European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2024.05.6

INCOMAR 2023
The 9th International Conference on Marketing and Retailing

HOUSEHOLDS WEEE BEHAVIOUR: A SYMBIOSIS PERSPECTIVE

Emy Ezura A-Jalil (a)*, Musyrifah Mahmod (b), Erni Salleh Awang Salleh (c)
*Corresponding author

(a) Technology and Supply Chain Excellence Institute, School of Technology Management & Logistics, 06010 Sintok, Kedah, Malaysia, ezura@uum.edu.my
(b) School of Computing, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia, musyrifah@uum.edu.my
(c) E-Idaman Sdn.BhD., 05400 Alor Setar, Kedah, Malaysia, erni.nerina@e-idaman.com

Abstract

The world estimation of e-waste projected around 70 million by the year 2030. Electronic waste encompasses various electric and electronic equipment that owners no longer find useful. With estimated 85% of the e-waste are channelled straight to landfill. And the irony is most of the e-waste materials were constituted from rare and valuable metals that highly recyclable. Managing electronic waste from households is quite complex and necessitates a strategic approach by local authorities. Local governments must design the electronic waste flow from the source so that waste is not cross-contaminated with general household waste. The study utilised a mixed-methods strategy to address the fundamental questions and objectives for the sustainable approach. The investigation employed a qualitative and quantitative strategy appropriate for a multidisciplinary study (Waste; Logistics and Behaviour). To identify the overarching values in addressing human behaviour in e-waste recycling at its source, simultaneously investigate both situational and personal factors, whose interaction represents a symbiosis perspective.

Keywords: Recycling, reverse logistics, solid waste management, WEEE

https://doi.org/10.15405/epsbs.2024.05.6
Corresponding Author: Emy Ezura A-Jalil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

Since the early 1990s, e-waste has been a severe environmental concern due to its fast volume development and dangerous component (Rawat et al., 2020). Over the last several decades, the global economy and technology have continued to advance, which has led to the production of enormous amounts of e-waste. The ever-increasing volume of e-waste has significantly hampered waste management in developed and developing nations. The proliferation of e-waste is partially fueled by the exponential rate of technological advancement and the steadily decreasing average product lifetime (Baldé et al., 2017). According to Forti et al. (2020) research, Asia had the most significant e-waste magnitudes in 2019, generating 24.9 Mt of e-waste with a collection and recycling rate of less than 12%.

Additionally, household e-waste management has not yet been effectively implemented in Asia, which is one of the reasons recycling operations are ineffective without well-established frameworks for e-waste management (Forti et al., 2020). The introduction and quick growth of e-waste as a new element to the waste stream needs an all-encompassing management system. The introduction and quick growth of e-waste as a new element to the waste stream needs an all-encompassing management system. E-waste is generated by various devices, from industrial equipment to household appliances (Baldé et al., 2017). Research conducted by Almulhim (2022) stated that a significant increase in the creation of e-waste might be attributed to economic expansion, rapid population growth, and improvements in regional living standards. In addition, the research also found that households' typical disposal behaviour was to store unused electronic equipment in general and obsolete mobile phones in particular, where the e-waste recycling ratio was relatively low. Some components of electronic devices include hazardous chemicals that can threaten the environment and human health compared with typical municipal waste (Ramesh et al., 2023).

The inappropriate disposal of electrical items leads to environmental damage. According to Baldé et al. (2017), just 20% (8.9 Mt) of the e-waste created in 2016 was collected and recycled appropriately. It demonstrates the inefficiencies of e-waste management systems, which is highly important for household e-waste, particularly in Malaysia. Adopting effective e-waste management systems to execute successful e-waste reuse, recycling, and value recovery activities is critical. Collaboration among stakeholders in the logistics chain, including households and public and private stakeholders, is essential in ensuring the overall success of e-waste management. Recycling is one of the most feasible methods to tackle this distressing issue. Recycling and sustainability are always interrelated, as recycling leads to environmental sustainability. According to the statistics provided by the Department of Environment Malaysia (DoE, 2018), only about 25% of the country's waste is disposed of, while the remaining waste is placed in landfills, worth about RM 3 billion. According to Kang et al. (2020), e-waste in Malaysia could be reduced dramatically if more people participated in recycling programs from the source.

