DETERMINING FACTORS INFLUENCING THE E-WASTE SEPARATION INTENTION AMONG MOBILE PHONE REPAIRERS IN BANGLADESH

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BI	Behavioural Intention
BTRC	Bangladesh Telecommunication Regulatory Commission
CMV	Common Method Variance
DoE	Department Of Environment
EOL EEE	End-Of-Life Electrical And Electronic Equipment
EM	Expectation-Maximization
GPS	Global Positioning System
HTMT	Heterotrait-Monotrait Ratio of Correlations
IT	Institutional Theory
LCA	Life Cycle Assessment
LED	Light-Emitting Diode
LiBs	Lithium-Ion Batteries
MFA	Material Flow Analysis
MoEF	Ministry Of Environment & Forestry
TAM	Technology Acceptance Model
MSWM	Municipal Solid Waste Management
MTES	Motivation Toward The Environment Scale
NGO	Non-governmental organization
NEP	New Environmental Paradigm
OCV	Openness To Change Values
PEB	Pro-Environmental Behaviour
PGMs	Platinum Group Metals

PLS	Partial Least Squares
SDT	Self- Determination Theory
SEM	Structural Equation Modeling
SPSS	Statistical Package For Social Sciences
VBN	Value-Belief-Norm
CR	Composite reliability
NGOs	Non-governmental Organisation
WEEE	Waste Electrical and Electronic Equipment

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FAKTOR YANG MEMPENGARUHI NIAT PEMISAHAN E-SISA: KAJIAN DI KALANGAN PEMBAIKI TELEFON BIMBIT DI BANGLADESH

ABSTRAK

Terdapat pertumbuhan yang besar dalam penggunaan telefon bimbit di seluruh dunia yang membawa kepada penjanaan jumlah e-sisa yang besar setiap tahun. Di Bangladesh, telefon bimbit sentiasa dibaiki dengan menggantikan bateri, skrin, dan aksesori lama, yang akhirnya menyebabkan penjanaan e-sisa besar-besaranPengetahuan yang tidak mencukupi mengenai pemisahan e-sisa menyebabkan individu membuang e-sisa dengan sisa lain, yang tidak boleh digunakan dalam proses kitar semula. Untuk mengkaji niat pemisahan e-sisa, adalah penting untuk mendedahkan faktor-faktor yang mempengaruhi. Oleh itu, kajian semasa mengintegrasikan model norma kepercayaan nilai (VBN), teori penentuan nasib sendiri (SDT), dan teori institusi (IT) untuk meramalkan niat pemisahan e-sisa pembaiki telefon bimbit. Reka bentuk penyelidikan kaji selidik telah digunakan manakala data merangkumi 200 responden (pembaiki) yang sah, yang dikumpulkan melalui soal selidik tinjauan (dicetak), dengan menggunakan pensampelan purposif. PLS-SEM telah digunakan pada data yang dikumpul untuk ujian hipotesis. Model bersepadu itu menjelaskan 73.5% daripada varians niat pemisahan e-sisa. Hasil ini menunjukkan kepentingan mengintegrasikan model untuk meningkatkan kuasa penjelasannya dalam meramalkan niat tingkah laku. Penemuan kajian ini menunjukkan bahawa, nilai-nilai altruistik, keterbukaan untuk mengubah nilai-nilai, kepercayaan alam sekitar, norma peribadi, demotivasi, peraturan luaran, peraturan yang introjected, peraturan yang dikenal pasti, peraturan bersepadu, motivasi intrinsik, tekanan mimetik dan normatif adalah peramal utama niat pemisahan e-sisa. Manakala

hipotesis untuk nilai pemuliharaan, nilai egoistik, dan tekanan paksaan ditolak dan semuanya mempunyai kesan yang tidak penting terhadap niat pemisahan e-sisa. Kajian ini memperkayakan kesusasteraan pemisahan e-sisa membantu memahami perspektif pembaiki telefon bimbit dan memberikan pandangan yang akan membantu pihak berkuasa kerajaan dan pengurusan sisa memahami niat pemisahan e-sisa pembaiki dan merumuskan strategi sedemikian yang akan meningkatkan penglibatan pembaiki dalam aktiviti pemisahan e-sisa.

DETERMINING FACTORS INFLUENCING THE E-WASTE SEPARATION INTENTION AMONG MOBILE PHONE REPAIRERS IN BANGLADESH

ABSTRACT

There is an enormous growth in mobile phone consumption worldwide which leads to generation of a large volume of e-waste every year. In Bangladesh, mobile phones are constantly repaired by replacing old batteries, screens, and accessories, which ultimately causes massive e-waste generation. Insufficient knowledge of e-waste separation causes individuals to dispose of e-waste with other waste, which cannot be used in the recycling process. To study the intention of e-waste separation, it is essential to disclose the influencing factors. Therefore, current study integrates the value belief norm (VBN) model, self-determination theory (SDT) and institutional theory (IT) to predict mobile phone repairers' e-waste separation intention. Survey research design was employed whereas data includes valid 200 respondents (repairers), collected through survey questionnaire (printed), by employing purposive sampling. PLS-SEM was applied on the collected data for hypotheses testing. The integrated model explained 73.5% of the variance of e-waste separation intention. This result indicates the importance of integrating models to enhance its explanatory power in predicting behavioural intention. The finding of this study indicates that, altruistic values, openness to change values, environmental beliefs, personal norms, amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, intrinsic motivation, mimetic pressure and normative are major predictors of e-waste separation intention. Whereas hypothesis for the conservation values, egoistic values and coercive pressure were rejected and they all have insignificant impact on e-waste separation intention. This study enriches the literature of e-waste separation helping

to understand the mobile phone repairer's perspective and provides the insights that will help government and waste management authorities to understand repairers' e-waste separation intention and formulate such strategies that will increase the involvement of repairers in e-waste separation activities.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter highlights on e-waste separation, its fundamental importance and how the e-waste will benefit mobile phone repairers. The proceeding section explains the current state of e-waste scenario in both global and local context. The next section highlights the problems that are addressed in this study. Next, the study objectives are provided, as well as the study's significance. This section also sets out appropriate definitions of important concepts used in the research.

