

Determinants of Intention of Electronic Waste Recycling: Application of Theory of Planned Behavior

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Abstract

This study aims to analyze the factors that influence people's behavioral intentions to recycle waste and focus on people's perceptions of informal waste recycling. The low level of participation in the e-waste recycling process makes research on the factors that encourage household interactions in sorting waste or recycling waste a priority. The purpose of this study is to build a comprehensive model and examine the relationship between perceptions of informal recycling, implementation e-waste management, behavioral intention, convenience of recycling and perceived behavioral control. The framework is the Theory of Planned Behavior (TPB). The implementation variable e-waste management is used to mediate the relationship between the two constructs. Respondents in this study were cellular phone users who had changed their phones. The number of respondents in this study totaled 165, using the purposive sampling technique. Data analysis techniques in this study used PLS-SEM with WarpPLS version 6.0. The findings show that: (1) perception of informal recycling, e-waste management, and behavioral intention have a significant positive effect; (2) management of e-waste, perception behavioral control and behavioral intention have a positive effect; and (3) the implementation of e-waste management, which causes the convenience of recycling, will increase the intensity of behavior, indicating the results are rejected.

Keywords: E-Waste Management, Recycling Behavior, Informal Recycling, Perceived Behavioral Control, Theory of Planned Behavior

JEL Classification Code: M3, M20, M30, M39, M40

1. Introduction

Studies on recycling electronic waste have been carried out. Many factors influence the behavior of electronic waste recycling, for example, the attitude of recycling, previous recycling experience, and community awareness of electronic waste, as well as other factors (Bouvier & Wagner,

2011; Orlins & Guan, 2016; Thomas, 2001; Tonglet et al., 2004). Boldero (1995) shows that attitudes and intentions to recycle in every activity support recycling behavior. The inconvenience factors of recycling as well as programs provided by the government ultimately lead to positive changes in recycling behavior. However, Wang et al. (2016) and Ylä-Mella et al. (2015) provide different results, which show that not all perception of informal recycling increases behavioral intention. They show that consumer awareness of the importance and existence of a waste recovery system is high, however, awareness has not been translated into intention to recycle behavior.

To study the factors that influence behavior and intention to recycle electronic waste, many scientists use the Theory of Planned Behavior (TPB) as a framework (Armitage & Conner, 2001; Tonglet et al., 2004; Wu et al., 2020; Zhang et al., 2016). By adopting TPB, a conceptual model was developed to explain the process of people's perceptions of informal recycling of electronic waste, expressed by Orlins and Guan (2016), where there is still a lack of public awareness to do electronic waste recycling. Wang et al. (2016) show the important role of convenience of recycling

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and perceived behavioral control. This model is then tested in the context of people who have electronic waste, especially mobile phones.

2. Literature Review and Hypothesis Development

To connect perception of informal recycling to behavioral intention, it is necessary to be associated with the implementation of e-waste management. In TPB there are three conceptual determinants, first is attitudes toward behavior, which refer to favorable or unfavorable judgments about one's behavior. Second, subjective norms, which refer to the social pressure felt by someone to adopt or not the behavior. Third, intensity is the control of one's perceived behavior based on past experience and the obstacles that will be anticipated (Boldero, 1995; Warshaw & Davis, 1985). By using the theoretical basis of TPB, through the expansion of the model, we conduct research especially on factors that influence the implementation of e-waste management by combining e-waste factors and the convenience of recycling in society.

2.1. The Effect of Perception of Informal Recycling

The increase in the amount of electronic waste causes environmental problems. One effective way to solve environmental problems is by engaging in electronic waste recycling. Informal recycling is the main source of strength in the mobile phone e-waste process. Therefore the existence of informal recycling is a special concern for the community, especially the government. Wilson et al. (2006) write that the level of recycling achieved by the informal sector in four developing countries (the Philippines, India, Pakistan, and China) is quite high. The informal sector is characterized by small-scale manufacturing, mostly irregular and unregistered, with weak technology services. In the research by Wilson et al. (2009) entrepreneurs or the corporate sector from the informal sector do not pay taxes, do not have trade licenses, and are not included in social welfare schemes. The government needs to change and educate about understanding of informal recycling so that the actors of informal recycling can reach the entire community.

The cellular phone user community is the main force behind the community e-waste telephone recycling. Cognition of the population toward the informal sector influences its intentions and choices in the process of recycling electronic waste. Based on this explanation, this study proposed the following hypothesis 1:

H1: The influence of perception of informal recycling will improve the implementation of mobile phone e-waste management.

