing serious human and environmental problem in developing countries. Individual awareness regarding social consequences of e-wastes improves worker's life as well as economic development and reduce poverty (Petersen & 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, Lucchetti, Massa, & Valente, 2016). According the products end-of-life cycle, it's important to focus on recycling, reuse, re-assemble and proper disposal practice. Upstream and downstream reduction of e-waste generation through green design and cleaner engenderment is gaining interest and attention. However, there is 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 on to succeed in e-waste environmentally sound

management system (Herat & Agamuthu, 2012). Local and federal government also play very 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 (Poggiali, 2015). It is also important for individual to choose green and environmental friendly appliances for everyday needs. Life cycle assessment (LCA) is one of the powerful process to identify the environmental impacts of the disposal of electronics products and helps company to develop eco-design products (Kidee, Naidu, & Wong, 2013). This process also helps to identify laptop uses experience and the results help to handle replacement claims (Hatcher & Ijomah, 2013). Remanufacturing of a product requires more work than reconditioning or rehabilitating. The resultant product will be better quality with elongated life in utilization. It's also influence individual's attitude to consume the product until its lifespan end (Kidee, Naidu, & Wong, 2013). However, attitude towards upgrading to new electronic products are depend 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 span life.

Individual behavior of disposal practice is also 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 provide 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 have shown that people from least developing countries are reluctant to practice ethical e-waste disposal and retrieved e-waste at small family workshops or follow primitive recycling process (Awasthi, Zeng, &

Li, 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, and lower impacts on human health and job engenderment. (Hotta, Visvanathan, & Kojima, 2014). 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 condition of the technological waste, practices, and economic condition 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 & Victor, 2013). The e-waste management system of Malaysia was not well developed back in 2010 (Kalana, 2010). The country is expecting to be a develop 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 (Shumon, Ahmed & Islam, 2014). Furthermore, Malaysia is also lack of hazardous waste management system, including, transportation and disposal of waste and enforcement (Nnorom & 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, electronics uses and its disposal practice influence individual conviction on laptop disposal practice. Conviction is defined as the degrees of belief and understanding on specific practice (Anderson, 2012). It is an attitude or belief system towards the behavior done by 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 believe (Kvalnes, 2015). Consumer's or individual's responsibilities are mainly ranged of actions which focuses on the understanding of certain attitudes. Therefore, allocation of certain decision with a single motive is highly arbitrary (Spangenberg & Lorek, 2002). Individuals can successfully assess his action on environmental consequences (Spangerberg, 2014). Availability of appropriate information to individuals facilitate them to purchase green product and make sure of effective disposal practices to confirm green environment (Lojacono & Zaccai, 2004). Therefore, the buying decision, usability, and the disposal practice always remain with the

end user consumers (Zaccai, 2008). The present research focuses on the conviction of laptop disposal practices and 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 contain with chemical concern, which is hazardous to environment and human health. Batteries contains with mercury, lithium and lead, while printed circuit board contains with cadmium, lead, antimony and beryllium (Tsydenova, 2011). Laptop or monitor with LCD screens, which contain a coalescence of 10-20 substances in each liquid crystal suspected to be very hazardous (Prakash & Manhart, 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 contains with high level of heavy metal as silver, antimony, chromium, zinc. The chemical hazard will impact surrounding living being (Kwarta, Pandey, & Sharma, 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 impacts elaborate impact towards individual, 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 & De, 2015). According to Petersen and Finnveden (2013), working condition at China was partly identifies as an area with social impact hotspot with 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. Long working hours and without proper safety equipment when performing recycling that not only impact the workers but also the community in surrounding will actually lead individual to convince the laptop disposal practice (Petersen & Finnveden, 2013).

2.3 Laptop Usage

E-waste becomes an even more crucial issue when a product considers the lifespan reduction due to continue innovation to new product and upgrades. As an example, Apple's iPods, iPhones, batteries life span are only for certain years. The product was design to fail according to the years and the products life

span. While, it will be choice for individual to use LCA (life cycle assessment) as one of the powerful tools that can identify environmental impacts that help to develop eco-design products that can further improve on laptop usage (Kidee, Naidu, & Wong, 2013). Apart of the laptop design, knowledge on how to use and maintain laptop usage will be another factor that prolongs the laptop life.