1.2 Background of the study

The earth has seen an unprecedented increase in e-waste production over the past decade, particularly South Asia faces a significant threat of e-waste intensification due to domestically produced and illegal import of e-waste (Priyashantha et al., 2022). The amount of electronic waste made around the world is expected to grow by 16–28% each year, lead to the fastest waste streams in terms of quantity and impact on the earth (Shaikh et al., 2020; Fu et al., 2018; Oleszek et al., 2018). Which is increasing higher than municipal waste (Boubellouta et al., 2020). E-waste refers to waste electrical and electronic equipment (WEEE). According to Step Initiative (2014), "E-waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and it is part that has been discarded by the owner as waste without the intention of re-use." The fastest growth of new and more sophisticated multifunctional items in the electronics sector has stimulated a steady turnover of consumer spending and the disposal of old equipment, greatly increasing the global waste stream of outdated electronic equipment (Nduneseokwu et al., 2017). Among the developing countries, the e-waste problem is particularly severe and consequential because there is a deficiency of both the actionable policies, environmental management procedures, and sustainable model to regulate this huge waste stream (Miner et al., 2020). Consequently, most developing nations use landfilling, a disposal option, which is harmful to the overall nation (Samadder et al., 2017). Electronic waste is known to contain a lot of non-decomposable toxic metals and harmful compounds, which contaminate the environment and cause various health problems **(**Purushothaman et al., 2021). Therefore, obsolete electronics devices should not be thrown with other rubbish since they contain harmful and poisonous elements.

On the positive side, electronic waste often contains precious and rare particles, for example gold, silver and other valuable materials like organics and polymers, glass, copper, ceramics etc (Huang et al., 2022). The global e-waste monitor report (2017) stated that, the raw material value of e-waste was estimated in 2016 was $60 billion, however a fraction of this value is retrieved as part of waste management procedures (Baldé et al., 2017). An effective strategy for dealing with electronic waste should confirm proper source separation, quick collection, transportation facilities, warehouse, chemical treatment, recovery of metals, and ultimate residual disposal (Tiwari et al., 2019). Matter et al. (2013) defined waste separation as the process of separating recyclable trash from non-recyclable waste in order to increase recycling rates and decrease waste volume.

For the purpose of waste recycling, source separation at the point is mandatory (Heidari et al., 2018). Although e-waste recycling rate can be increased through the proper source separation practices. Operationally, waste separation and waste recycling are two distinct processes. Waste separation is the practise of grouping waste that is similar in nature, on the other hand, waste recycling is the treatment of processing waste that is no longer useful in its actual form and utilising it to create new forms (Agovino et al., 2018). The improving waste separation at the source saves money for the government by lowering the total quantity of waste that has to be managed and increasing the percentage of waste that is recycled (Yang et al., 2018; Ayob et al., 2017).

Besides households, mobile phone repair shops also generate e-waste (Ansari et al., 2010), which contains valuable metals like (gold, silver, and copper) have high economic value (Attia et al., 2021). On the other hand, the lithium-ion batteries (LiBs) from mobile phones (Jain et al., 2019), which have hazardous effect on both human health and climate (Horeh et al., 2016). Due to its poisonous effect, it is advised to separate e-waste while discarding at the source to avoid its harmful impact directly in landfills (Spalvins et al., 2008). However, e-waste is typically disposed of with municipal waste in developing countries which has very low chance of separation (Kumar et al., 2017). Therefore, the influential factors behind e-waste separation intention needed to be identified with an appropriate research model.

1.2.1 Overview of Global e-waste

The Global E-waste Monitor (2020) report estimates that 53.6 million metric tonnes (Mt) of e-waste were produced globally in 2019 with the growing rate 5-10% annually (Forti et al., 2020) (See figure 1.1). It is also projected that, a total of 74.7 million metric tonnes of e-waste would have been produced worldwide by 2030 (Global E-waste Monitor Report, 2020). The evidence showed that in 2019, 9.3 MMT of produced e-waste was recycled through the formal sector, which accounts for 17.4% of total e-waste (Shaikh et al., 2020; Sahajwalla & Gaikwad, 2018). However, around 82.6% of electronic waste is either landfilled or discarded by the unauthorized sectors

(Preetam et al., 2022). In general, a little fraction (1–3%) of the MSW (1636 Mt) is filled up with electronic waste in developing countries (Mallawarachchi and Karunasena, 2012). In contrast, developed countries accounts 5%, which is higher than developing countries (Rasheed et al., 2022).

