Assessing Electronic Waste Recycling and Disposal Intentions Based on an Extended Valence Theory in a Developing Country Context

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Abstract

The severity of the E-waste dilemma may ascribe to the consumer's or end user's low involvement in making sure the appropriate disposal and recycling of those resources. Previous research has shown that the knowledge of behavioral determinant dimensions related to E-waste recycling and disposal intentions is still scrappy. Understanding the role of Government and E-waste awareness is key in E-waste disposal and recycling intentions, thus cannot get ignored. Based on a cross-sectional survey design and Valence Theory, the study examined the determinants of senior government employees' E-waste recycling and disposal decisions and consequently developed a conceptual model. The study also examined the role of the Government in E-waste management as a moderator in the relationship between perceived benefits and E-waste disposal and recycling decisions. Upon obtaining 346 valid questionnaires from the employees in the Ugandan cities, the partial-least-squares structural equation modeling-(PLS-SEM) assessed each construct's effectiveness. The findings reveal that perceived risks, the government's role, and E-waste awareness significantly predicted E-waste recycling and disposal intentions. The moderation results were likewise positively significant. However, perceived benefits insignificantly predicted E-waste disposal intentions. The study proposes an extended Valence Theory model, in addition to perceived risks and perceived benefits, to include the role of government and E-waste awareness in E-waste management when determining intentions to recycle and dispose of E-waste. Besides, the study assessed E-waste intentions of recycling and disposal in one study, a significant theoretical contribution. The study also provides insightful implications and recommendations.

Keywords: E-waste; Extended Valence Theory, Moderator, Recycling and Disposal Intentions.

Introduction

Electrical and electronics manufacturing has witnessed rapid economic growth, technological innovations, both increasing urbanization and globalization (Borthakur & Govind, 2018). The absurdity of exponential advancement, nonetheless, is the current worldwide electronic waste (E-waste) disturbance. Undoubtedly, the disposal of the old, discarded, and defective E-wastes has been and will continue to be a real challenge if not adequately addressed. Dhir *et al.* (2021a) stress that more electronic and electrical equipment (EEE) turns out to be outdated and without

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meaningful value to owners. To this extent, end-users should make informed decisions regarding whether and perhaps how to dispose of those devices. Forti *et al.* (2020) highlight that approximately or just over 50million tons of E-waste were produced globally in 2019 alone, with a projection to rise beyond 75million tons by 2030. The paradox in such exponential growth of E-waste generation and accumulation has partly shaped the waste management predicament and poses severe environmental and far-reaching human health-related problems.

Unsurprisingly, both advanced and developing nations have had an equal share of the troubles caused by the E-waste crisis, which has not spared the private and public sector either in trying to alleviate its impact. Remarkably, governments globally have put in place the required infrastructure for processing E-waste and promise proper solid and E-waste management (Forti *et al.*, 2020). Zhang *et al.* (2019) provide statistics showing approximately 20% of E-waste is formally treated despite such efforts. In contrast, others are either dumped with household waste, stored at home, or sold to informal recyclers and second-hand peddlers. According to Leblanc (2019), nearly 75% of E-waste are stored in households due to the unavailability of appropriate recycling and disposal options. Consumers or end-users are soft E-waste targets or merely offered economic incentives, convenience, and a rather attractive disposal alternative. Unfortunately, the informal recyclers and second-hand peddlers inappropriately dispose of this E-waste while recovering valuable metals such as gold, palladium, copper, and silver (Dixit & Badgaiyan, 2016; Dias *et al.*, 2018). As much as E-waste contains precious metals, in equal measure, it has numerous noxious materials that can inflict substantial health-related and environmental harm when disposed of recklessly and inappropriately (Brannon *et al.*, 2014). Moreover, Kumar *et al.* (2017) highlight that the harmful materials existing or mixed in electronic products is hazardous to wildlife and aquatic. Kumar *et al.* (2017) indicate that E-waste is cancer-causing, posing severe health-related dangers to the kidney system, respiratory system, liver, and nervous system.

Despite the adverse impacts, only a lesser proportion of E-waste is recycled or disposed of, which should be of concern since they end up in landfills or incarcerated. Besides, recovery of precious metals for new electronic production are inappropriately is irresponsibly handled (Wang et al., 2012). Evidence shows that when E-waste is not recycled appropriately and more so in designated facilities, they are destined to landfills leaching hazardous compounds into the groundwater and losing recoverable materials (Arain & Neitzel, 2019; Zeng et al., 2018). Therefore, we cannot ignore the importance of awareness and government in recycling, reduction, reuse, and disposal intentions of E-waste. More so, there is scarce scholarly literature exploring end-users waste management perceptions, and their intentions to recycle and dispose of E-waste. Consequently, the study assesses the determinant dimensions related to E-waste recycling and disposal intentions that are still scrappy. The study attempts to address this gap by determining the contributing factors of E-waste recycling and disposal. We utilize the Valence Theory (VT) to build a model based on perceived risk, perceived benefits, and a proposed extension of the theory through the role of government and E-waste awareness in recycling and disposal.

Previous studies have been choosy about debating the factors influencing the E-waste recycling and disposal intentions by adopting the theory of planned behavior (TPB) and besides measured variables, such as economic benefits (Mishima & Nishimura, 2016), convenience (Zhang *et al.*, 2019; Liu *et al.*, 2019), recycling cost and past experiences (Wang *et al.*, 2016), and, awareness (Wang *et al.*, 2018). Based on the Valence Theory, we contribute to theory by integrating the E-waste recycling and disposal behavioral intention in a single study, and practically, to policymakers and government.

