



Department of Computer Science And Engineering

System Analysis Design and Development

CSE - 402

Information Gathering Report

E-waste Management Using Digital Ledger

And

Cryptographic Transactions

Group - 03

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Preface

When China banned 24 kinds of solid waste last September, countries such as the U.S., the United Kingdom, Australia, and Japan realized they had a big problem. Until last year, China accepted 70 percent of the world's electronic waste—discarded computers, cell phones, printers, televisions, microwaves, smoke alarms, and other electronic equipment and parts. After China stopped accepting this e-waste out of concern for its environment, Europe and North America began shipping more of it to Southeast Asia—but now Vietnam and Thailand, whose ports have been overwhelmed, are curbing imported e-waste as well.[1]

In 2016, the world's population discarded 49 million tons of e-waste (equivalent to about 4,500 Eiffel Towers). It's estimated that by 2021, that number will grow to more than 57 million tons.[3]

The concept of zero waste is an ideal situation that will require different solutions for different categories of waste. Electronic waste (E-waste), the fastest growing category of solid hazardous waste presents various unique challenges. Electronic product repair, reuse and remanufacture are crucial for effective source reduction of E-waste and the integration of the electronics industry into a circular or zero-waste economy framework. Increasingly, remanufacturing and selling implementation is restricted by regulatory difficulties, particularly the invocation of copyright laws.[6]

1. Introduction

1.1 Method of Information gathering

The aim of this project is to make the e-waste management system in Bangladesh efficient. Our technique is based on smart contracts, developed using blockchain technology.

To make the project effective we followed some methods for gathering the information needed to complete this project. Those are :

- **Questionnaires** : An online survey was completed using a google form to know normal user's perspective e-waste management.
- **Literature review** : We have read some articles and research papers and found out some important perspectives and insights about the project.
- **Interview** : An interview with a local e-waste collector was conducted during the field visit.

1.2 Source of Information

The gathered some important information about e-waste recycling process in Bangladesh and how to make this existing system more efficient using block-chain based smart contract system. And the sources of our information are :

- General Users.
- Local E-waste collectors.
- Online articles and research papers.
- Field Visit.

1.3 Information needed

1. What idea does general people have electronic waste?
2. How do people process domestic e-waste products?
3. Do people know about the environmental impact of e-waste ?
4. How to create awareness about proper e-waste disposal among general people?
5. What do general users prefer to do with their e-waste?
6. How can we make the system secured using blockchain?
7. Where does the existing systems fail?
8. How important is the participation of the manufactures in this whole process?
9. What conditions need to be set for the smart contracts to operate?
10. Can the system be used for illicit activities? If so, how can we reduce that?
11. What information can we share with suppliers?
12. How revenue is generated in e-waste recycling process?
13. How are the e-wastes collected from the locality?
14. How are the e-wastes processed?

2. Glossary

Block Chain: A blockchain is a decentralized, distributed, and oftentimes public, digital ledger consisting of records called blocks that is used to record transactions across many computers so that any involved block cannot be altered retroactively, without the alteration of all subsequent blocks.

Smart Contracts : A smart contract is a self-executing contract with the terms of the agreement between buyer and seller being directly written into lines of code.

3. Information Gathering

3.1 Information Gathered Through Questionnaires (Method – I)

Source of information : General Users (Source – I)

Information needed	Questions	Answers
Information #1 What idea does general people have electronic waste?	Do you know what is electronic waste?	Yes (Majority)
	Have you received education on e-waste before?	No (Majority)
Information #2 How do people process domestic e-waste products?	What do you do with working electronic/electrical products that you no longer use?	1. Sell on second hand. (42%) 2. Put it in a storage. (50%) 3. Give it to a friend. (9%)
	What do you do with broken electronic/electrical products?	1. Sell on second hand. (38%) 2. Put it in a storage. (47%) 3. Take to local Recycling center. (11%)
	How long do you expect the following electronic/electrical items to last?	1. TV : 30yrs 2. Mobile : 11yrs 3. Laptop : 15yrs

Information needed	Questions	Answers
Information #3 Do people know about the environmental impact of e-waste ?	Do you know that improper e-waste disposal is harmful to the environment?	Yes (Majority)
	How much do you know about the materials used in electronic/electrical products?	1. I know a bit. (58.3%) 2. I know more than avg (33.3%) 3. I know nothing (8.3%)
	Do you think it's important to recycle electronics ?	Yes (Majority)
	Are you aware of the health risks associated with e-waste?	Yes (Majority)
Information #4 How to create awareness about proper e-waste disposal among general people?	Would you want more education and awareness about e-waste?	Yes (Majority)
Information #5 What do general users prefer to do with their e-waste?	Would you be willing to sell an e-waste product in order to have someone effectively dispose your e-waste?	1. Yes (41.7%) 2. Maybe (36.1%) 3. No (22.2%)
	Which factors would affect your choice whether to repair an object or not?	1. Price of repaired compared with replacing. (80.6%) 2. Warranty of product. (27.8%)