2.4 Laptop Disposal Practices

There are several types on laptop disposal practice such as give 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, Osibanjo, & Weber, 2016) individual incline to keep their obstacles mobile phones for long time and dump their mobile phones with the general household wastes. While, some individual will put in drop box provided by laptop producer as Dell.

2.5 Computer Literacy

Computer knowledge or literary can be defined as knowing some basics details on how to use computer. Thus, computer literacy or computer knowledge can be defined a sort comfort level when using the computer (Patrick, 2014).

3.0 Conceptual research framework and hypotheses development

Drawing on Kohlberg's stage of moral development theory (Kohlberg, 1964), this study argues causal relationships between e-wastages awareness and conviction on laptop disposal practice. Four factors have been discussed as e-wastages awareness. These factors are e-waste hazard, social consequences, laptop usage, and e waste disposal practice. This article considered computer literacy has potential moderating effect on the relationship between e-wastages awareness and the conviction on laptop disposal practice. Figure 1 displays the conceptual research framework of the present study.

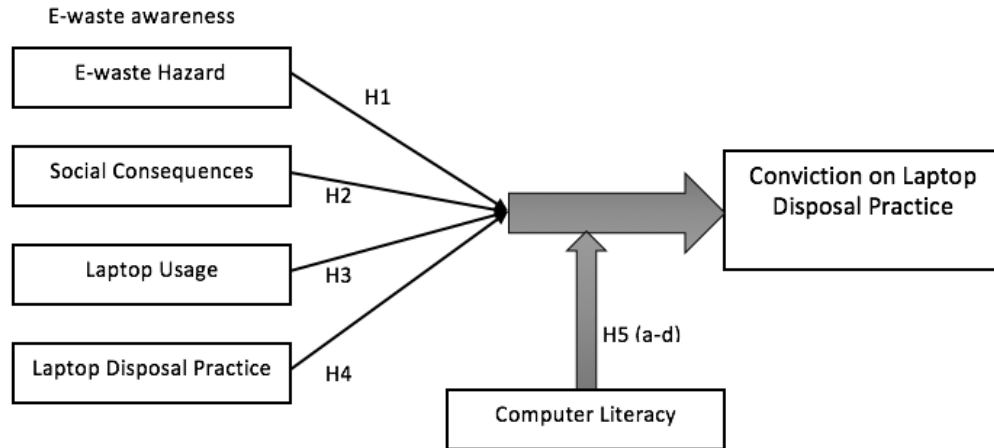


Figure 1. Conceptual Research Framework

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 (Heart & Agamuthu, 2012). These chemical contaminates with environment and creates severe threats for living being (Kwarta, Pandey & Sharma, 2014). Higher level of awareness in concerning to the ethical disposal practice minimizes negative hazardous effects. These behaviors of individuals will not only help them but also create awareness in the whole society (Nwagwu & Okuneye, 2016). Awareness of disposing locations which are far from household area also help individuals to minimize pollution in the locality. The awareness in on the grounds that a very much outlined reusing system can viably decrease the negative effect of the disposal activities on environment and 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, therefore, increase the needs of awareness to control the maintenance of hazardous e-waste disposal (Adediran & 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 surrounding (Petersen & Finnveden, 2013). Although individuals are aware of social consequences, however lack of practices of proper disposal practices cause negative consequences (Kalana,

2010). Minimum level of knowledge on social impact of e-waste disposal practices cause severe negative environmental footprints including China, Pakistan, Ghana, and Nigeria (Moran et al., 2014; Puckett et al., 2002, 2005; Lio 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 of the consequences of improper disposal of laptop can improve individual conviction for disposal practices.