2. Problem Statement

Given that improper e-waste management poses a high risk to both the environment and human health, this study seeks to identify factors that influence householders' participation in e-waste recycling to increase householders' recycling rate and promote environmental sustainability. In particular, the

https://doi.org/10.15405/epsbs.2024.05.6
Corresponding Author: Emy Ezura A-Jalil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

research investigates situational and personal factors influencing householders' recycling behaviour on e-waste. Householders and stakeholders are the primary participants in household recycling systems (A Jalil et al., 2016). In addition, the combination between behavioural elements and environmental circumstances might affect household behaviour such as recycling facilities and infrastructure, convenience, municipalities' communication or advertising, and stakeholders' engagement (A Jalil et al., 2016; Almulhim, 2022; Rautela et al., 2021). Not just situational variables but personal factors are also crucial to be studied to support e-waste recycling performance in the household. Therefore, the outcome showcases the symbiosis between stakeholders' engagement and household behaviour in recycling e-waste, represented by situational and personal variables.

2.1. Situational Factors

The situational factor is critical for municipalities/ local authorities to develop a sustainable recycling waste framework. The factor included public recycling initiatives on the current recycling e-waste system and the municipalities' efforts to promote householder recycling behaviour (HRB). A situational factor such as a recycling e-waste system (RES) may include various factors such as collection times, accessibility, and availability (of facilities and services). Furthermore, the situational factor, also not limited to including domestic disposal processes (levels of separation/sorting and time consumption after A Jalil et al., 2016; Williams & Cole, 2013), have been identified as supplying impacts on recycling levels that represent situational factors. These operational/situational factors were found as strong predictors in prior research. Nonetheless, the studies mentioned above neglect the potential interaction between the situational and behavioural aspects of RES (i.e., personal factors). Situational factors are considered the "pre-condition" aspects of the recycling waste system, which is required for HRB to manifest (A Jalil et al., 2016). Therefore, it is crucial for the local authority to engage with individuals and to understand how different individual reacts to certain situational factors.

2.2. Personal Factors

Personal factors are influenced by values, culture, religion, education, and income, including working status or life experiences (A Jalil et al., 2016; Thøgersen, 2006). The assumption is that a cognition by which individuals accept recycling can be conceptualised as a symbiosis effect between individuals and the local authority organising the recycling system. Symbiosis is an interaction between two entities in a close physical association, typically to the advantage of both (Oxford Dictionary, 2023). The symbiosis effect between the recyclers (householders) and providers (municipalities) instigates the recovery of materials that can ultimately re-enter the supply chain (A Jalil et al., 2016). If the individuals respond positively to RES, the local authority may further refine them to achieve the next level of recycling rate.

Alternatively, if one condition (situational or personal factor) diminishes the other conditions, anticipated recycling performance will remain low. Therefore, implementing a strategic RES is vital to map the flow of WEEE back to the supply chain, and the potential of a new business model can be the next frontier (Fu et al., 2020). Although the number of e-waste is escalating, the existing e-waste recycling system was only designed to cater to industrial E-waste. Thus there needs to be a complete

https://doi.org/10.15405/epsbs.2024.05.6
Corresponding Author: Emy Ezura A-Jalil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

system for household e-waste recycling (DoE, 2018, 2019). Since household e-waste is increasing in numbers, there is a need for a system to help the e-waste players properly manage e-waste. DoE has laid out the normal e-waste management process in Malaysia that involves three key components: suppliers, collectors, and recyclers, as depicted in figure 1.