E-waste recycling intentions and Valence Theory

Recycling intentions predictors have mainly used the Theory of Planned Behavior (TPB). The TPB theoretical framework indicates that attitude, perceived behavioral control (PBC), and subjective and norms (SN) significantly predict intentions in engaging in the behavior or an act (Kumar, 2019). These results, however, are scrappy, with some studies such as (Nguyen *et al.*, 2018) highlighting that attitude significantly and positively affects E-waste recycling intentions and while others found an insignificant link between them (Dixit & Badgaiyan, 2016). More so, regarding norms, Kumar (2019) and Dixit and Badgaiyan (2016) had resulted in a positive link with intentions of E-waste recycling. Peter and Tarpey (1975) proposed the Valence Theory (VT) framework to explore the valence role in comprehending consumers' willingness to engage in a service, product, or behavior (Bilkey, 1953). They also posit that the consumers or end-users consider the related risks and benefits holistically in achieving a net valence. The standalone perceived benefit and risk models contend that end-users expect to make the most of the perceived positive utility of an action or behavior. The VT or net valence model also emphasizes the need to reduce its perceived negative utility. Furthermore, Peter and Tarpey (1975) recommended that VT possibly describe more variance in end-user or consumer intentions than TPB or/and behavioral reasoning theory and, in that way, prove the VT framework superiority.

To this end, VT assumes that the perceived net valence has to take center stage whenever consumers decide. VT is different from other behavioral theories by considering both the perceived risk and benefit, implying a better assessment of the individual's intentions in engaging in a behavior (Peter & Tarpey, 1975). Ozturk *et al.* (2017) state that VT considers perceived benefit consisting of two major components: convenience and utilitarian value. Utilitarian value mentions evaluating the functional or practical attributes of the action (Han *et al.*, 2017), while convenience describes the perception of the consumer's time and effort necessary to perform a behavior. Perceived risk comprises costs associated with adverse and uncertain effects while engaging in a behavior (Ozturk *et al.*, 2017). It includes the high recycling cost, the threat of personal information on the verge of getting stolen from laptops and mobile phones, and misuse of electronic devices disposed of (Ozturk *et al.*, 2017). Thus, the conceptual framework is based on the Valence theory emphasizing perceived risks and benefits constructs and attempts to extend it by recognizing the role of E-waste awareness and government in recycling and disposal intentions.

Hypothesis development

The study employs the valence theoretical framework to investigate the E-waste disposal and recycling intentions determinants. VT recommends that measuring the perceived benefits and risks of E-waste recycling should help better understand the behavior of consumers' net perceived utility, which leads to the improvement of the overall comprehension of E-waste recycling and disposal intentions. Also, the study examines the part played by the government role and E-waste awareness role in predicting the recycling and disposal of E-waste intentions.

E-waste Awareness value and E-waste recycling and disposal intentions.
Awareness is a vital factor in E-waste management. Hansmann *et al.* (2006) established that the Switzerland populations' knowledge, awareness, and decisiveness to recycling positively influenced the citizen's battery recycling. Nixon and Saphores (2007); Tonglet *et al.* (2004) held that the attitude to recycling and the environmental or eco-friendly protection awareness effectively stimulated the recycling and disposal behavioral intention of residents E-waste. Many countries, for instance, the United States of America, India, Japan, China, and South Korea, and regional blocks such as the European Union have given importance to the awareness and study of the e-waste effects (Breivik *et al.,* 2014). Further, Masud *et al.* (2019) allude to the fact that awareness and understanding of the producers are some of the factors towards creating a positive attitude and intent to proper E-waste management supported by Government, civil society organizations, and environmental experts. Furthermore, whereas awareness from producers and consumers will enhance a better environment situation, knowledge acts as an essential element for a conducive environment to stay in and healthy humans (Watkins, 2007). Thus, we hypothesize that:

H1. The value of E-waste awareness is directly related to E-waste disposal intention.
H2. The value of E-waste awareness is directly related to E-waste recycling intention.

Role of Government in E-waste disposal and recycling intentions
Government has a vital role in providing leadership amidst the E-waste management challenges, which include unregulated recycling and poor disposal methods resulting in water, air, and soil pollution. Government plays a significant role in regulating E-waste by championing solid waste reduction and facilitating proper recycling and disposal through legislation, laws, and policies. Yang *et al.* (2008); Li *et al.* (2006) affirmed that government agencies have enacted better-targeted laws regarded E-waste to reduce or prevent pollution as a result of E-waste. Proper recycling and disposal require a collective approach with partners, right from manufacturing to the point of final disposal. Government, repairers, importers, users, waste management companies, the public, and the media play a significant role in combating unsustainable E-waste management through proper disposal of E-waste and the use of appropriate recycling technologies. There is a need for government to collaborate with all stakeholders for effective recycling and disposal of E-waste. Inadequate national regulations have held back recycling rates in many countries significantly. Brown *et al.* (2014) argue that governments and agencies must engage further on E-waste issues to promote green societal growth and its associated benefits. For instance, awareness campaigns about the dangers of risk exposure to hazardous E-waste components, regulation setting to monitor the E-waste importation flow; establishing legislation to sanction companies and organizations that inappropriately dispose of E-waste, and setting up educational/training and institutions to deal with the E-waste challenge. Therefore, the study hypothesizes that:

H3. The E-waste regulation role of the government positively influences E-waste disposal intention.
H4. The E-waste regulation role of the government positively influences E-waste recycling intention.

Previous studies on E-waste recycling have considered consumers' experience and contact with recycling centers on the relationship between perceived risks and benefits to recycling E-waste

(Dhir *et al.,* 2021b). It was found that the relationships partially supported the moderation results. Despite the significance of the role of the government in influencing E-waste management, studies are yet to investigate their role in disposal and recycling intentions. The study, therefore, hypothesizes that:

H5. The role of the government moderates the relationship between perceived benefits and E-waste disposal intentions.
H6. The role of the government moderates the relationship between perceived benefits and E-waste recycling intentions.

Perceived benefit to E-waste disposal and recycling intentions
Peter and Tarpey (1975) aver that perceived benefits can create a positive perception of consumers of a particular action or behavior. For instance, E-waste disposal in an eco-friendly manner that takes care of safety needs results in desirable behavior (Dhir *et al.*, 2021). In contrast, the E-waste dumping with household waste without separation or the selling of E-waste to second-hand merchants can result in several negative externalities, such as environmental dangers and threats to human health (Dias *et al.,* 2018) can lead to undesirable behavior. Thus, reducing the health issues and saving the environment from the undesired informal E-waste dumping could benefit or drive users to engage in E-waste recycling. Studies have previously stated that perceived benefit will positively influence the consumer intentions to engage in an act, behavior, or task. For instance, Wang and Hazen (2016) acknowledged a positive relationship between perceived benefits and purchase intentions to the remanufactured product. Likewise, Kumar (2019) revealed that environmentally-conscious users have a positive intention to E-waste recycling since they are aware of the negative impact of E-waste when not disposed of in the formal channels. Similarly, Gilal *et al.* (2019) recommended that persons' intrinsic motivation, self-determined needs, and satisfaction to perform E-waste recycling reveal a positive predictors power of the intentions to engage in recycling E-waste. Implying that perceived benefit influences understanding consumer behavior's E-waste recycling intentions.