Knowledge regarding the product life cycle also have 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 mentioned. As a consumer, it is important for them to acquire proper knowledge of the usage of the products before proceed with final buying decision (Poggiali, 2015). Knowledge of the usage of the product also 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 (Kidee, Naidu & Wong, 2013). In fact, firms like universities where students are more focused on digital education system rather than reading from textbook also learn the efficient use of digital device to enhance the user experience. This culture of using laptops in educational institutes is widespread. Hence, creating awareness of efficient laptop uses is compelling (Duncan Selby et al., 2014). This usage experience also develops individual's mindset to consume laptops until its lifespan end. 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, Osibanjo & Weber, 2016). Sufficient knowledge on e-waste disposal practice also plays crucial role in maintaining natural resources, handle irreparable drastic damage to the environment and individual's health (Duraismy, Ramakrishna & Ranganath, 2017). Adequate knowledge on disposal practices also advocate 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 above discussion, this study poses 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 e-waste disposal practices and individual conviction on laptop disposal practice.

3.2 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 product also 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-Porte et al., 2009). It is a pre-requisite for information literacy to broaden and efficient the user experience of a laptop user in many ways of the time that laptops are used and not used; such as, put the laptop in sleep-mode is not good for its battery health (Kurbanoglu & 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 experience the laptop in a proper manner (Raut, Ghatekar & Pandharikar, 2015). Based on 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 e-waste disposal practice) and conviction of laptop disposal practice.

4.0 Research Methodology

The empirical research setting of the study consists one of the emerging economies in Asia, namely Malaysia. The samples of this study were collected from individual who owns laptop. The sample consists the respondents from students of colleges, universities, working peoples, and retired persons. Cross-sectional study had been conducted to get the respondent 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 to 40 years old with 53%, followed by age group between 21-30 years with 31%, while 12% under age group of 41 to 50 years. Only 2% of the respondents were below 21 years and above 51 years. About 63% of the respondents have Bachelor Degrees or Professional Qualification, continued with Master Degree 22%. About 11% of 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 (2010), PLS method demands categorically fewer requirements compared to that of covariance based structure analyses, hence delivers consistent estimation results. This characteristic 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 leads PLS approach to be appropriate for explorative analysis of structural equation models, thus offering a significant contribution to theory development.

4.1 Dependent variable

Conviction on laptop disposal practice. Conviction on laptop disposal practice is the dependent variable

in this research model. This variable reflects on individual awareness towards need to dispose the laptop in proper manner. The operationalization of the variable concerning on environment issue, social issue, laptop usage stage and laptop disposal practice. The items to measure this variable include such as I 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; Kwarta, Pandey, & Sharma, 2014). These items are such as I have intention to know on how laptop parts are disposed; I aware improper disposal method leads to pollution. *Social consequences* were measured based on four items such as I aware e-waste increase 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 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 lap top; 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 measured based on seven items such as I change my laptop even its still in good working condition; I only discarded my laptop when its 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 items in this study were measured based on five point Likert scale (Allen & Seaman, 2007).

4.4 Significant Results from data analysis

The output of the Smart PLS reveals that the indicators included in Figure 2 have main loadings above 0.7 fulfils the thumb rule of Hair et al., 2013. The average variance extracted (AVE) is that is a 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 range of 0.707 to 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. Figure 2 shows the results of the measurement model of the conceptual framework on conviction of laptop disposal practice.