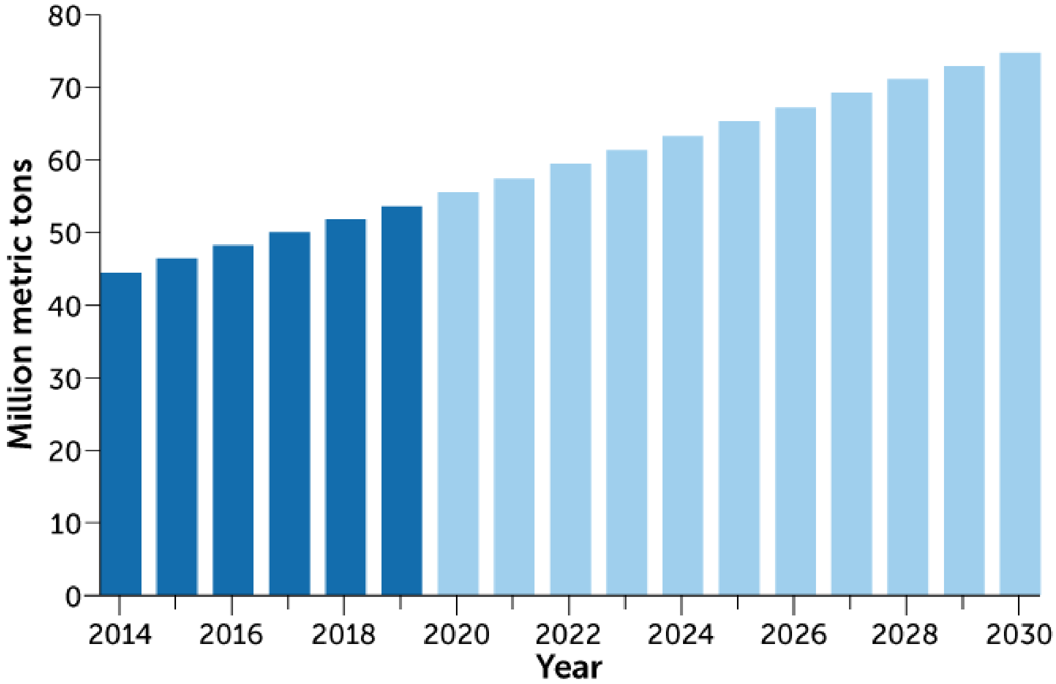

Figure 1.1 Global e-waste statistics
Source: (The Global E-waste Monitor Report 2020)

Over half of the world's population currently resides in metropolitan areas, and that number has doubled in only the past 50 years (Tansel, 2017). Prospects of an urban life often involve the use of electrical and electronic equipment (EEEs) to accomplish a variety of routine activities. The electronic sector has become one of the most significant industries in the world in recent years. From its constant development in the recent decades, resulting in a substantial number of job prospects, the promotion of technical advancements, and the eventual fuelling of a rising amount of electronic garbage (E-waste) through discarded the unwanted or obsolete devices (Singh et al., 2016). Furthermore, transboundary circulations of e-waste is a worrisome method of disposal, with approximately 80% of e-waste created in affluent nations shipped to underdeveloped countries (Illes & Geeraerts, 2016). For instance, large importers of e-waste for recycling include Bangladesh, Pakistan, Ghana, Nigeria, and Kenya. (Masud et al., 2019).

Balde et al. (2015) divided electronic waste into six distinct categories. For instance, Temperature exchange equipment: refrigerators, freezers, air conditioner Screens & monitors: televisions, monitors, laptops, notebooks, tablets; Lamps: fluorescent lamps, LED lamps, high-intensity discharge lamps; Large equipment: washing machines, clothes dryers, electric stoves, large printing machines, copying machines, photovoltaic panels; Small equipment: vacuum cleaners, toasters, microwaves, ventilation equipment, scales, calculators, radio, electric shaver, kettles, camera, toys, electronic tools, medical devices, small monitor and control equipment and Small IT and telecommunication equipment: Mobile phones, GPS, pocket calculators, routers, personal computers, printers, telephones. The current study mainly focuses on mobile phone waste due to its fastest-growing trend.

E-waste differs chemically from other types of solid waste, which include both toxic and valuable metals (Bhat et al., 2012). E-waste contains harmful substances including mercury, lead, chromium, and poly-brominated biphenyls and cadmium (Anselm et al., 2021). Waste that has not been explicitly identified but shows one of the following four criteria are considered hazardous waste. Such as 40 CFR Part 261 Subpart C - ignitability (D001), corrosivity (D002), reactivity (D003), and toxicity (D004 - D043) (Maulida et al., 2022). Mobile phone batteries fall under the Reactivity category. Reactive particles are become unstable under neutral situations. They can cause explosions, release toxic gases if heated, compressed, or combined with water (Islam et al., 2021). Furthermore, Hira et al. (2018) analysed the presence of nine metals across various mobile phone components and concluded that lithium batteries contain hazardous chemicals that poses a serious health risk to the users. Electronics waste may be more dangerous since it stays in the environment for longer and release toxic substances (Islam et al., 2020). There is a significant risk of contaminating soil with toxic substances from e-waste if it is not separated from other types of waste (Needhidasan et al., 2014). The soil-crop-food pathway is considered one of the leading access points for hazardous chemicals that are released from electronic waste into the human body. Evidently, hazardous e-waste is a major problem with severe repercussions if it is not properly controlled and recycled (Ochir & Buyankhishig, 2014).