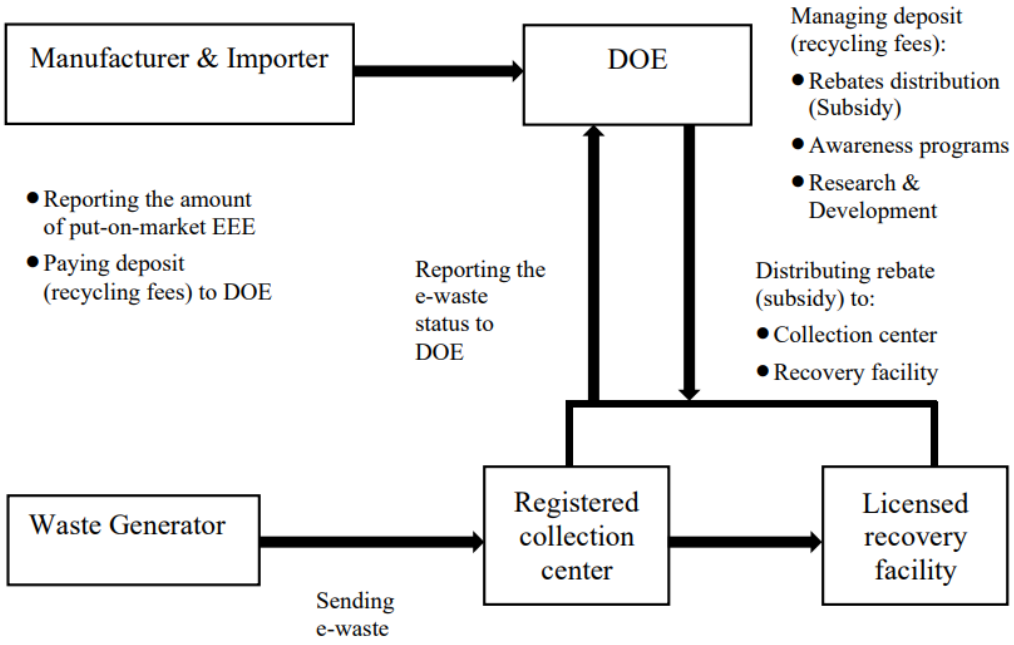

Figure 1. E-waste Management Mechanism Framework in Malaysia (DoE, 2019)

3. Research Questions

i. What are the situational and personal factors in managing household e-waste?
ii. What is the attribute between situational and personal factors in managing household e-waste?
iii. What does a sustainable approach to exercising a recycling e-waste system?

4. Purpose of the Study

The study's primary purpose of investigating situational and personal factors is to seek the overarching values in addressing human behaviour in e-waste recycling from the source. Therefore, the expected output of a holistic framework of the e-waste recapture model (Recycling E-Waste Framework) could be a reference point for stakeholders, including Local Authorities and E-Waste Collection Operators, which currently are ambiguous and inconclusive.

5. Research Methods

This study investigates the situational and personal factors of RES from the households or source and household behaviour of e-waste recycling. This aim was achieved with the following research objectives (RO): 1. To analyse the situational and personal factors in managing household e-waste; 2. To

https://doi.org/10.15405/epsbs.2024.05.6
Corresponding Author: Emy Ezura A-Jalil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

analyse the attribute between situational and personal factors in managing household e-waste; and 3. To develop a sustainable approach to exercising a recycling e-waste system. The stratified method of selecting samples from the population was used; a proportional balance of socio-economic background is vital to generalise the Malaysians' views on the household e-waste recycling system. The stratification method is based on geographical location (a proportionate of urban, suburban, and rural areas will be selected). Using Sekaran and Bougie (2016) technique for sampling size, the estimation for each state in Malaysia is based on the population size (MyCensus, 2020), a 99% confidence level, and a margin error of 2.5%.

5.1. Demographic Analysis

A survey method was employed to obtain respondents' feedback to address the study's aims. One hundred twenty-four respondents participated in the study and the demographic Analysis as in Table 1.

Table 1. Demographic analysis (n=124)

Item	Frequency	Percentage
Gender		
Female	70	56.5
Male	54	43.5
Age Group		
21 - 30 years old	42	33.9
31- 40 years old	57	46.0
41 – 50 years old	17	13.7
51 years old and above	8	6.4
Household numbers		
Single Occupant	23	18.5
Double Occupants	20	16.1
3 – 4 Occupants	61	49.2
More than 5 Occupants	20	16.2
Residential Location		
Urban	55	44.4
Suburban	54	43.5
Rural	15	12.1
Type of Dwelling		
Landed	118	95.2
Others	6	4.8

6. Findings

Personal factors are investigated to establish correlations and predict values. To examine the symbiosis effect between RES and HRB, the analysis begins with correlation, as this technique investigates the existence of a relationship between RES and HRB (Table 2).

https://doi.org/10.15405/epsbs.2024.05.6
Corresponding Author: Emy Ezura A-Jalil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

Table 2. Correlation Analysis (n=124)

SITUATIONAL FACTORS	RECYCLING PERFORMANCE (Pearson/Sig.)
Accessibility And Availability	0.580** (<.001)
Convenience	0.781** (<.001)
Engagement	0.658**(<.001)
Advertising	0.609**(<.001)
Education	0.764**(<.001)
PERSONAL FACTORS	
Attitude	0.715**(<.001)
Norm And Habits	0.503**(<.001)
Knowledge And Experience	0.645**(<.001)
Awareness	0.775**(<.001)

6.1. Correlation Analysis

The correlation analyses shown retrospectively show that personal and situational factors are interdependent towards HRB and RES. Past literature supported personal and situational factors consistent with the given analyses on the given population sample (n=124). Personal and situational factors have shown a positive relationship with significant (p) in the correlation measure. The analysis is a satisfactory outcome of extending the analysis to multi-regression whereby the particular correlation can be addressed as causal relation to determining the symbiotic relationship between personal and situational factors.