Value compatibility is the adequacy or appropriateness of the service or innovation in meeting the consumer's norms and values (Bunker *et al.,* 2007). Value compatibility is extensively in use by information technology (IT) researchers to investigate users' adoption intentions. Kang *et al.* (2015) found that value compatibility is positively influenced by the intentions to use mobile learning. In contrast, pro-environmental behavior perspective, Ting *et al.* (2019) stressed that value compatibility is a crucial predictor of whether users can continue to use their mobile phones or dispose of them. The findings advise that should a consumer see value compatibility when owning a mobile phone rather than disposing of it, they will try to keep hold of the product while waiting for a new phone with better compatibility or feeling obliged to abandon or discard the product. Saphores *et al.* (2012) contend that consumers are likely to perceive E-waste recycling to be more compatible with consumers' values when it aligns with their current beliefs, previous experience, and established needs. Therefore, value compatibility can adequately support the intention to engage in E-waste recycling. However, unlike Dhir *et al.* (2021a), who add value compatibility and environmental concern as an extension of the valence theory-based framework, we suggest those dimensions are components of perceived benefits.

Environmental concern or benefit is also a vital measure that has gained considerable attention in the literature regarding consumers' pro-environmental behavior. Nnorom *et al.* (2009) define environmental concerns as the user's or consumer's evaluation of own actions and others' attitudes toward behaviors related to the environment. Environmental concerns demonstrate the extent of consumers' awareness of environmental degradation and recognize that engagements are vital to prevent it from happening further. The environment concerns value dimension is related to the guilt that users usually experience when they unsuccessfully protect the environment. Dwivedy and Mittal (2013) assert that environmental concerns significantly and positively influence the users' willingness or readiness to participate in E-waste recycling. As such, consumers may perhaps prefer E-waste recycling to informal disposal and open dumping. We hypothesize that the:

H7. Perceived benefits are positively related to E-waste disposal intention.
H8. Perceived benefits are positively related to E-waste recycling intention.

E-waste Perceived risk to consumer disposal and recycling intentions
Ozturk *et al.* (2017) defined perceived risk as the probability of experiencing or feeling a loss and possibly harmful consequences resulting from a behavior. Characteristically, consumers seek to lessen their day-to-day decision-making processes' uncertain and undesirable concerns. Individuals with a higher risk perception are less predictable to do an act. In comparison, those around lower risk perceptions typically, as a result, have increased behavioral intentions (Wang & Hazen, 2016). Indeed, studies across several research domains have proved the significance of perceived risk on consumer behavior. For example, He *et al.* (2018) emphasized that perceived risk will negatively influence purchase intentions when they considered a study on consumers of electric vehicles.

Similarly, Kaur *et al.* (2020) highlighted that perceived risk hinders the acceptance of mobile payment solutions. In the E-waste recycling context, users also perceive risks through E-waste disposals, such as loss of effort and time, the threat of loss of private data or stealing personal data, and monetary loss. Likewise, Li *et al.* (2018) additionally demonstrated that perceived risk will share a negative relationship with consumers who expect to share their health information. Wang and Hazen (2016) also reported a negative association between perceived risk and intentions to purchase remanufactured products. Further, Zhang *et al.* (2019) emphasized that a perceived economic disadvantage will negatively influence the intentions to recycle E-waste using E-commerce platforms. When the convenience of recycling increases, the E-waste recycling intentions also increase (Zhang *et al.*, (2019). In other words, when the level of inconveniences certainly goes high, people may correspondingly be less willing to engage in E-waste recycling. Furthermore, in their study, Nguyen *et al.* (2018) revealed a negative relationship between the inconvenience of recycling and intentions to recycle E-waste. For instance, Zhang *et al.* (2020) assert that persons perceiving a high risk of personal information stolen or taken from their own devices are less likely to recycle it once they become obsolete. Whereas Kumar (2019) found that consequence awareness (perceived risk) doesn't significantly influence the E-waste recycling intentions of customers. Thus, the study hypothesizes that:

H9. Perceived risk is negatively related to E-waste disposal intention.
H10. Perceived risk is negatively related to E-waste recycling intention.

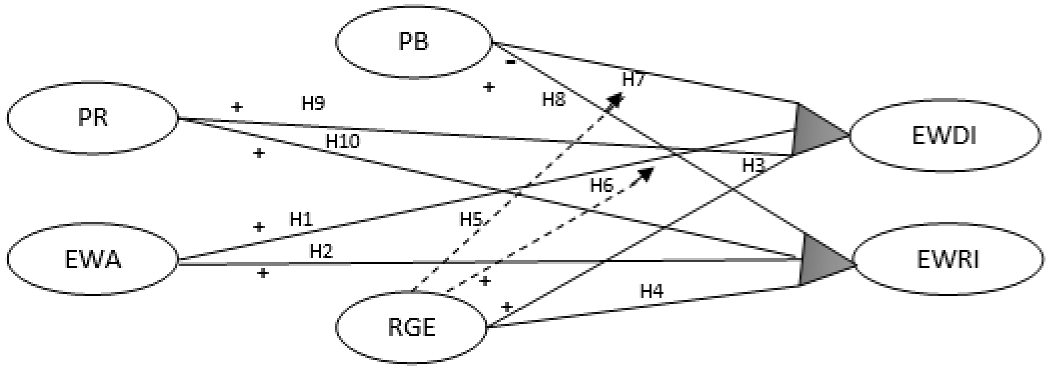

Figure1: Proposed model for E-waste Recycling and Disposal Intentions

EWA: E-waste Awareness Role, **RGE:** Gov't Role in E-waste Management, **PB:** Perceived Benefits, **PR:** Perceived Risks, **EWDI:** E-waste Disposal Intentions and **EWRI:** E-waste Recycling Intentions.