On the other hand, e-waste provides a rich supply of valuable metals such as aluminium, silver, iron, copper, gold, and other metals (Madrigal-Arias et al., 2015). Furthermore, Namias (2013) found in electronic waste as many as sixty precious metals including copper, gold, silver, palladium, and platinum. The most valuable component of e-waste is the printed circuit board, which accounts for more than 40% of its metal value (Golev et al., 2016). As mentioned by Cucchiella et al. (2015), the existence of a higher concentration of valuable metals makes IT devices the most precious types of the e-waste. For example, printed circuit boards, which make up almost 3-6% of all e-waste contains a sizable number of valuable metals including gold, platinum, silver, and palladium. The great majority of the planet's gold and PGMs, as well as 70 percent of the silver are trapped in the tiny circuitry of computers, monitors, and other IT gadgets (Golev et al. 2016). Scholars have brought attention to the financial benefits of recycling e-waste since the recovery of e-waste may be profitable due to the fact that it includes valuable metals that can be recovered and reused if the appropriate processes are utilised **(**Dias et al., 2018). Additionally, recycling e-waste might reduce the requirement for virgin materials to be made from the scratch (Baxter et al., 2016**)**. Separating waste at the source point is essential for efficient e-waste recycling program. Therefore, proper e-waste separation practice at the initial point is needed to retrieve those precious metals and contribute to the circular economy.

1.2.2 E-Waste statistics, management and government policy in Bangladesh

Bangladesh, a developing nation in South Asia, moved up from the rank of least developed nation to low-middle-income nation in 2018 (Kabir & Khan, 2020). Due to the economic expansion and technological advancement, the amount of e-waste in Bangladesh growing faster (Masud et al., 2019). The demand for electronic products has also expanded due to factors such as rising urbanisation, open trading, cheaper e-products, and purchase ability, which has led to an increase in the production of e-waste (Abalansa et al., 2021).

In Bangladesh about 600 million kilogrammes of electronic waste has accumulated, where mobile phones alone are responsible for generating 10.5 kilo tons (Roy et al., 2022a). At the current pace of 20% annual growth, e-waste production in Bangladesh is expected to reach approximately 4.19 MMT by 2035 and 10 billion kg by 2050 (Tleuken et al., 2022). Devices like cell phones and television sets account for a disproportionate share of electronic waste (Masud et al., 2019). Surprisingly, past two decades only mobile phones itself have generated 10,504 tonnes of hazardous waste (Priyashantha et al., 2022).

Bangladesh has higher mobile penetration than other low- and low-middle-income nations, making it a distinct market when compared to the average worldwide mobile penetration for various income levels (Mannan et al., 2017). According to the BTRC (Bangladesh Telecommunication Regulatory Commission) data, there are 162.920 million subscribers of mobile connections and 93.102 million internet users available now. According to the NBR survey report, 63,003,818 phones have been introduced to the Bangladeshi telecommunications sector since 2012. Given that mobile phones have a maximum lifespan of two and a half years, the bulk of them are now being discarded in the country's overall municipal waste stream (Mahboob and Shafinaz 2015). It indicates that this huge amount of used mobile phones will be turned into e-waste within a few years (Dutta & Goel, 2021). Therefore, mobile phone waste/e-waste management is required at an urgent time basis.

The disassembly and recycling of E-waste is now a growing industry in Bangladesh. In addition, there are relatively few formal recycling company that dismantle E-waste, however recycling is mostly performed by the informal sector (Goel & Agrawal, 2022). Nearly 120,000 urban poor individuals are participating in Dhaka's illegal e-waste recycling sector. A total of 1360 informal e-waste recyclers in Dhaka city, recycle 15% of all created e-waste, including waste from mobile phones (Sudipta et al., 2017).

Bangladesh has an enormous prospect to transform e-waste into valuable resource. In order to deal with the recent spike in e-waste, the local government has initiated a number of rules, policies, and guidelines. Table 1.1 outlines the legal frameworks initiated by Bangladesh government in terms of sustainable e-waste management procedures. Regardless of the current regulations, formal recycling practices in Bangladesh, the collecting system is poorly developed and disorganised.

Generally, in Bangladesh e-wastes are discarded and recovered under unauthorized sectors. The metal recovery techniques are dangerous, and as a consequence, they also have consequences for the natural surroundings (Masud et al., 2019).

Table 1.1 Environment related policies and regulations in Bangladesh.

Laws and regulation	Implementation	Method of Enforcement	References
Constitution of Bangladesh	1972	Government	Bhuiyan (2017)
The National Environment Policy	1992	Policy	(Ananno et al., 2020; The Ministry of Environment Forest and Climate Change, 1992)
National Environmental Management Action Plan (NEMAP)	1992	Policy	Khan (2009)
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	1993	Administrative rule	(Basel.int, 2011)
Environment Conservation Act	1995 (Revision up to 2012)	Act	Ahammed and Harvey (2004)
Environment Conservation Rule	1997	Regulation	(The Ministry of Environment Forest and Climate Change, 1997)
Introduction of Urban Management Policy Statement	1998	Policy	Nasrin (2016)
Lead Acid Battery Recycling and Management Rules	2006	Regulations	(The Ministry of Environment Forest and Climate Change, 2006)
Clean Development Mechanism (CDM)	2007	Policy	Mechanism (2020)
Medical Waste Management Rules	2008	Regulations	(The Ministry of Environment Forest and Climate Change, 2008)

Table 1.1 (Continued)

Laws and regulation	Implementation	Method of Enforcement	References
Hazardous Waste Management Policy of Bangladesh	2009	Policy	Alam and Qiao (2020)
National 3R Strategy for Waste Management	2009	Policy	Nasrin (2016)
The Environment Court Act	2010 (Amended) Drafted 2000	Act	Ministry of Law (2010)
E-waste Management Rules	2011	Regulation	Association (2011)
Ship breaking and Hazardous Waste Management Rules	2011	Regulations	(The Ministry of Environment Forest and Climate Change, 2011)
The Seventh Five Year Plan	2016–2020	Plan	Ministry of Agriculture (2016)
National Environment Policy	2018	Policy	(The Ministry of Environment Forest and Climate Change, 2018)
Proposed Hazardous E-waste Management Rules	Drafted in 2019	Regulations	The Ministry of Environment Forest and Climate Change, B., 2019.