6.2. MultiRegression

As mentioned earlier, the correlation analyses demonstrate the existence of bivariate relationships between personal and situational variables with significant tendencies. Field (2013) suggested this analysis address the strength and direction between variables before proceeding to multiple regression. Multi-regression analysis was relevant, considering it addresses the examination of relationships using the information from the independent variables, which will improve the accuracy in predicting values for the dependent variable, as recommended by numerous authors (Field, 2013). Table 3 successfully shows that the model fit with R2 is 0.76 (α<.001), which is a considerably good fit in explaining the predictor power (situational and personal factors influencing RES performance).

Table 3. Model Summary/ANOVA/Coefficient

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.871[a]	0.758	0.739	1.43551

a. Predictors: (Constant), personal, situational
b. Dependent Variable: Recycling Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	736.266	9	81.807	39.699	<.001[b]
	Residual	234.920	114	2.061		
	Total	971.185	123			

a. Dependent Variable: Recycling Performance

https://doi.org/10.15405/epsbs.2024.05.6
Corresponding Author: Emy Ezura A-Jalil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

b. Predictors: (Constant), personal, situational

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.870	1.034		0.842	0.402
	Accessibility & Availability	-0.106	0.069	-0.116	-1.543	0.126
	Convenience	**0.385**	**0.086**	**0.379**	**4.486**	**<.001**
	Engagement	-0.115	0.083	-0.135	-1.389	0.168
	Advertising	**0.247**	**0.065**	**0.332**	**3.788**	**<.001**
	Education	0.159	0.084	0.174	1.892	0.061
	Attitude	**0.186**	**0.085**	**0.217**	**2.191**	**0.030**
	Norm and Habit	-0.074	0.059	-0.099	-1.249	0.214
	Knowledge and Experience	-0.157	0.088	-0.171	-1.772	0.079
	Self-Awareness	**0.312**	**0.087**	**0.370**	**3.577**	**<.001**

The coefficient table (Table 3) shows that situational and personal factors are equally essential to influence the dependent variables, especially with significant demographic aspects of personal factors, as shown in the model fit (Table 3). Therefore, this analysis showcases the critical aspect of situational factors such as the facilitation of services and infrastructure that are convenient and well-advertised by the critical actors in RES, have a significant contribution to HRB changes as supported by Srivastava and Pathak (2020) discussed on integrated roles key actors should play in changing HRB (Barr et al., 2005; Boldoczki et al., 2020). Al-Rahmi et al. (2018) discussed that the situational factors suited for RES would significantly change the household attitude toward recycling from the source (Agovino et al., 2018).

However, some situational factors are not predictive in initiating HRB, for example, accessibility and availability of the infrastructure and facilities. Even though the factors had a significant correlation coincided with engagement and education henceforth, we can assume that the factors are significantly correlated with RES. Still, convenience and advertising contributed significantly to predictive value (Srivastava & Pathak, 2020). In addition, personal factors that lack predictive values are norm and habit, knowledge, and experience. The factors were significantly correlated. However, self-awareness and attitude were considered supreme. To conclude, the study found situational and personal factors as strong predictors of initiating HRB.

Therefore, convenient infrastructure and facilities with substantial advertising encourage e-waste recycling from the household. The government should emphasise standards and legislation, public awareness, practical implementation, and government incentives for developing cost-effective RES, which will play an essential role in the circular economy.

7. Conclusion

The interaction between situational and personal factors may influence household behaviour regarding RES facilities and infrastructure, convenience, and critical actors' communication or advertising without forgoing the household's attitude and self-awareness of the WEEE eco-system. For household e-waste recycling performance to be supported, situational variables and personal factors must be integrated. Consequently, the outcome demonstrates the symbiosis between personal and situational

factors in recycling e-waste, as represented by situational and individual variables. The study shed some practical implications for local authorities and waste operators to conform to convenience infrastructures and facilities to instil HRB from the source. Furthermore, advertising from various agencies to promote positive attitude increase self-awareness of e-waste recycling from the source suggested by the study's empirical findings.

Acknowledgments

This research was supported by the Ministry of Higher Education (MoHE) of Malaysia through Fundamental Study Grant Scheme (FRGS/1/2020/SS0/UUM/02/4)

References

A Jalil, E. E., Grant, D. B., Nicholson, J. D., & Deutz, P. (2016). Reverse logistics in household recycling and waste systems: a symbiosis perspective. *Supply Chain Management: An International Journal, 21*(2), 245-258. https://doi.org/10.1108/scm-02-2015-0056

Agovino, M., D'Uva, M., Garofalo, A., & Marchesano, K. (2018). Waste management performance in Italian provinces: Efficiency and spatial effects of local governments and citizen action. *Ecological Indicators, 89*, 680-695. https://doi.org/10.1016/j.ecolind.2018.02.045

Almulhim, A. I. (2022). Household's awareness and participation in sustainable electronic waste management practices in Saudi Arabia. *Ain Shams Engineering Journal, 13*(4), 101729. https://doi.org/10.1016/j.asej.2022.101729

Al-Rahmi, W., Alias, N., Ali, A., Yahaya, N., Saleh, M., & Al-Maatouk, Q. (2018). Strategies To Manage Electronic Waste Approaches An Overview In East Asia. *International Journal of Engineering & Technology, 7*(4), 3268-3275.