Methodology

Questionnaire survey design and data collection

The study adopted a cross-sectional study. A questionnaire-based on E-waste recycling and disposal got adapted from past literature. The research model was analyzed using cross-sectional data from top government employees from 10 Ugandan cities, including Kampala, and the regional cities, employed across the Ministries, Departments, and Agencies (MDAs). These MDAs have top technocrats engaged in policymaking processes. A 7point Likert scale spreading from (7) "strongly agree" to (1) "strongly disagree" was employed for the measurement of the desired constructs. The questionnaire had an E-waste definition, which improved the understanding and validity of results. Because the official list of the would-be technocrats in the cities was not readily available before data collection, the study considered a sample comprising of 382 respondents (Krejcie & Morgan, 1970) (with a population of 75,000 and above government employees. The study employed a convenience sampling technique to arrive at the respondents. However, before data collection, a pilot survey was conducted through 3 experts, excluding the 384 target technocrats for the main study, to understand the relative items and appropriateness of language. We made amendments to the questionnaire based on comments received from the pilot study. In total, 346 respondents returned usable questionnaires.

Demographic characteristics of sample

Table 1 below displays the demographic features wherein the survey, 186 (53.8%) respondents were males, and 160 (46.2%) were females. The majority of the respondents, 102 (29.5%) and 100 (28.9%) were aged between 31-40years and 41-50years, respectively. In addition, most respondents, 186 (47%) had a working experience in a city setting of 5 years and below. The Government created Cities barely less than 2years ago.

Table 1: Respondents' demographic information

Variable	Description	Frequency	Percentage
Gender	Male	186	53.8%
	Female	160	46.2%

Age	20 – 30 years	60	17.3%
	31 – 40 years	102	29.5%
	41 – 50 years	100	28.9%
	51 – 60 years	54	15.6%
	Above 60 years	30	8.7%
Level of Education	Diploma	46	13.3%
	Undergraduate Degree	144	41.6%
	Master & Postgrad. Diploma	150	43.4%
	Ph.D.	6	1.7%
Working experience in City setting	Below 5 years	186	47%
	5 – 10 years	80	20.6%
	11 – 20 years	51	13.2%
	Above 21 years	29	7.5%

Data analysis and results

The study used a statistical analysis technique based on the structural equation-modeling (SEM) to measure and have the proposed model validated and the relationships amongst the hypothesized constructs. Gotz, Liehr-Gobbers, and Krafft (2010) affirm that SEM is regarded widely as a model for measuring the validity of the hypothesis. It involves the estimation of the measurement and structural models. Hair, Hult, Ringle, and Sarstedt (2021) stated that SmartPLS software is one of those well-known PLS-SEM applications used to analyze the collected data. Shackman (2013) states that PLS offers over SEM due to easier testing of moderation relationship, lower sample size requirements and, a built-in capability to handle formative indicators. Besides, PLS-SEM is robust against multicollinearity problems and does not consider assumptions for variable distribution (Ringle et al., 2020; Sarstedt et al., 2020). Data was input into the Microsoft Excel sheet and imported to SmartPLS software for statistical analysis. The effect of moderation got tested using the bootstrapping process in Smart PLS.

Measurement model

The measurement model was evaluated by examining the convergent and discriminant validity and the internal reliability (Boyd *et al.*, 2013). The internal reliability is evaluated based on the composite reliability, and the Cronbach's alpha (α) was 0.70 and above, the acceptable internal consistency threshold (Hair *et al.*, 2021). Besides, the convergent validity is assessed by the extracted Average Variance Extracted (AVE) with items loadings of at least 0.50 of AVE a sign for construct validity (Hair *et al.*, 2013; Boyd *et al.*, 2013). The calculated loadings, Cronbach's alpha (α) AVE, and composite reliability is presented in Table 2. Table 2 displays the assessed Cronbach's alpha (α) values ranging from 0.706 to 0.878, while the composite reliability (CR) values are estimated from 0.806 to 0.912, thus indicating strong internal reliability. The estimated constructs loadings ranged from 0.705 to 0.910 (figure2) and AVE was measured from 0.600 to 0.804 hence greater than the suggested threshold of 0.5. This shows that all convergent validity conditions are satisfied for proper analysis. All items that didn't meet the criteria were discarded and analysis redone.

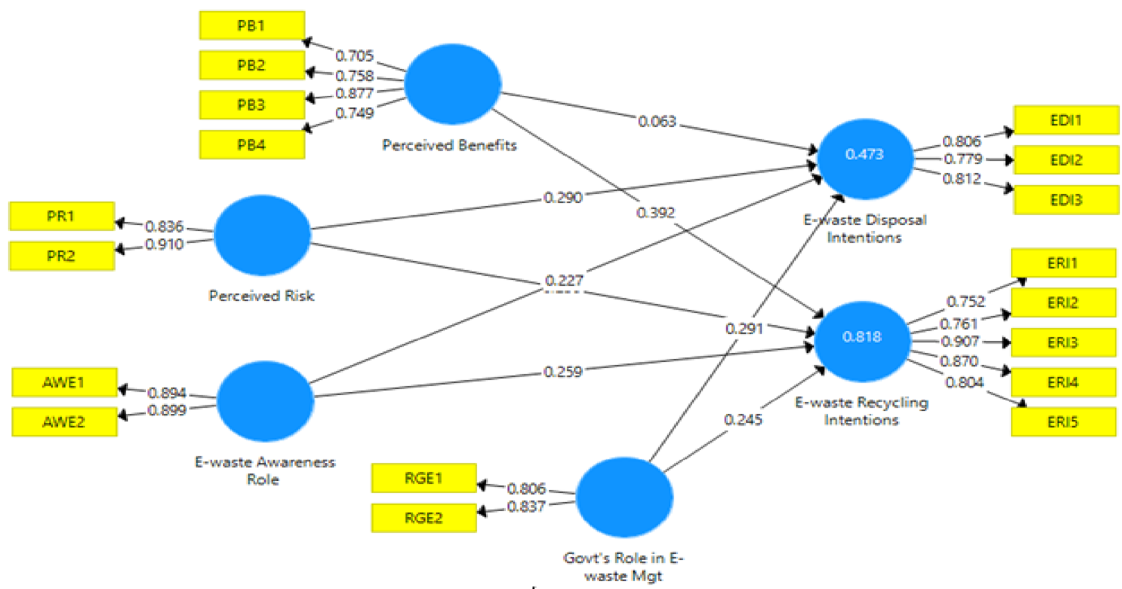

Figure 2: Model fit (Measurement model)