Summary of legislative framework and sustainable e-waste management practices
Source: Ananno et al., 2021

Electronic waste handling is regulated by strict laws and restrictions in developed nations. However, in developing nations, the problem is even worse owing to a lack of such legislation and regulations, as well as a lack of public knowledge about safe e-waste disposal (Masud et al., 2019). In 2011, Bangladesh has revised its initial proposal for "e-waste management laws." Certain sections of legislation were included in the proposal, such as ship breaking, medical waste, 3R policy and hazardous waste management (Alam & Bahauddin, 2015). Consequently, 'E-waste management rules' was developed and amended in 2011, 2017, and 2019 respectively under the Environment Conservation Act, of 1995. In accordance with the proposed

2017 E-waste Management Rules, the government intends to implement deposit or return systems for unwanted electronic devices. In addition, the proposed regulations established a target of increasing producer responsibility from 15% to 55% during the course of the first year and the next four years of rule implementation. The Bangladesh Department of Environment (DoE) has recently announced the development of new guidelines for the management of electronic waste, which are being referred to as the "Hazardous Waste Management Rules, 2019" (Herat, 2021). The Rule prohibits the use of up to 15 chemicals or groups of compounds in particular EEE. Home appliances, monitoring and control devices, medical devices, automated machinery, and information technology and telecommunications items are included under the rule. It is mandatory for manufacturers to register with the DoE and provide a comprehensive strategy for dealing with End-of-Life (EOL) EEE. As an additional requirement, they must disclose details about any potentially harmful substances. Besides, all electronic item consumers are advised to discard their non-functioned electronic items to the responsive e-waste collectors or drop in such point assigned by local government agency. Moreover, mobile phone waste generated by users and repairers are not recorded to the current e-waste inventory management system, due to the poor infrastructure and less government intervention. Although the local government efforts to formulate a sustainable waste management model, however it is hampered by the ineffective monitoring system.

1.2.3 Mobile Phone Repair sector in Bangladesh

Repairing goods is a vital part of the circular economy, preserving access to valuable resources that would otherwise be lost to landfill (Oxford Analytica, 2019). According to mobile phone repair expert, there are certain reasons why individuals need to see repair shops. For instance, Damaged or broken screens, Buttons Stop Working, Battery or charger issues, Virus or other application issues, and Dead phones (Expressirepairs, 2021). In addition, mobile phone or e-gadget consumption, repairing and replacing tendency subject to the individual's socio-economic situations, lifespan of electronic items, readiness to buy new products, and warranty plan. None the less, it is not solely determined on financial factors rather emotional connection towards a product might influence a person to repair it (Laitala et al., 2021). In developing countries, cell phones are frequently repaired and exchanges its ownership multiple times among different people until it finishes its lifespan (Kant et al., 2022).

Currently, the Bangladesh mobile phone market is valued at about Tk 100 billion, which is remarkably growing each year (Chowdhury, 2020). The mobile phone repair and accessories market valued Tk25-30 billion, which is quarter of the total cell phone industry (Chowdhury, 2020). A study by (Hossain & Rahman, 2020) showed that, when mobile phones are non-functioned, are taken to the repair shop and the damaged parts of electronic products are replaced by a new one. An exploratory study of Mobile phone repairing by Ahmed et al., (2016) found that, there are 10 major mobile phone repair markets in capital city Dhaka. Gulistan Underground Market is known one of the major mobile phone repair markets where employs around 500 mobile phone repairers. The repair shops are situated underground of cross section in Gulistan town in Dhaka. Nearly all repair shops provide cell phone repair services or sells accessories required in mobile phone repairing. A similar study by Ansari et al., (2010) examined mobile phone user's behavior toward the disposal of the batteries to repair shop when replaced by a new one. While in most cases, the discarded nonfunction items are thrown away without separation in municipal bin, landfill, and local waste scrappers. Therefore, it increases the difficulty and cost of further treatment in landfill and incineration. However, having a weak inventory control management system, the actual figures for total e-waste produced by mobile phone repair shops are not identified.

1.3 Research Problems

The Global E-waste Monitor (2020) report represents the latest worldwide e-waste facts and figure. The entire world accumulated an enormous amount 53.6 Mt of electronic waste an average of 7.3 kilogrammes per capita. Since 2014, the global e-waste production has surged by 9.2 Mt and by year 2030, it is anticipated to reach about 74.7 Mt. Another study by Oxford Analytica, (2019) projected, e-waste to increase 120 million tons annually by 2050. This massive volume of e-waste is become disaster for mankind, if it is not properly separated or recycled (Deva & Weijden, 2021). E-waste is hazardous and often contains elements such as lead and mercury, which are known carcinogens, negatively impacting the atmosphere and human health via contaminated soil and water (Banaszkiewicz et al., 2022; Rabani et al., 2020). Such evidence reported that, each year, unreported global e-waste flows contain 50 ton of mercury and 71 kilotons of BFR plastics (Global E-waste Monitor, 2020). Consequently, lead and mercury from e-waste leak into the ground (Munro et al., 2022; Chakraborty et al., 2018, Song and Li, 2015), where they eventually get into the food chain through plants (Guala et al., 2010). In addition, micro plastic from the e-waste which contains chemical additives, seriously threaten marine organisms through ingestion or entanglement (Hale et al., 2020).