Outcome :

- Most of the people have idea about electronic waste.
- Most of the people sell their e-waste on second hand.
- Most of the users think improper disposal of e-waste is harmful for environment.
- Most of the people wants to grow awareness and have education about e-waste.
- Most people are willing to sell their e-waste product in order to have someone effective dispose it.

3.2 Information Gathered through Literature Review (Method-2)

Information needed	6. How can we make the system secured using blockchain? 7. Where does the existing systems fail? 8. How important is the participation of the manufactures in this whole process?
Source	References [1] [3] [4] [6]
Outcomes	1. Blockchain can be implemented in e-waste recycling schemes where people can exchange their old gadgets and non-working electronics for digital tokens. 2. A set of international regulations, including repair, reuse, remanufacture, refurbish, fake/counterfeit product and copyright exhaustion disparage E-waste recyclers. 3. To create a proper supply chain from manufacturers, retailers, users and recyclers manufactures plays a big role.

Information needed	<p>3. Do people know about the environmental impact of e-waste ?</p> <p>9. What conditions need to be set for the smart contracts to operate?</p> <p>10. Can the system be used for illicit activities? If so, how can we reduce that?</p> <p>11. What information can we share with suppliers?</p> <p>12. How revenue is generated in e-waste recycling process?</p>
Source	References [2] [5] [7] [8]
Outcomes	<p>1. Most of the people ignore the environmental impact of e-waste.</p> <p>2. Co-ordination among producers, importers, retailers and recyclers of EEEs is needed.</p> <p>3. Every user can add information to the blockchain and all data in the blockchain is secured through cryptography.</p> <p>4. One of the most prominent capabilities of blockchain technology in this context is to enable transparency and traceability of e-products by storing the entire life-cycle, starting from their origin through every point of contact on the journey.</p> <p>5. After purchasing a waste product, they first run a check to see whether the product is functioning or not.</p> <p>6. If the product is functioning then they sell it to a purchaser who looks for second hand parts.</p> <p>7. Sometimes they break the product into pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things.</p> <p>8. They sell the raw materials to factories and plants.</p> <p>9. Those items which are not recyclable in our country are sold to recyclers from overseas.</p>

3.2 Information Gathered through Interview (Method-3)

Source of Information : Azizu Correspondent (Local E-waste collector)

Information needed	Questions	Answers
Information #13 How are the e-wastes collected from the locality?	How does the company collect all these wastes for processing?	E-wastes are collected from local e-wastes collection shop (vangari) as well as corporate and public clients.
	Can people use your website to deposit their e-wastes?	Yes, anyone can fill up an online form from the company's website and judging from the amount of waste transportation will be carried out by company representatives.
	Does your company do any contractual basis works with other corporate companies to collect their e-wastes?	Yes, the company does so that
Information #14 How are the e-wastes processed?	What are the main tasks in processing a regular e-waste to usable raw material?	1. Sorting 2. Segregation 3. Recycling or Refurbishing
	What are the end products of this recycling process?	1. Usable raw materials (eg: PCB powder, Copper powder etc) 2. Refurbished products

Information needed	Questions	Answers
Information #14 How are the e-wastes processed?	Is the recycling process fully automated apart from e-waste collection?	No, the process is not automated manual labor from local areas is trained and used.
	Is company data processed or documented in any sort of software.?	No such software is used. Day to day records are written manually in paper and monthly revenue records are documented in excel.
Information #12 How revenue is generated in e-waste recycling process?	How does the company generate revenue?	1. By providing raw materials for factories and plants all around the country. 2. By exporting raw materials and refurbished products overseas.
	Is the demand for raw materials in these local factories over-whelming or under-whelming?	It is indeed over-whelming.
	Does the company face any sort of competition in recycling market by other similar companies?	No, the company doesn't face that much competition as such companies are very sporadic.
	Is the recycling market heavily monitored by the government or local authority?	Government laws does exist even in case of recycling e-waste management. Although reliable monitoring is absent by the local authority.