Table 2: Composite Reliability (CR), Cronbach's Alpha and Average Variance Extracted (AVE)

Model constructs and references	Measurement items	Loadings	CA	CR	AVE
Perceived Benefits	**PB1:** Recycling and disposal of E-waste are environmentally friendly.	0.705	0.776	0.856	0.675
	PB2: Embracing E-waste recycling and disposal is far much better than storing the used product at home.	0.758			
	PB3: Recycling and disposal of E-waste would be in accordance with my own personal values.	0.877			
	PB4: Recycling and disposal of E-waste do not offer me monetary benefits.	0.749			
Perceived Risks	**PR1:** Recycling E-waste may be exposed to a high risk of having personal information stolen from them.	0.836	0.734	0.866	0.763
	PR2: E-waste programs involving recycling are costly.	0.910			
E-waste Awareness Role	**AWE1:** I am aware of the consequences of poor E-waste practices.	0.806	0.706	0.806	0.675
	AWE2: I am aware of my responsibility regarding E-waste for environmental protection, maintaining good human health and safety.	0.837			
E-waste Management Government Role	**RGE1**: Government has established appropriate E-waste legislation to address E-waste challenges.	0.894	0.756	0.891	0.804
	RGE2: Government does not sanction people or culprits over irresponsible disposal of E-waste.	0.899			
E-waste Disposal Intentions	**EDI1:** I am willing to spend some time taking my old electronic appliances to be disposed of.	0.806	0.717	0.841	0.639
	EDI2: I am willing to pay the E-waste disposal fees should they set up a disposal infrastructure or a disposal collection center.	0.779			
	EDI3: I will drop off my E-waste if formal/recognized collection systems are accessible.	0.812			
E-waste Recycling Intentions	**ERI1:** I am willing to speak to my friends about appropriate modes of recycling E-waste.	0.752	0.878	0.912	0.675
	ERI2: I am willing to spend some time taking my old electronic appliances to be recycled.	0.761			
	ERI3: I am willing to pay with an extra cost the E-waste recycling fees should they set up a recycling infrastructure or recycling center.	0.907			
	ERI4: I am willing to meet formal or recognized E-waste recycling organizations/stakeholders that deal with E-waste.	0.870			
	ERI5: I am willing to participate in E-waste programs intended by the government to promote good human health and environmental programs.	0.804			

Further, the discriminant validity is generally measured using the AVE square root and the cross-loading matrix. Boyd *et al.* (2013) stress that the square root (√) of the AVE of a construct should be greater than that of its correlation given other constructs to ensure satisfactory discriminant validity. Moreover, Henseler and Sarstedt (2013) demonstrate that the diagonal elements or values must be greater than the entries in corresponding columns and rows to support the discriminant validity of the data. Thus, the results demonstrate that all constructs in this research support the discriminant validity.

***Table 3: Fornell-Larcker Criterion* (Correlation matrix and AVE square root)**

Variables/Model Constructs	**(EWA)**	**(EDI)**	**(ERI)**	**(GRE)**	**(PB)**	**(PR)**
E-waste Awareness Role (EWA)	**0.896**					
E-waste Disposal Intentions (EDI)	0.582	**0.799**				
E-waste Recycling Intentions (ERI)	0.726	0.641	**0.821**			
Gov't Role in E-waste Management (GRE)	0.528	0.528	0.645	**0.822**		
Perceived Benefits (PB)	0.485	0.466	0.767	0.480	**0.775**	
Perceived Risk (PR)	0.590	0.545	0.683	0.301	0.527	**0.874**

Note: The diagonal show square root of AVE.

Structural model for E-waste Disposal and Recycling

Table 4: Path Coefficient, R-Squared Values & T-Statistics for E-waste Disposal and Recycling

Exogenous Variable		**Endogenous Variable**	**(β) Path Coefficient**	**T-Statistics**	**P(two-tailed)**	**Decision**
H1: EWA	⇒	EDI (**R^2 = 0.473**)	0.227	4.090	0.000	**Supported**
H2: EWA	⇒	ERI (**R^2 = 0.818**)	0.259	9.677	0.000	**Supported**
H3: RGE	⇒	EDI	0.291	5.283	0.000	**Supported**
H4: RGE	⇒	ERI	0.245	10.100	0.000	**Supported**
H7: PB	⇒	EDI	0.063	1.254	**0.211**	**Not Supported**
H8: PB	⇒	ERI	0.392	11.170	0.000	**Supported**
H9: PR	⇒	EDI	0.290	4.847	0.000	**Supported**
H10: PR	⇒	ERI	0.250	8.379	0.000	**Supported**
H5: Role of Gov't as moderator in R/S PB & EDI	⇒	EDI	-0.099	2.906	0.004	**Supported**
H6: Role of Gov't as moderator in R/S PB & ERI	⇒	ERI	0.096	3.731	0.000	**Supported**

Significant at P < 0.05 – EWA: E-waste Awareness Role, RGE: Gov't Role in E-waste Management, PB: Perceived Benefits, PR: Perceived Risks, R^2: R Square, EWDI: E-waste Disposal Intentions and EWRI: E-waste Recycling Intentions.