On the other hand, when e-waste is dumped in a landfill, precious raw materials including rare transition metals and alkali metals like lithium, cobalt, copper, and gold are also lose its economic value (Van Yken et al., 2022). According to UN estimates, 7 percent of the world's total gold is hidden amid various e-waste (Ray et al., 2022; Iqbal et al., 2020). The evidence from global e-waste monitor report (2017) have exposed the raw materials value from e-waste, which is worth 60 billion dollars. Due to the lowest waste separation rate, however a small percentage of this value is managed to recover (Baldé et al., 2017).

Bangladesh produces over 2.81 million metric tonnes of electronic waste annually, which roughly 20–30% is recycled through formal and informal channel (Roy et al., 2022; Masud et al., 2019). Among various e-waste, mobile phone waste is become the major contributor of generating e-waste in Bangladesh (Roy et al., 2022), due to its short lifespan and heavy usage by a large group of population (Meem et al., 2021). Moreover, mobile phone repair shop in Bangladesh has been growing rapidly (Chowdhury, 2020), which therefore increases the discarded mobile phone waste like hazardous batteries and other recyclable metals (Randhawa & Chopra, 2022). In Bangladesh around 97% of e-waste which is going to landfills is proportionally collected by unauthorized sectors and export them to other countries who have recycling capacity (Aziz, 2022). Although higher waste separation rate will increase the recycling ability and also improve the quality of the recyclable items. However, waste separation at source is not compulsory in Bangladesh (Jerin et al., 2022). Therefore, the actual practice of e-waste separation is barely visible to the society.

The Government of Bangladesh has taken several steps to implement waste management policy at route level. For example, the implementation of National 3R strategy, promoted individuals to separate their waste, reuse and recycle. Moreover, in accordance with the Environment Conservation Act of 1995, e-waste management regulations were established and revised in 2011, 2017, and 2019, consecutively.

Nevertheless, the rules and regulations imposed by governments are not seen as effective, due to less intervention and monitoring system.

Globally, most of the studies have been conducted on e-waste recycling, exclusively focused on students, residents, consumers, and the household's point of view. Besides, some studies have been also found from different countries point of view like, Spain (Arbués & Villanúa, 2022), India (Kumar, 2019; Borthakur & Govind, 2018), China (Zhang et al., 2020; Liu et al., 2019; Wang et al., 2016), Malaysia (Kianpour et al., 2017). Importantly, limited studies have been attempted in the context of Bangladesh, which primarily aimed to solve households and recyclers issues (Barua et al., 2020; Uddin et al., 2020; Javed & Chakrabort, 2018; Alam et al., 2018). In addition, researches were conducted research on household residents (Nnorom et al., 2009; Otto et al., 2018; Song et al., 2012; Wang et al., 2011, 2016, 2018; Zhang et al., 2018), consumers (Yin et al., 2014; Zhong and Huang, 2016) and students/academia (Kochan et al., 2016; Kumar, 2019; Oztekin et al., 2017). As a result, there is a need to conduct research on the people who repair electronic items and generate e-waste.

Separating waste is one of the most effective ways to manage e-waste (Zhang et al., 2022; Yu et al., 2018). The separation of e-waste is vital for the recovery of recyclable waste fragments and the subsequent use of those components as virgin materials in the development of new products (Pan et al., 2022). Material recovery is a critical challenge in the circular economy prospect, which further involves circular consumption, sustainable economies, and the conservation of natural resources (Singh et al., 2016). Therefore, sustaining a circular economy relies heavily on the effective separation of e-waste at the source. Furthermore, lack of e-waste separation causes serious environmental pollution and create human health problems (Siddiqua et al., 2022). Therefore, it is needed to identify whether the individuals have the intention towards e-waste separation.

Since intention is the most significant construct, it has been used in numerous pro-environmental research as an ultimate outcome (Alhassan et al., 2017). “Intention” alludes to the individual’s motivation regarding the performance of a given behaviour. The intensity of intention has been conclusively demonstrated and rigorously documented across numerous studies on waste separation (Stoeva and Alriksson, 2017; Ofstad et al. 2017; Xu et al. 2017). The process of separating e-waste in Bangladesh is still in its early stages, therefore numerous challenges need to overcome in order to achieve the nationwide success. Besides, most of the previous waste recycling studies only concentrated on municipal/household waste separation intention (Xu et al.2017; Zhang et al. 2020; Liao et al., 2018). In order to fill the research gap and contribute to the literature on waste recycling, it is essential to concentrate more on individuals' intentions to separate their e-waste.j