2.2. Implementation of Informal E-Waste Management

To correlate perceptions about informal recycling of the intensity of cellular phone recycling behavior, it is necessary to implement e-waste management. It is important to understand the existing system in Indonesia, especially in the management of e-waste management. Each country implements e-waste management with a variety of different policies. Kahhat et al. (2008) argue that government plays an important role in understanding existing systems and learning from previous experiences. For example, in a country that relies on the EPR principle that imposes financial/physical responsibility on producers, the final management is not carried out by producers, but rather is the responsibility of the recycling company. Different from other e-waste management implementations, where producers take financial responsibility of electronic products, the costs of collection and recycling will still be assimilated by consumers.

There is a lack of information about e-waste cellular phones in Indonesia, giving rise to public unconsciousness in managing electronic waste, especially cellular phone e-waste. The implementation of management in this research is divided into three parts, namely, promoting the management system, increasing cooperation with government agencies, and encouraging companies to conduct e-waste management. The implementation of good e-waste management will be able to increase the intensity of changes in the behavior of mobile phone e-waste management. Based on this explanation, this study proposed hypothesis 2:

H2: The effect of implementation of e-waste management will increase the intensity of behavior.

2.3. Behavioral Intensity and Convenience of Recycling

Boldero (1995) revealed that intensity is assumed to capture motivational factors that influence behavior and to show how hard people want to try or how much they want to show behavior. Warshaw and Davis (1985) define behavioral intention as the extent to which a person consciously does or does not engage in some of the future behaviors he determines. Several studies have shown that absolute behavioral intention grows from their satisfaction, in terms of the behavior of recycling electronic waste (Goeltom et al., 2020; Tran & Le, 2020).

The convenience of recycling electronic waste can be felt by the community and people's perception of informal processes. Particularly in Indonesia, the lack of e-waste disposal information including the cost and convenience of recycling electronic waste comes from people's perceptions,

not real costs or real convenience, for example, in measuring recycling costs and transportation costs for sending e-waste from residents' homes to landfills. In addition, some scientists have proven that the cost of recycling and the convenience of recycling are factors that have a significant influence on the behavior of recycling community waste (Song et al., 2012; Tonglet et al., 2004; Yin et al., 2014).

Analysis of the findings of Tonglet et al. (2004) shows that perceived control and situational factors are highly correlated with recycling attitudes. This shows, first, that having the right skills, resources and opportunities to recycle contributes to a positive recycling attitude; and second, that the recyclers in this study do not feel that recycling causes discomfort, requires too much space or time, is too complicated or the recycling program is a waste of money, and as such, they view behavior positively. Thus, the recycling scheme must be designed with priority to comfort, based on current household needs for space and time. This has been emphasized by McDonald and Oates, (2003), who emphasize the need for detailed research on public acceptance of the construction and visual impact of waste containers.

Research on public acceptance of e-waste will produce clear instructions about how the scheme operates, how to communicate the benefits of recycling, and emphasize that recycling does not have to be troublesome, or take up too much time or space at home (Thomas, 2001). Eventually it gives rise to specific attitudes that are most correlated with recycling behavior, that is, responsible, useful, reasonable and good recycling, and besides that the community shows concern to maintain a good place to live. Thus, Emery et al. (2003) revealed that campaigns aimed at strengthening positive attitudes of recyclers and changing negative attitudes of non-recyclers should focus on aspects of recycling behavior. Based on this explanation this study proposed the following hypotheses:

H3: Implementation of e-waste management will lead to the convenience of recycling.

H4: The convenience of recycling will increase the intensity of behavior.

2.4. Perception Behavioral Control

PBC is a derivative of TPB theory, which is developed from a theory of reasoned action (TRA) that includes measures of control beliefs and perceived behavioral control (PBC). The main factor in TPB is the individual's intention to perform certain behaviors (Ajzen, 1991; Boldero, 1995; Luc, 2020), where planning it takes intensity. Intensity is assumed to capture motivational factors that influence behavior, for example, how hard someone wants to try, how much effort will be done, or to show behavior.

When someone has displayed the intensity of behavior, it will lead to perception and control of perception. So, that behavioral control perception (PBC) influences intention and behavior. According to Armitage and Conner (2001), basic thought of PBC is the possibility of prediction of one's behavior so that the person is not controlled by full personal will, but rather consider perceptions and beliefs in a person that comes from past experience and future needs. PBC provides information about every action taken by someone, PBC also explains why intensity does not always predict behavior. Thus, intensity is expected to influence the performance of the extent to which a person has behavioral control, and performance will increase along with the increase in control of one's behavior to the extent that the person is motivated to try.