In assessing the E-waste recycling and disposal intention model, the R-squared (R^2) values for the two dependent variables (EDI and ERI) and the path coefficients produced from the previous calculation of the PLS algorithm are considered as shown in Table 4. The R^2 value for E-waste disposal outcomes intentions is 0.473, which indicates that 47.3% of the variation of E-waste disposal outcomes intentions in the model is described by the exogenous latent variables used in the model. Meanwhile, the R^2 value for E-waste recycling outcomes intentions is 0.818, demonstrating that 81.8% of the variation of E-waste recycling outcomes intentions in the model is explained by the exogenous latent variables used in the model. The structural model pinpoints the associations amongst the research model constructs. The hypotheses were all tested using the bootstrapping method (using SEM). It converted the slope coefficients to T-Statistics utilized to test the significance of the relationship between the independent (exogenous) latent variables and the dependent (endogenous) latent variables as hypothesized. Subsequently, the standard errors and t-statistics of the parameters were established. Table 4 above presents the PLS-SEM structural model results. For the hypotheses results to be deemed supported, the t-Statistics value should be greater than 1.96.

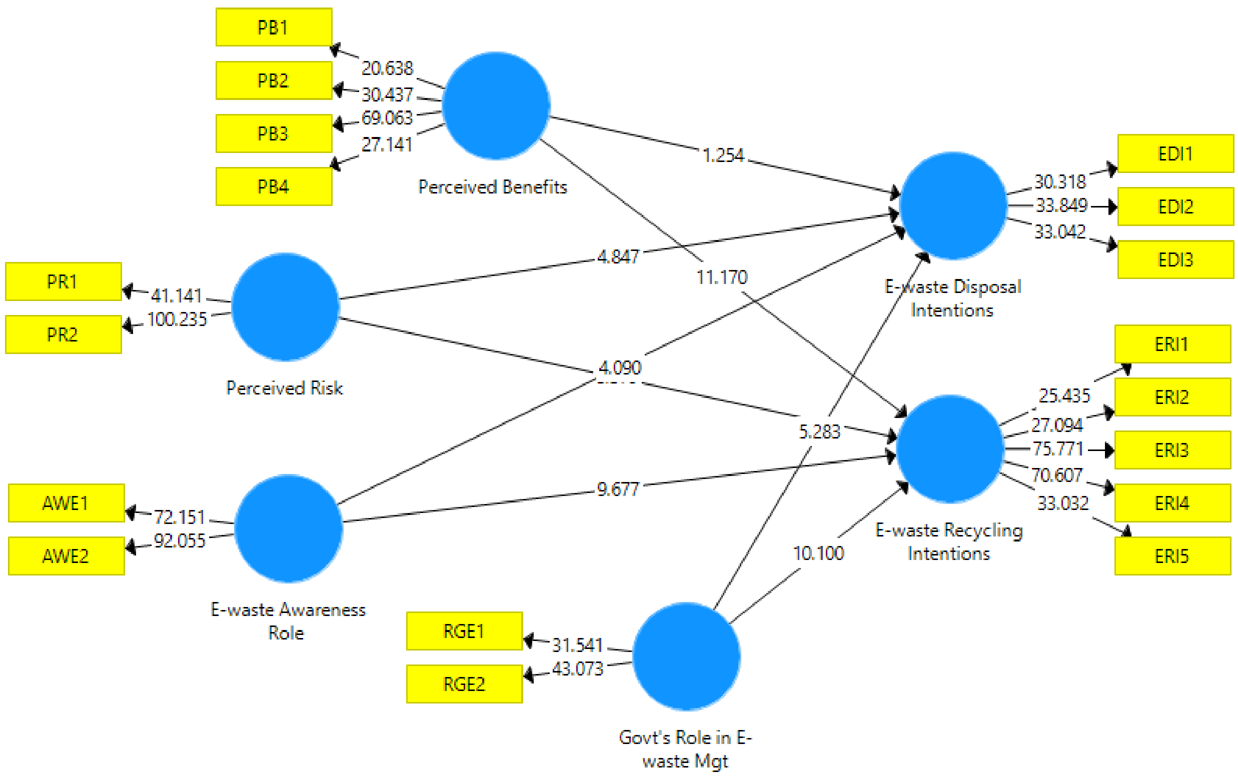

Figure 3: Model fit test (Structural model)

As indicated Table 4 and partly in figure3, the results pinpoint the associations between EWA and EDI ($t = 4.090$, $\beta = 0.227$, $P < 0.05$), EWA and ERI ($t = 9.677$, $\beta = 0.259$, $P < 0.05$), RGE and EDI ($t = 5.283$, $\beta = 0.291$, $P < 0.05$), and RGE and ERI ($t = 10.100$, $\beta = 0.245$, $P < 0.05$), to be significant. Similarly, RGE as moderator in the relationship between PB and EDI ($t = 2.906$, $\beta = -0.099$, $P < 0.05$), and the RGE as moderator in the relationship between PB and ERI ($t = 3.731$, $\beta = 0.096$, $P < 0.05$), were significant. Therefore, H1, H2, H3, H4, H5 and H6, were supported. On the other hand, the relationships between PB and EDI ($t = 1.254$, $\beta = 0.063$, $P > 0.05$) was not significant. Thus, H7 was not supported in the current study. Though H8, that is, the relationships between PB and ERI ($t = 11.170$, $\beta = 0.392$, $P > 0.05$) was significant. Similarly, the results pinpointed the associations between PR and EDI ($t = 4.847$, $\beta = 0.290$, $P < 0.05$), and that relationship PR and ERI ($t = 8.379$, $\beta = 0.250$, $P < 0.05$), as significant respectively. Thus, H9 and H10 were supported.