Value belief norm (VBN) is a legitimate theoretical model that able to justify a person’s pro-environmental behavior such as e-waste separation (Steg et al. 2005). An individual's behaviour toward the environment is entirely determined by their own set of values (Stern, 1994). In addition, the VBN model is able to provide further insights of an individual's arrangement that extends from the higher hierarchy of values to the immediate predecessor of behavioural intention (Chen, 2020). Ananno et al., (2021) observed that value-belief norms are applicable for Bangladeshi context, since individuals are mindful of both consciousness and environmental preservation. When it comes to determining environmental behaviour, values are always considered as important elements (Bamberg, 2003). In the VBN theory, human values (Egoistic, Altruistic, Openness to change and Conservation) are expected to affect their beliefs and personal norm (Vanderploeg & Lee, 2019; Stern, 2000). Previous research has found that owner-manager values are main sources of ethics and standards in small enterprises (Jenkins, 2006; Lange & Fenwick, 2008; Williams & Schaefer, 2013). Individuals are more inclined to engage in environment-conscious conduct if they adhere to values other than their self-interest (Onel & Mukherjee, 2017; Steg &Vleg, 2009; De Groot & Steg, 2008). Altruistic values were identified as most influential and statistically significant constructs in order to measure environmental beliefs (Chua et al., 2016; Fritzsche & Oz, 2007; Papagiannakis & Lioukas, 2012; Stern et al., 1999). In theory, an egoistic person would defend and protect their own interests and family resources if the environment is become threat for them (Stern et al., 1993). Similarly previous research has stated that people with strong conservation values are less likely to be worried regarding ecological issues, whereas people with high openness to change values shows opposite reaction as well (Raudsepp, 2001). Prior waste recycling studies have neglected to examine conservation and openness to change values together with altruistic and egoistic values. Therefore, the first research question of this study will ask about the impact of values (Egoistic, Altruistic, Openness to change and Conservation) on environmental belief.

Prior studies have revealed that individuals who hold favourable environmental beliefs and worried about the planet’s future are more inclined to participate in pro-environmental behaviour. The New Ecological Paradigm (NEP) Scale was employed to measure environmental beliefs which therefore found direct association with personal norms (Vanderploeg & Lee, 2019; Chua et al., 2016; Steg et al., 2005; Stern et al., 1999). Therefore, the second research question will ask whether environmental belief have any influence on personal norm.

Personal norm is one of the principal factors of this model, has direct relation to the waste separation intention (Li et al., 2018). Investigating different pro-environmental behaviour, prior evidence has found personal norm as the strongest predictor. For instance, green energy (Fornara et al., 2016), minimize car usages (Jakovcevic & Steg, 2013), and reduction (Steg et al., 2005). Consequently, the third research question concerns the influence of personal norm on e-waste separation intention.

Implementing self-determination theory to the domain of sustainable development and environmental conservation, many researchers have found the prediction ability of self-determined factors toward intention and behaviour (Cho, 2019). Nguyen & Watanabe, (2020) have analysed both autonomous and controlled motivation responsible for waste separation practice. Individuals with an autonomous motivation are more likely to believe in the effectiveness of recycling and to oppose the idea that humans have dominance over the world and therefore encourage to exhibit recycling behaviour (Huffman et al., 2014). Empirical evidence indicates that motivation is a prerequisite for environmentally conscious behaviour (Ryan & Deci, 2020). Prior studies have revealed that self-determined motivation stimulates individual's intentions to behave in an eco-friendly way (Green-Demers et al., 1997; Lavergne et al., 2010; Osbaldiston & Sheldon, 2003; Pelletier et al., 1998; Seguin, Pelletier, & Hunsley, 1998; Tabernero & Hern´andez, 2010). Moreover, Green-Demers et al. (1997) have showed the negative correlation between amotivation and pro-environmental behaviour, whereas intrinsic motivation, integrated, identified, and introjected regulations are positively related with self-reported behaviour. Consequently, the fourth research question concerns the Influence of SDT factors

(Amotivation, External regulation, Identified regulation, Introjected regulation, Integrated regulation and Intrinsic motivation) on e-waste separation intention.

Institutional theory emphasises the importance on social acts, which is viewed as a way to obtain legitimacy instead of monetary or utility optimization (DiMaggio & Powell, 1983; Harcourt et al., 2005). Coercive isomorphism, exhibited in the form of laws, rules, and regulations, is commonly regarded as the primary driver for sustainable behaviour (Jennings & Zandbergen, 1995). Individuals may be experienced with coercive pressures in the form of both formal and informal, which are intended to encourage them to adopt the same attitudes, behaviours, and practises. This emerges due to increased pressure from more powerful actors (individuals) within the society (DiMaggio & Powell, 1983; Jan et al., 2012). In particular, influential actors belong to the society, such as family, friends, colleagues, coerce others into engaging in specific behaviours in order to evade punishment (Grewal and Dharwadkar, 2002. In addition, Wang and Cheung (2004) explained that coercive isomorphism emerges from customers who add pressure on travel businessperson to adopt the latest technology. Coffey et al., (2013) in their study stated that, coercive pressure is the most efficient predictor of both intention and behaviour.

Moreover, normative pressures indicated that individual actors are more persuaded to emulate an act if many other social actors have already performed it (Jan et al., 2012). The act of imitating is not obligatory, nor done consciously; rather, it just becomes a part of norms. When people within a society spend time together, they create norms that may lead to incline their overall normative behaviour (Raab et al., 2018). The effect of memetic pressure is more intense when the individuals who accept norms belong to the similar societal group and reside in the same geographical area (Goodstein, 1994). The results of earlier research have shown the significant influence of mimetic pressure on technology adoption (Bozan et al., 2015) and student's behavioural intention with relation to education (Gao and Yang, 2015).

Recently, institutional theory has been utilised to understand environmental practises and its overall impact on environmental performances in both emerging and developed countries (Betts et al., 2018). However, in the domain of waste recycling, this theory has seldom been investigated at the individual level. Current study has employed institutional theory at individual level, helps to fill the theoretical gap and contributing to the research knowledge. Therefore, the final research question will ask about the impact of institutional theory (IT) predictors (Coercive pressure, Mimetic pressure, Normative pressure) on e-waste separation intention.