PBC includes two components: firstly, utilizing conditions, where the resources available and needed involve a behavior, such as time, money, and effort, and success through self-efficacy or the confidence of an individual in his ability to conduct behavior (or demotivate) the intensity of influence which is based on the individual's judgment, and secondly, beliefs, especially those relating to attitudes, are unstable and can vary across settings (Taylor & Todd, 2015).

PBC in the research by Armitage and Conner (2001) was held to understand intention and behavior. There are two antecedents of behavioral intensity, namely, subjective norms and attitudes toward behavior. Subjective norms refer to individual perceptions of general social pressure to do or not exhibit behavior. If an individual feels that someone who is significant supports (or does not support) the behavior, they are more (or less) intent on doing so. Attitudes toward behavior reflect positive or negative evaluations of individuals in conducting certain behaviors. In general, the better the attitude toward behavior, the stronger the intensity of the individual to exhibit it. In this study PBC is based on Taylor and Todd (2015) research where PBC consists of self efficacy, compatibility and resource facilities. Based on this explanation, this study proposed for the following hypothesis:

H5: Implementation of recycling will increase PBC.

H6: The effect of PBC will increase the intensity of behavior.

3. Research Method

This study uses survey methods and the population consists of mobile phone users in Semarang. Data is collected via purposive sampling technique. The questionnaire is distributed to 200 respondents, of which 165 were returned.. Data analysis techniques in this study used PLS-SEM with WarpPLS version 6.0.

4. Results

4.1. Reliability and Validity

With validity test using loading factor and average variance (AVE), the value of AVE 0.5 meets the criteria of convergent validity. While the reliability test uses composite reliability produces the composite reliability value of each variable above 0.6. Table 1 shows that all sample instruments were declared valid and reliable because their values were above the requirements.

To test the acceptance of the proposed model and hypotheses, as developed in the previous section, the results of the full analysis are presented in Figure 1.

Table 1: Loading Factor Value, Composite Reliability and Average Variance Extract

Variable	Indicator	Loading Factor	Composite Reliability	AVE
Perception of Informal Recycling (PIR)	PIR1	0.684	0.76	0.518
	PIR2	0.631		
	PIR3	0.829		
Convenience of Recycling (CRV)	CRV1	0.813	0.777	0.539
	CRV2	0.688		
	CRV3	0.677		
Implementation E-Waste Management (IMW)	IMW1	0.81	0.806	0.583
	IMW2	0.649		
	IMW3	0.82		
Perceived Behavioral Control (PBC)	PBC1	0.773	0.738	0.585
	PBC2	0.754		
Behavioral Intention (BIN)	BIN1	0.667	0.748	0.5
	BIN2	0.658		
	BIN3	0.751		

Based on the full structural model analysis, a summary of the hypothesis testing results is presented in Table 2.

The research model has a good fit, with the *P* value for APC, ARS and AAR < 0.05 with an APC value = 0.212, ARS value = 0.093 and AARS value = 0.084. Likewise with the resulting AVIF and AFVIF values < 3.3, which means that there is no multicollinearity problem between indicators and between exogenous variables. The resulting GoF is 0.225 > 0.1 means that the fit model can be accepted. SPR, RSCR, SSR and NLBCDR produce values equal to 1, which means there is no causality problem in the model.

Based on the Full Structural Model Analysis above, the value of *R*-squared (*R*²) is obtained to influence the implementation of waste management (IMW) of 0.11, which means that the effect of Perception of Informal Recycling (PIR) on the implementation of waste management is 11% and the remaining 89% is influenced by other variables outside this research model. Perceived Behavioral Control (PBC) is 0.11, which means that variations in this study affect Perceived Behavioral Control (PBC) by 11% and the remaining 89% are influenced by other variables outside this research model. Convenience of Recycling (CRV) produces *R*² value of 0.03, which means that the variation in this study affects Convenience of Recycling (CRV) for only 3% and 97% is influenced by other variables outside this research model. Behavioral Intention (BIN) produces an *R*² value of 0.12, which means that variations in CRV and PBC affect Behavioral Intention (BIN) by 12% and 88% are influenced by other variables outside this research model. All *R*-squared (*R*²) values generated in this research model are categorized as low because they produce values below 0.25. Furthermore, the Squared *Q* values generated in this research model all produce values (>0), which means that the model has predictive relevance.