Baldé, C. P., Forti, V., Gray, V., Kuehr, R., & Stegmann, P. (2017). *The Global E-Waste Monitor 2017: Quantities, Flows and Resources*. United Nations University, International Telecommunication Union, and International Solid Waste Association.

Barr, S., Gilg, A., & Ford, N. (2005). Defining the multi-dimensional aspects of household waste management: A study of reported behavior in Devon. *Resources, Conservation and Recycling, 45*(2), 172-192. https://doi.org/10.1016/j.resconrec.2004.12.007

Boldoczki, S., Thorenz, A., & Tuma, A. (2020). The environmental impacts of preparation for reuse: A case study of WEEE reuse in Germany. *Journal of Cleaner Production, 252*, 119736. https://doi.org/10.1016/j.jclepro.2019.119736

DoE. (2018). *Household E-Waste Management In Malaysia: The Existing Practice And Future Direction*. Retrieved December 5 2019, from http://file:///C:/Users/end%20user1/Downloads/1.-THE-EXISTING-PRACTICE-AND-FUTURE-DIRECTION-PN-HAZNI%20(1).pdf

DoE. (2019). *What is E-waste? Why does it matter?* Retrieved December 5 2019, from https://www.doe.gov.my/hhew/what-is-e-waste-why-does-it-matter/

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. Sage.

Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). *The Global E-Waste Monitor 2020.* United Nations University (UNU), *International Telecommunication Union (ITU) & International Solid Waste Association* (ISWA). Bonn/Geneva/Rotterdam, 120.

Fu, J., Zhong, J., Chen, D., & Liu, Q. (2020). Urban environmental governance, government intervention, and optimal strategies: A perspective on electronic waste management in China. *Resources, Conservation and Recycling, 154*, 104547. https://doi.org/10.1016/j.resconrec.2019.104547

Kang, K. D., Kang, H., Ilankoon, I. M. S. K., & Chong, C. Y. (2020). Electronic waste collection systems using Internet of Things (IoT): Household electronic waste management in Malaysia. *Journal of Cleaner Production, 252*, 119801. https://doi.org/10.1016/j.jclepro.2019.119801

MyCensus. (2020). *Portal Rasmi Banci Penduduk dan Perumahan Malaysia* [The Official Portal of the Population and Housing Census of Malaysia]. Retrieved on January 18, 2023, from https://www.mycensus.gov.my/

Oxford Dictionary. (2023). *Oxford Learner`s Dictionaries*. Retrieved on January 18, 2023, from https://www.oxfordlearnersdictionaries.com/

Ramesh, M. V., Paramasivan, M., Akshay, P., & Jarin, T. (2023). A review on electric and electronic waste material management in 21st century. *Materials Today: Proceedings*. https://doi.org/10.1016/j.matpr.2023.01.057

Rautela, R., Arya, S., Vishwakarma, S., Lee, J., Kim, K.-H., & Kumar, S. (2021). E-waste management and its effects on the environment and human health. *Science of the Total Environment, 773*, 145623. https://doi.org/10.1016/j.scitotenv.2021.145623

Rawat, S., Verma, L., & Singh, J. (2020). Environmental Hazards and Management of E-waste. *Environmental Concerns and Sustainable Development*, 381-398. https://doi.org/10.1007/978-981-13-6358-0_16

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill Building Approach*. John Wiley & Sons.

Srivastava, R. R., & Pathak, P. (2020). Policy issues for efficient management of E-waste in developing countries. *Handbook of Electronic Waste Management*, 81-99. https://doi.org/10.1016/b978-0-12-817030-4.00002-4

Thøgersen, J. (2006). Norms for environmentally responsible behaviour: An extended taxonomy. *Journal of Environmental Psychology, 26*(4), 247-261. https://doi.org/10.1016/j.jenvp.2006.09.004

Williams, I. D., & Cole, C. (2013). The impact of alternate weekly collections on waste arisings. *Science of the Total Environment, 445-446*, 29-40. https://doi.org/10.1016/j.scitotenv.2012.12.024