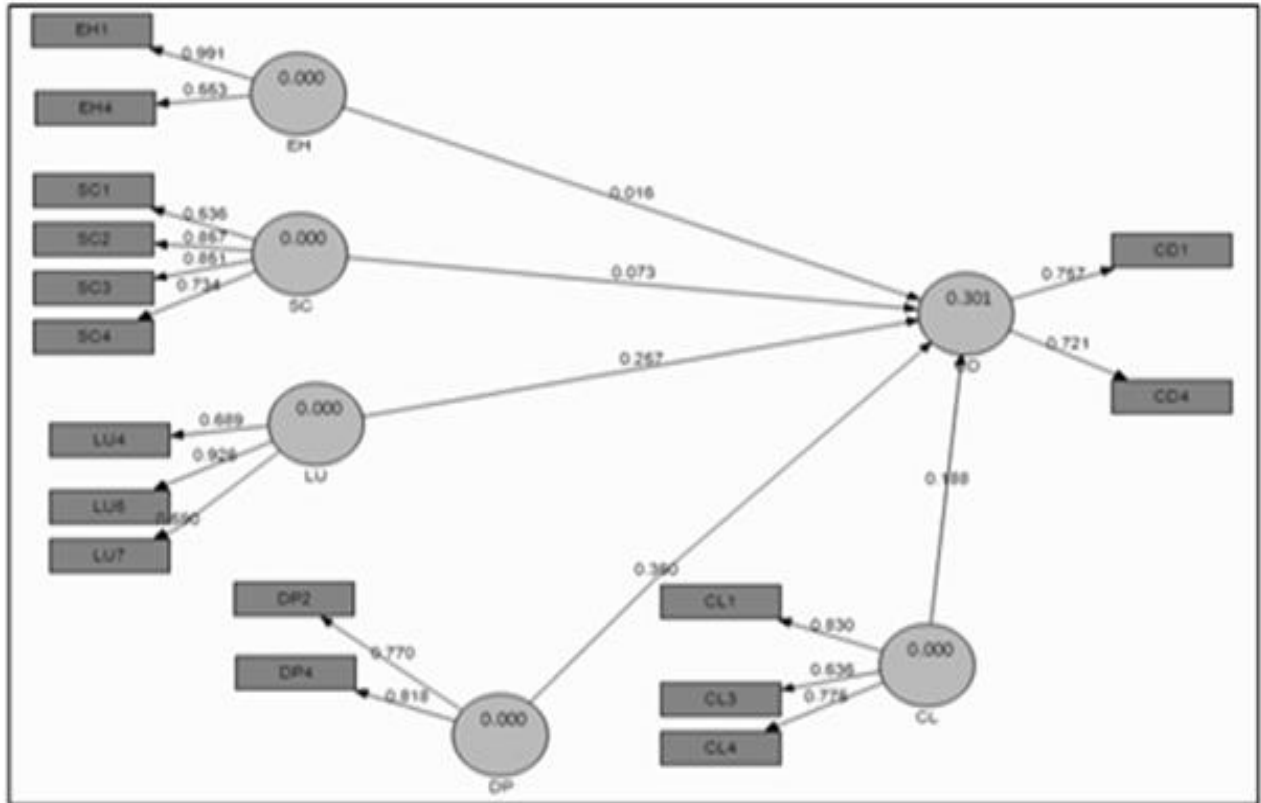


Figure 2: Results of the Measurement Model

Note: CD = Convinced Disposal Practice, CL = Computer Literacy, DP = Disposal Practice, EH = E-waste Hazard, LU = Laptop Usage, SC = Social Consequence.

Table 2 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 have less knowledge on e-wastages implications and they are not considering it as a serious issue. Further, Table 2 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. The more the 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 influencing 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 ($\beta=0.188$, $t=2.158$, $p<0.05$).

Table 2: 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

When it comes the moderation effect on the relationship between independent variables and dependent variable it should be noted in Table 3 and Figure 3 that computer literacy significantly moderate 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 moderate 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.