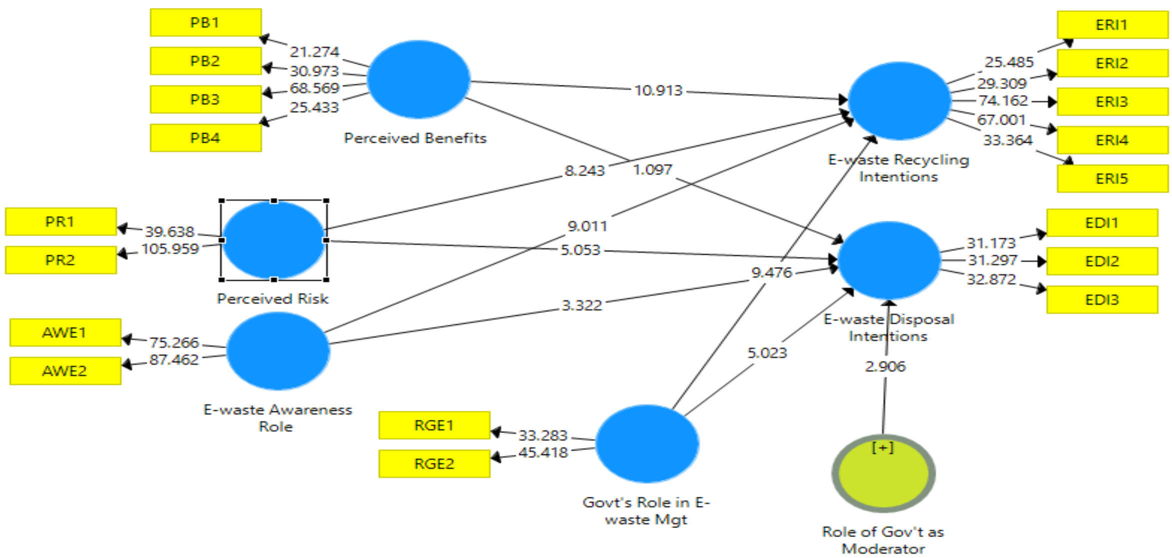

Figure 4: Model fit test (Structural model when Government role moderates in the relationship between perceived benefits and E-waste disposal intentions)

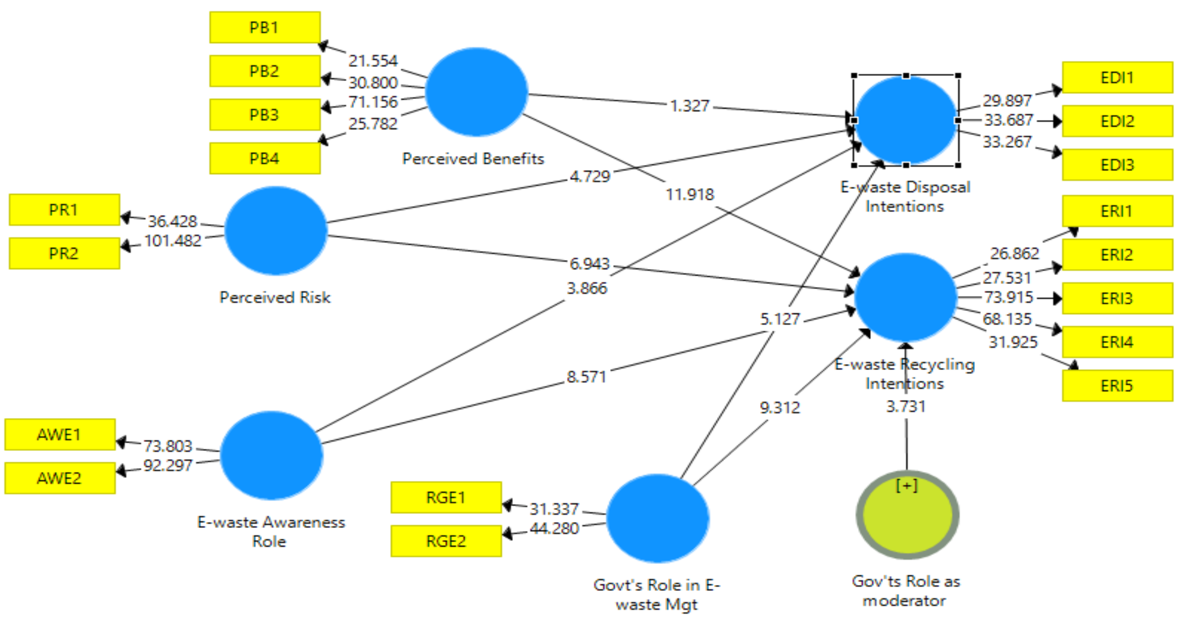

Figure 5: Model fit test (Structural model when Government role moderates in the relationship between perceived benefits and E-waste recycling intentions)

Discussion of results

The relationship between perceived benefits and E-waste disposal intention is insignificant at the 0.05 level, $\beta = 0.063$, p=0.211, and t=1.254. Hence, perceived benefits will yield valuable E-waste recycling outcomes but will not impact E-waste disposal intentions. This indicates that employees may not take old electronic appliances to be disposed of. Similarly, they will not be willing to pay the E-waste disposal fees even when a disposal infrastructure has been set up but rather benefit from it monetary-wise upon disposal. Besides, they will be reluctant to drop off E-waste even if formal/recognized collection systems are accessible. Moreover, employees will also be unwilling to pay for the E-waste disposal fees should the government set up a disposal collection center. This seems to be in line with (Borthakur & Govind, 2018), who argued that consumers repeatedly believe their outdated electronic and electrical products may still possess some value after all. However, the relationship between perceived benefits and E-waste recycling intention is significant at the 0.05 level, $\beta = 0.392$, p=0.000 and t=11.170. It shows that perceived benefits, with a coefficient of 0.392, play the most vital role in employees' E-waste recycling intention. Hence, it's apprehensible that perceived benefits are the most crucial factor influencing employees' behavior in E-waste recycling intention. This is consistent with Nixon & Saphores (2007) and Tonglet *et al.* (2004) who believed that environmental protection awareness effectively encouraged and motivated the residents' behavioral E-waste recycling intentions. Dhir *et al.* (2021a); Wang *et al.* (2019) state that the individual and related environmental benefits of E-waste recycling significantly and positively affect consumer intentions.

The relationship between perceived risks and E-waste disposal intentions is significant at 0.05 level, $\beta = 0.290$, p=0.000 and t=4.847. Also, the relationship between perceived risk and E-waste recycling intentions is significant at 0.05 level, $\beta = 0.250$, p=0.000 and t=8.379. The study found that E-waste recycling may lead to exposure to high risk of information loss, besides the high costs associated with it. Therefore, perceived risk will not only increase E-waste disposal intentions but will also not yield valuable E-waste recycling outcomes. The result is consistent with (Zhang *et al.*, 2020), who found that end-users stood less likely to recycle their outdated smartphones or devices once perceived at a high risk of having personal information stolen from them. Similarly, Wang *et al.* (2016) found that the peoples' or dwellers' intention toward E-waste recycling weakened when the recycling costs increased, to the extent people might also decline to engage in formal E-waste recycling programs should they have to pay more. On the contrary, Kianpour *et al.* (2017), Kumar (2019), Saphores *et al.* (2012) found no significant relationship between financial incentive, perceived risk, and recycling intention. These findings suggest that when employees have a high level of awareness about the risks of pollutants in E-waste, they will try to pay much more consideration to protect their health and the environment. They will also engage in E-waste recycling, and notwithstanding the cost or expenditure they ought to pay.