How revenue is generated in this recycling process?	Is the company willing to be in a greater chain with other similar companies working as a structured unit?	Currently the company don't have any plans to do so. If it is required in the future the company will go to its R&D team beforehand.
Outcomes: <ul style="list-style-type: none"> ▪ E-wastes are collected from local e-wastes collection shop (vangari) as well as corporate and public clients. ▪ If a product is functioning they sell it to a purchaser who looks for second hand parts. ▪ Sometimes they break the product into pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things. ▪ They sell the raw materials to factories and plants. ▪ Those items which are not recyclable in our country are sold to recyclers from overseas. 		

4. Outcome Summaries

1. Most of the people have idea about electronic waste.
2. Most of the people sell their e-waste on second hand.
3. Most of the users think improper disposal of e-waste is harmful for environment.
4. Most of the people wants to grow awareness and have education about e-waste.
5. Most people are willing to sell their e-waste product in order to have someone effective dispose it.
6. Blockchain can be implemented in e-waste recycling schemes where people can exchange their old gadgets and non-working electronics for digital tokens.

7. A set of international regulations, including repair, reuse, remanufacture, refurbish, fake/counterfeit product and copyright exhaustion disparage E-waste recyclers.
8. To create a proper supply chain from manufacturers, retailers, users and recyclers manufactures plays a big role.
9. Most of the people ignore the environmental impact of e-waste.
- 10.Co-ordination among producers, importers, retailers and recyclers of EEEs is needed.
- 11.Every user can add information to the blockchain and all data in the blockchain is secured through cryptography.
- 12.One of the most prominent capabilities of blockchain technology is this context is to enable transparency and traceability of e-products by storing the entire lifecycle, starting from their origin through every point of contact on the journey.
- 13.After purchasing a waste product, recyclers first run a check to see whether the product is functioning or not.
- 14.If a product is functioning, they sell it to a purchaser who looks for second hand parts.
- 15.Sometimes they break the product into pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things.
- 16.They sell the raw materials to factories and plants.
- 17.Those items which are not recyclable in our country are sold to recyclers from overseas.
- 18.E-wastes are collected from local e-wastes collection shop (vangari) as well as corporate and public clients.

4. Existing System

With the rapid update of technological product, large amount of electronic goods are becoming obsolete and are disposed of in a short period of time. The equipment that are disposed of after various official use and personal use go to people involved in different tiers to recycle things. In Dhaka, very commonly they are known as the vangari shops (waste dealer shops) those who are involved in the waste product selling business.

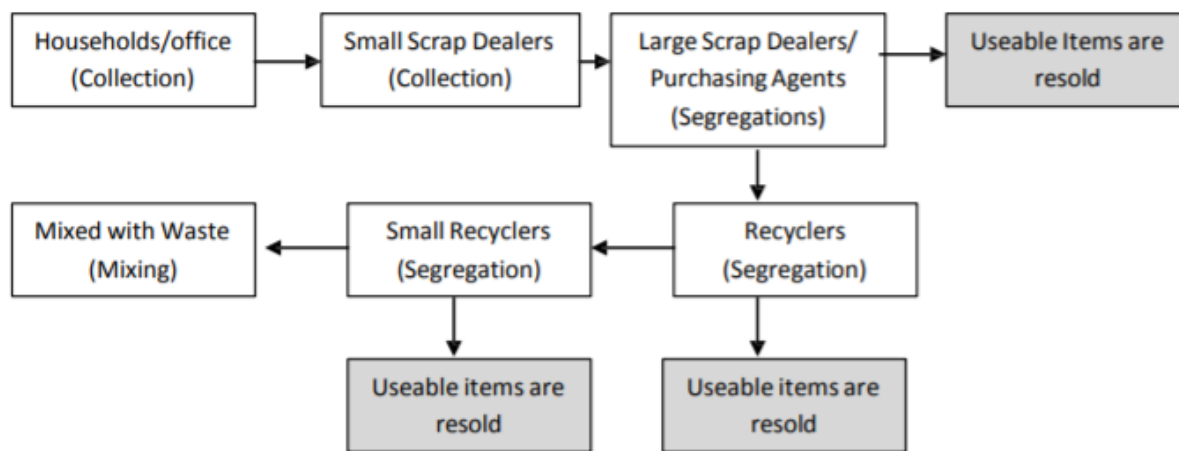


Figure: Informal sector recycling process

The recycling flow of the informal sector in Dhaka is shown by Figure. Vangari shops buy personal computer (PC) parts from various organizations through auction. They also buy from hawkers, personal users, retail shops (old parts) and internal buying from the waste shops. According to the shop owners there are 200-250 purchasing agents of these types of products who bring PC parts as wastage to them. After purchasing a waste product, they first run a check to see whether the product is functioning or not. If the product is functioning then they sell it to a purchaser who looks for second hand parts. Otherwise they break the product into

pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things. They disassemble these products without any protection which can be injurious to their health and surrounding environment.