Table 3: 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

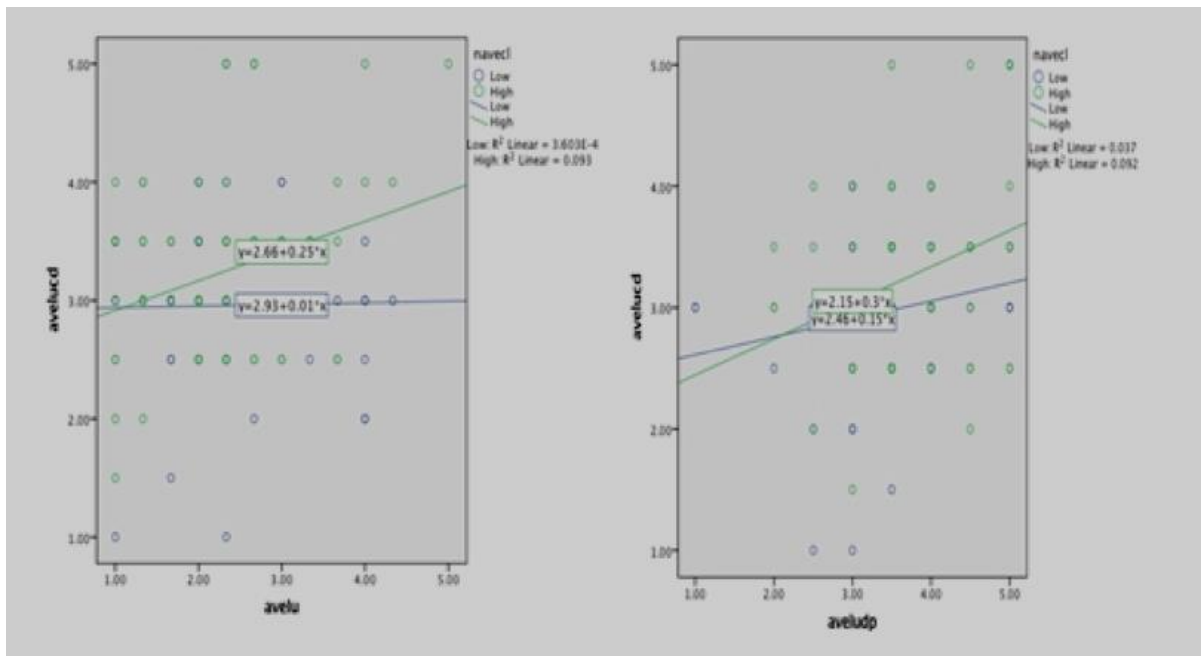
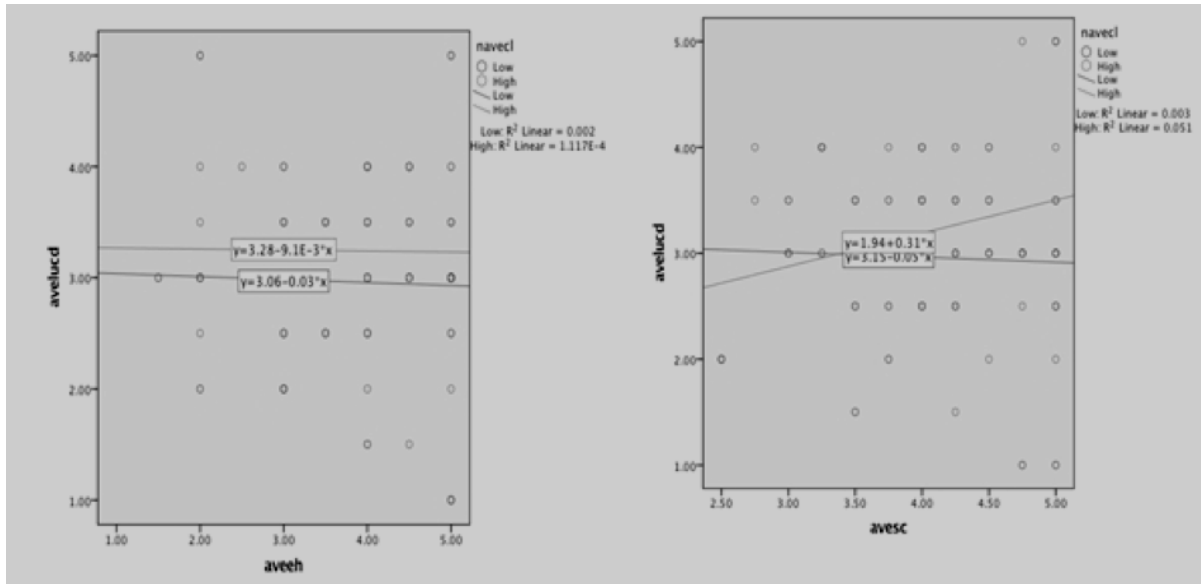


Figure 3: Moderating effects

5.0 Discussion on the findings of the study

Out of four direct hypotheses, only two hypotheses (H3 and H4 are supported) have positive relation on the conviction of individual laptop disposal practice. When individuals are using laptop more and more they get to know on 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 opinioned 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 recognizes 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 more than 83% of them updates 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 relation within 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. While, 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-wastages and practice appropriate measures of disposal of laptops.