To sum up, there are problem of low e-waste separation rate, that affect overall e-waste recycling system, in which require present study to identify the key drivers to close the gap. Based on identified gap in the literature, the mobile phone repairers value, belief, norm, motivation and institutional pressure needed to be examined for better e-waste separation. Therefore, the study aimed to examine the multiple factors through integrated theory of **VBN** (Altruistic values, Egoistic values, Openness to change values, Conservation values, Environmental beliefs and Personal norms); **SDT** (Amotivation, Intrinsic motivation, External regulation, Integrated regulation, Introjected regulation and Identified regulation and **IT** (Coercive pressure, Normative pressure, Mimetic pressure) to measure the e-waste separation intention among the mobile phone repairers in Bangladesh.

1.4 Research Questions

Finally, this study asks five research questions:

RQ1: Do values (Egoistic values, Altruistic value, Openness to change values and Conservation values) influence mobile phone repairer's e-waste separation intention through the environmental beliefs?

RQ2: Does environmental beliefs influence phone repairer's e-waste separation intention through personal norms?

RQ3: Does personal norms influence mobile phone repairer's e-waste separation intention?

RQ4: Do self-determination theory (SDT) constructs (Amotivation, External regulation, Introjected regulation, identified regulation, integrated regulation and Intrinsic motivation) influence mobile phone repairer's e-waste separation intention?

RQ5: Do institutional theory constructs (Coercive pressure, Mimetic pressure, Normative pressure) influence mobile phone repairer's e-waste separation intention?

1.5 Research Objectives

In order to find out the answers to above research questions, this study have generated following five research objectives:

RO1: To examine the influence of values (Egoistic values, Altruistic values, Openness to change values and Conservation values) on mobile phone repairer’s e-waste separation intention through the environmental beliefs.

RO2: To examine the influence of environmental beliefs on mobile phone repairer’s e-waste separation intention through personal norms.

RO3: To examine the influence of personal norms on mobile phone repairer’s e-waste separation intention.

RO4: To examine the influence of self-determination theory constructs (Amotivation, External regulation, Identified regulation, Introjected regulation, Integrated regulation and Intrinsic motivation) on mobile phone repairer’s e-waste separation intention.

RO5: To examine the influence of institutional theory constructs (Coercive pressure, Mimetic pressure, Normative pressure) to mobile phone repairer’s e-waste separation intention.

1.6 Significance of the Study

This study contributes significantly in terms of, practicality and theoretically to the literature of e-waste separation among the mobile phone repairers in Bangladesh.

1.6.1 Theoretical significance:

This research holds interesting implications for understanding e-waste separation intention. Waste separation intention, which was explored previously has been mainly focused on municipal waste and household waste (Ayob et al., 2017; Issock et al., 2019; Tran et al., 2019; Razali et al., 2020). However, factors influencing e-waste separation intention are largely unexplored.

Secondly, this study will contribute to the literature by integrating three theories namely value belief norm, Self-determination and institutional theory. Both social phycological and social pressure theories are integrated in the current theoretical framework to get robust findings. Researchers previously have integrated many theories in context of waste separation and recycling studies (Cho, 2019; Mohamed Ali Khan et al., 2021). The findings from (Aboelmaged, 2020) showed that the integrated model has strong explanatory power and validates its strength in predicting young people' intentions to recycle e-waste. Park et al., (2014) concluded that integrated model portrays a solid conceptual foundation by forecasting traveller's pro-environmental behaviours. Nevertheless, an integrated model may improve model fit, increase the capacity to forecast behavioural intention, and provide a solid theoretical foundation for comprehending decision-making (Han, 2015). According to Chung et al. (2019) to get more holistic explanation of environmental decision-making, linking VBN to other theories is essential. On a similar note, Jackson et al. (2013) mentioned that an integrated perspective model offers a more thorough understanding of the causal mechanisms underlying the correlations, as well as deep insights that cannot be achieved with a single theory. However, a general integration of VBN, SDT and the Institutional theory has, to the best of our knowledge, not yet been carried out together in earlier e-waste recycling or other waste recycling research. As a result, integrating theories and waste related literature contributes to the theoretical development for this study. As current study conducts on mobile phone repairers in a business environment, therefore the integrated model along with institutional theory is more appropriate in this context. As a result, it is presumed that a framework that combines the VBN, SDT, and IT theories might be useful in the theoretical development and thus improve representations of complex variable relationships.

Thirdly, this study also highlights the importance of institutional theory in individual context and broaden the institutional theory by relating the concept with e-waste separation intention. In general, Institutional theory has mostly been employed at the organisational settings (DiMaggio & Powell, 1983; Liang et al., 2007). Based on evidence from Scott et al. (2001); Bozan et al., (2015); Gao and Yang (2015); Jan et al., 2012); Ghazali et al., (2022) revealed that, this theory has been validated at the individual area from several aspect of studies. However, no research has been conducted so far to investigate the impact of institutional theory on e-waste separation intention among mobile phone repairers in Bangladesh. That leads to a major gap in the theories and frameworks of e-waste separation. The current research aims to minimize this gap through the inclusion of institutional theory at mobile phone repairer level on particularly in repair shop.

Fourthly, the VBN framework mostly examined in developed country context (Gomes et al., 2022; Carfora et al., 2021; Primc et al., 2021; Vanderploeg & Lee, 2019; Chung et al., 2019; Li et al., 2018; Onel & Mukherjee, 2017). A review study by Canlas