4. Outcome Mapping

Method	Source	Information	Outcome
Information Gathered Through Questionnaires. (M1)	General Users (S1)	What idea does general people have electronic waste? (I1)	Most of the people have idea about electronic waste. (O1)
		How do people process domestic e-waste products? (I2)	Most of the people sell their e-waste on second hand. (O2)
		Do people know about the environmental impact of e-waste? (I3)	Most of the users think improper disposal of e-waste is harmful for environment. (O3)
		How to create awareness about proper e-waste disposal among general people? (I4)	Most of the people wants to grow awareness and have education about e-waste. (O4)
		What do general users prefer to do with their e-waste? (I5)	Most people are willing to sell their e-waste product in order to have someone effective dispose it. (O5)

Method	Source	Information	Outcome
Information Gathered through Literature Review (M2)	Research Papers (S2)	How can we make the system secured using blockchain? (I6)	Blockchain can be implemented in e-waste recycling schemes where people can exchange their old gadgets and non-working electronics for digital tokens. (O6)
		Where does the existing systems fail? (I7)	A set of international regulations, including repair, reuse, remanufacture, refurbish, fake/counterfeit product and copyright exhaustion disparege E-waste recyclers. (O7)
		How important is the participation of the manufactures in this whole process? (I8)	To create a proper supply chain from manufacturers, retailers, users and recyclers manufactures plays a big role. (O8)
		Do people know about the environmental impact of e-waste ? (I3)	Most of the people ignore the environmental impact of e-waste. (O9)

Method	Source	Information	Outcome
Information Gathered through Literature Review (M2)	Research Papers (S2)	What conditions need to be set for the smart contacts to operate? (I9)	Co-ordination among producers, importers, retailers and recyclers of EEEs is needed. (O10)
		Can the system be used for illicit activities? If so, how to reduce that? (I10)	Every user can add information to the blockchain and all data in the blockchain is secured through cryptography. (O11)
		What information can be shared with suppliers? (I11)	One of the most prominent capabilities of blockchain technology in this context is to enable transparency and traceability of e-products by storing the entire life-cycle, starting from their origin through every point of contact on the journey. (O12)
		How revenue is generated in e-waste recycling process? (I12)	After purchasing a waste product, recyclers first run a check to see whether the product is functioning or not. (O13)

Method	Source	Information	Outcome
Information Gathered through Literature Review (M2)	Research Papers (S2)	How revenue is generated in e-waste recycling process? (I12)	If a product is functioning they sell it to a purchaser who looks for second hand parts. (O14)
			Sometimes they break the product into pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things. (O15)
			They sell the raw materials to factories and plants. (O16)
			Those items which are not recyclable in our country are sold to recyclers from overseas. (O17)
Information Gathered through Interview (M3)	Azizu Correspondent (Local E-waste collector) (S3)	How are the e-wastes collected from the locality? (I13)	E-wastes are collected from local e-wastes collection shop (vangari) as well as corporate and public clients. (O18)
		How are the e-wastes processed? (I14)	If a product is functioning they sell it to a purchaser who looks for second hand parts. (O14)

Method	Source	Information	Outcome
Information Gathered through Interview (M3)	Azizu Correspondent (Local E-waste collector) (S3)	How are the e-wastes processed? (I14)	Sometimes they break the product into pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things. (O15)
		How revenue is generated in e-waste recycling process? (I12)	Sometimes they break the product into pieces to separate iron, lead, copper, silver, plastic etc. and sell this to a purchaser of these things. (O15)
			They sell the raw materials to factories and plants. (O16)
			Those items which are not recyclable in our country are sold to recyclers from overseas. (O17)