6.0 Novelty of the Current Research

Based on the empirical study discussed in sections 1-5 and from the reflections of the study respondents, it is timely 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 stay the same across the life cycle. 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 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 able 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. Figure 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.

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.

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.

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.

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.

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.

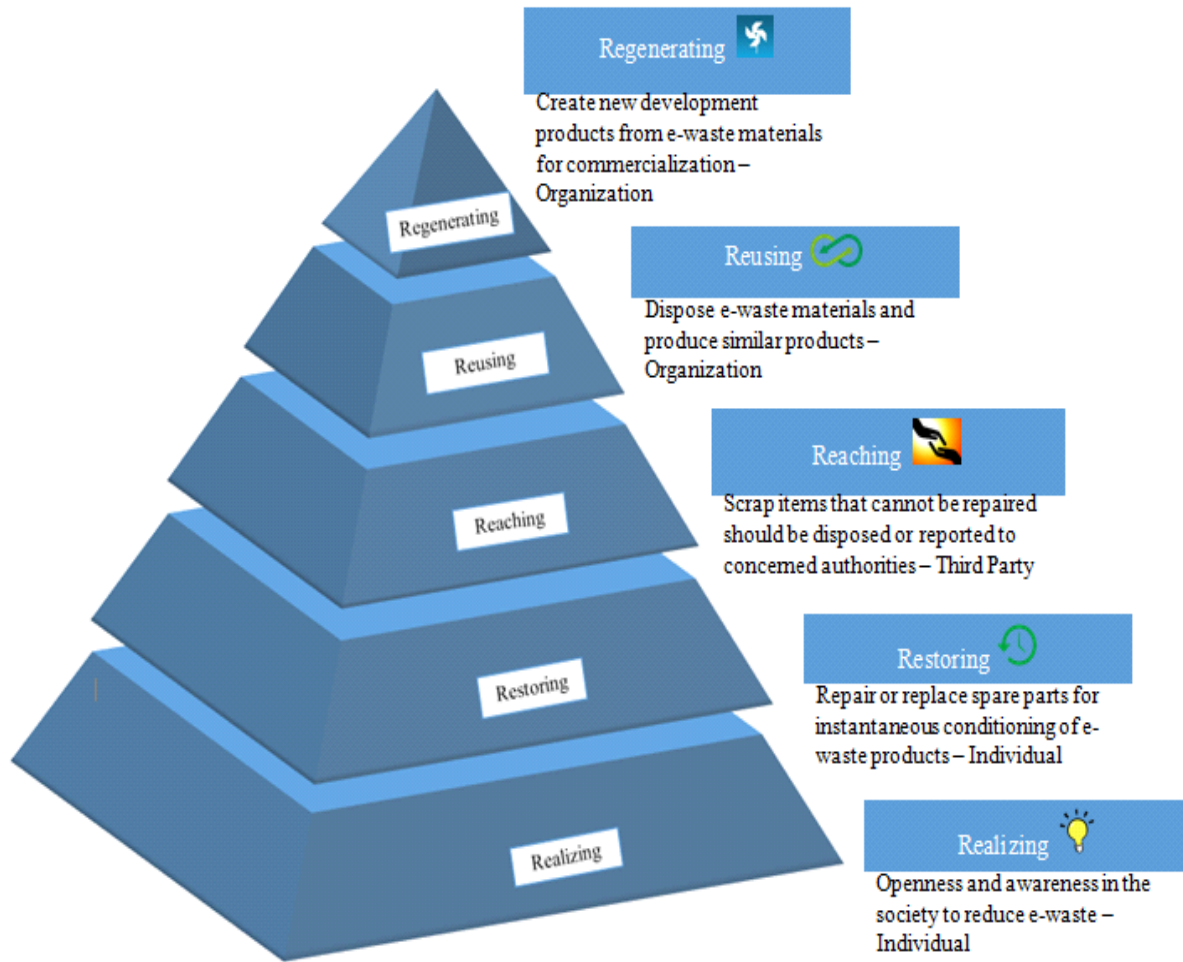


Figure 4: E-Waste Management Model

6.0 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 on 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 laptop

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