5. Discussion

The development of cellular telephones, which at first only served as a means of communication, developed into an

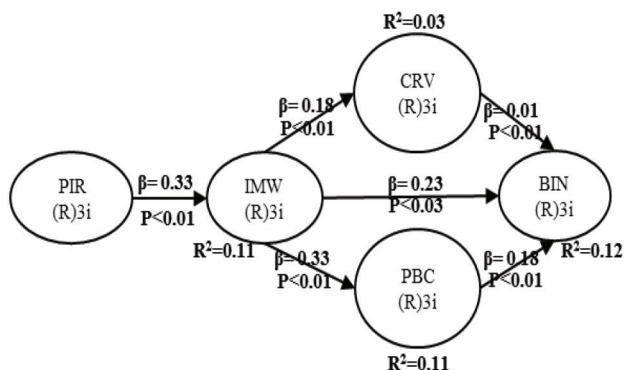


Figure 1: Full Structural Model Analysis

Table 2: Estimated Relationship Results Between Constructions

Description Path	Path Coefficient	<i>P</i> -Value	<i>R</i> ²	<i>Q</i> ²
PIR → IMW	0.334	<0.001	0.11	0.119
IMW → PCB	0.33	<0.001	0.11	0.110
IMW → CRV	-0.184	0.036	0.03	0.038
IMW → BIN	0.234	0.028	0.12	0.125
CRV → BIN	-0.007	0.477		
PCB → BIN	0.182	0.054		

Table 3: Goodness of Fit Model Structural

Criteria	Parameter	Rule of Thumb
Average Propensity Coefficient (APC)	0.212/ $P < 0.001$	Acceptable $P < 0.05$
Average R Squared (ARS)	0.093/ $P < 0.009$	Acceptable $P < 0.05$
Average Adjusted R-Squared (AARS)	0.084/ $P < 0.027$	Acceptable $P < 0.05$
Average Block Variance Inflation Factor (AVIF)	1.104	Acceptable if ≤ 5 , ideally ≤ 3.3
Average Full Collinearity VIF (AFVIF)	1.167	Acceptable if ≤ 5 , ideally ≤ 3.3
Tenenhaus Gof (Gof)	0.225	SMALL ≥ 0.1 , MEDIUM ≥ 0.25 , LARGE ≥ 0.36
Simpson's Paradox Ratio (SPR)	1.00	Acceptable if ≤ 0.7 , ideally ≤ 1
R-Squared Contribution Ratio (RSCR)	1	Acceptable if ≤ 0.9 , ideally ≤ 1
Statistical Suppression Ratio (SSR)	1	Acceptable if ≥ 0.7
Nonlinear Bivariate Causality Direction Ratio (NlbcdR)	1	Acceptable if ≥ 0.7

electronic media that eventually innovated beyond its nature as a communication tool aiming to meet the satisfaction of its users, such as the Internet, games, and even as a means of recording the needs of its users. However, every innovation that occurs in cellular phones causes users with older models to feel out of date. So, in the end it causes a buildup of cellular phone garbage. The results of this study indicate that the effect of perception of informal recycling (PIR) has a positive and significant effect on the implementation of cellular phone e-waste management. The effect of perception of informal recycling (PIR) supports the research by Wilson et al. (2009), phone users who are not involved with large companies, are not organized, are not included in the social welfare scheme, the government needs to change and address it by implementing the implementation of cellular phone e-waste management.

The implementation of e-waste management informs about how to manage secondhand cellular phones, informs about the law on electronic waste that requires citizens to be responsible for the electronic waste owned by each person, and informs how to manage secondhand phones having a significant positive effect on Behavioral Intention (Davies et al., 2002) that influences behavior to try and show their desire by being willing to cooperate with recycling manufacturers voluntarily and professionally, buying products that are environmentally-friendly and willing to provide information to the surrounding community about HP's recycling experience.

In general, the convenience of recycling that is felt can significantly increase behavioral intention. However, in this study, the convenience of recycling carried out has not been able to significantly increase behavioral intention in recycling HP. This is caused by several factors such as not having transportation, not having much time to send used

cellular phones to the last collection point, not having the will to dispose of used cellular phones, even the phone owners do not know where to recycle. Although the implementation of e-waste management has a significant positive effect on PBC where cellular phone users cannot recycle phones, the easy access to disposing of phones and the activities of disposing and recycling phones is purely the desire of phone users. The results of this study show that PBC has a significant positive effect on behavioral intentions.

6. Conclusion

Limitations of this study include: (1) not all indicators of goodness of fit show good value, (2) the object of this study is limited to HP users where e-waste is not just one type of electronic item, namely, HP. Further research must include moderating or control variables, such as culture, attitudes, and types of electronic waste. It is then recommended for further research to use a more complex model so that the perspective is not only limited to the use of TPB.

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