The relationship between E-waste awareness and E-waste disposal intentions is significant at 0.05 level, $\beta = 0.227$, p=0.000 and t=4.090. Also, the relationship between E-waste awareness and E-waste recycling intentions is significant at 0.05 level, $\beta = 0.259$, p=0.000 and t=9.677. The study concludes that E-waste awareness will increase in E-waste disposal intentions and yield valuable E-waste recycling outcomes. This outcome is consistent with earlier studies (Kochan *et al.*, 2016; Wang, Guo & Wang, 2016). Employees' awareness of their responsibility towards the environment and human health protection and its associated consequences due to E-waste has a strong impact, leading to satisfaction in disposal and recycling practices. Employees knowledgeable about E-waste's consequences due to poor practices are more likely to engage in E-waste recycling and disposal. Thus, E-waste awareness contributes to good intentions towards recycling and disposal. Thus Nguyen *et al.* (2019) indicated that residents agreed to pay fines due to legislation whenever they ignore the waste separation rule. An indicator cost may not be of serious concern for residents to engage in recycling activities.

The relationship between the role of government in E-waste management and E-waste disposal intentions is significant at 0.05 level, β = 0.291, p=0.000, and t=5.283. Furthermore, the relationship between the role of government in E-waste management and E-waste recycling intentions is significant at 0.05 level, β = 0.245, p=0.000 and t=10.100. The role of government in E-waste management will increase in E-waste disposal intentions and yield valuable E-waste recycling outcomes. Thus, consistent with Yu *et al.* (2014) and Nduneseokwu *et al.* (2017), laws and regulations were proved to positively influence the willingness of people's intentions to recycle E-waste. In addition, Wang *et al.* (2016) established that the promulgation, endorsement, and public dissemination of the relevant laws and regulations improved E-waste environmental awareness amongst citizens that prepared them for proper recycling E-waste. Laws and reasonable regulations positively influence the involvement of employees in E-waste recycling programs, thus emphasizing the importance of laws and regulations. Based on the laws, regulations and policies reigned by the government, authorities play an essential part in recycling E-waste. The role of government in E-waste (RGE) positively moderated the relationship between perceived benefits (PB) and E-waste disposal intentions (EDI) (t = 2.906, β = -0.099, P < 0.05). Similarly, the role of government in E-waste (RGE) also positively moderated the relationship between perceived benefits (PB) and E-waste recycling intentions (ERI) (t = 3.731, β = 0.096, P < 0.05). This is so since employees agreed that the government establishes appropriate E-waste legislation to address E-waste challenges and does not sanction people or culprits over irresponsible disposal.

Recommendations and policy implications

The findings demonstrate that Valence Theory constructs perceived risks and benefits to be real drivers of employees' E-waste recycling intentions. Though, it did not find support in the relationship between perceived benefits and E-waste disposal intentions because employees would like to dispose of E-waste with some monetary benefits attached to it. However, with the inclusion of government role in E-waste management as a moderator in the relationship between perceived benefits and E-waste recycling and disposal intentions, the relationship was positively significant. This study extends the Valence Theory to include E-waste awareness and government role when determining intentions to participate in E-waste recycling and disposal, in addition to perceived benefits and perceived risks. The inclusion of government and awareness role in E-waste management in the suggested model will provide valuable insight to promote recycling and disposal behavior. This is a substantial theoretical contribution to practical E-waste management literature in recycling and disposal systems. Besides, the study demonstrated a possibility of assessing E-waste intentions of both recycling and disposal in one study, thus an important theoretical contribution realized by PLS-SEM. Moreover, it sets a firm and practical foundation for E-waste management implementation in circumstances of surging amounts of E-waste. The results will also enhance the understanding of the dimensions and variables underlying the E-waste recycling and disposal intentions of electrical and electronic equipment consumers' and widen the knowledge of how government and its awareness programs can influence behavioral intentions.

As one of the top priorities, government should consider enforcing the existing legislation and regulations to address E-waste challenges. Enforcement of legislation at the organization level could be a better measure to control the E-waste problem by stimulating the rate of E-waste disposal and recycling. To ease the E-waste challenges, all government stakeholders should support the enforcement of the existing laws, such as the E-waste management (NEMA Act, 2020). More so, Local Government and City authorities should pass Bylaws to strengthen the weaknesses of the existing laws. Government should encourage all employees to engage in E-waste disposal and recycling. Government should strategically position practical initiatives such as providing tailor-made E-waste facilities like shelves and containers in public places. They also require E-waste management plans that support the segregation of E-waste that is largely lacking, generation and maintenance of data on E-waste while mindful of the growing population in correspondence increasing demand of EEE.

The government should spearhead and support programs by designating storage areas, evaluation, identification, and licensing of E-waste stakeholders to help with refurbishing, recycling, and treatment of waste to support government effort. Government should adequately support budgetary allocations for public awareness and E-waste collection for subsequent disposal. The sensitization approach to the population about the public health and environmental hazards of irresponsible E-waste management and engaging actively in the E-waste recycling and disposal efforts by entities is the utmost and appropriate way to reduce the impact of the problem. Sensitization championed by civil society organizations is also desirable compared to coercive enforcement. Government should build up an informative E-waste campaign to raise all employees' and citizenry awareness around the benefits of appropriate disposal and recycling. This will improve the disposal and recycling habits in the population. This study will help policymakers engaged in waste management design or plan human health and environmental protection interventions to ensure a net optimistic valence to consumers/households in the Cities due to the surging E-waste accumulation in homes. In a nutshell, perceived benefits are the most crucial factor influencing employees' behavior in E-waste recycling intention. However, the relationship between perceived benefits and E-waste disposal intention was insignificant. Thus, this study calls for further investigation based on other theories.

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