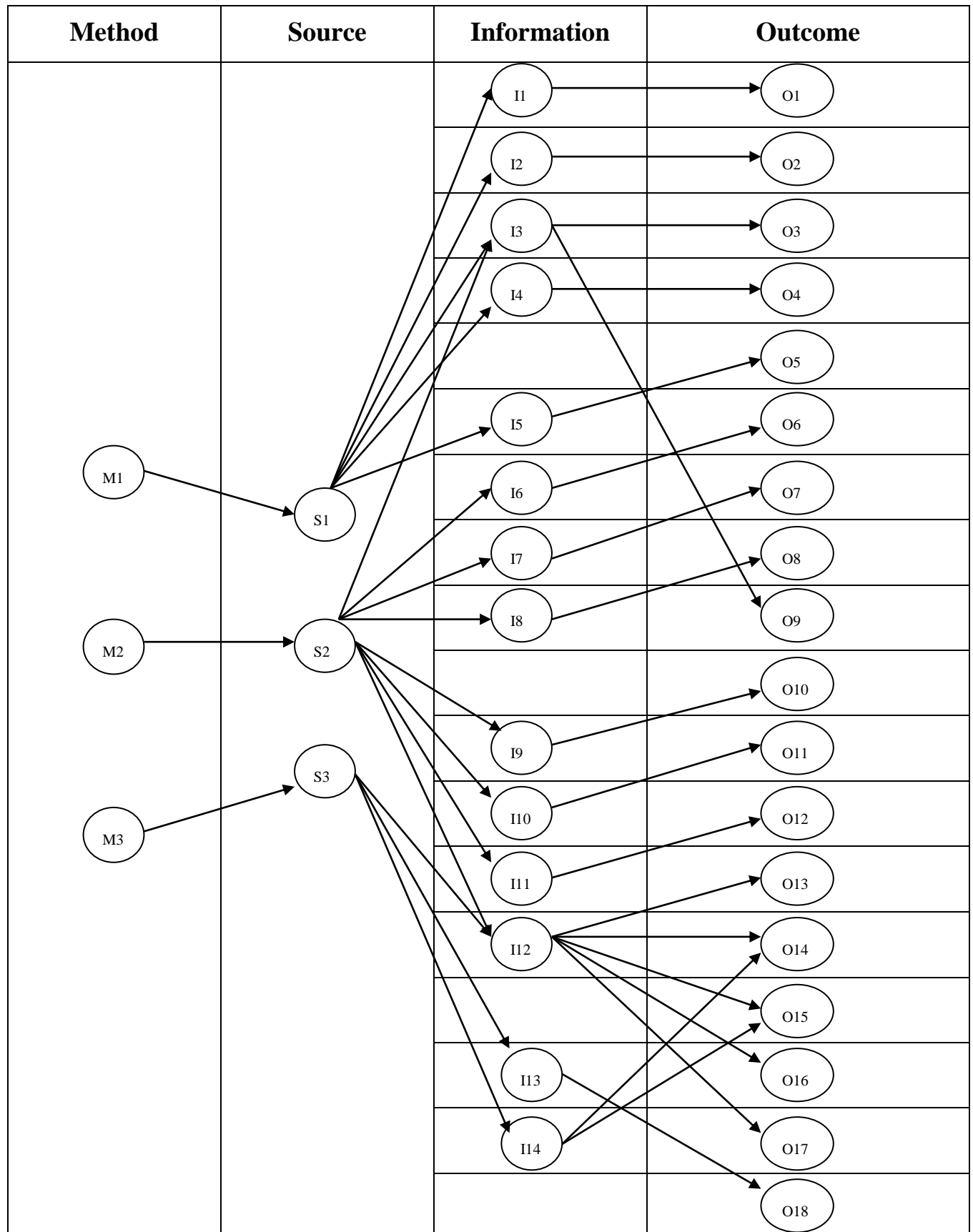
References

- [1] Gopalakrishnan, P. K., Hall, J., & Behdad, S. (2020). Cost analysis and optimization of Blockchain-based solid waste management traceability system. Waste Management. doi:10.1016/j.wasman.2020.10.027
- [2] M. Poongodi, M. Hamdi, V. Vijayakumar, B. S. Rawal and M. Maode, "An Effective Electronic waste management solution based on Blockchain Smart Contract in 5G Communities," 2020 IEEE 3rd 5G World Forum (5GWF), Bangalore, India, 2020, pp. 1-6, doi: 10.1109/5GWF49715.2020.9221346.
- [3] A. Dua, A. Dutta, N. Zaman and N. Kumar, "Blockchain-based E-waste Management in 5G Smart Communities," IEEE INFOCOM 2020 - IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), Toronto, ON, Canada, 2020, pp. 195-200, doi: 10.1109/INFOCOMWKSHPS50562.2020.9162845.
- [4] Sahoo S., Halder R. (2020) Blockchain-Based Forward and Reverse Supply Chains for E-waste Management. In: Dang T.K., Küng J., Takizawa M., Chung T.M. (eds) Future Data and Security Engineering. FDSE 2020. Lecture Notes in Computer Science, vol 12466. Springer, Cham. https://doi.org/10.1007/978-3-030-63924-2_12
- [5] N. Gupta and P. Bedi, "E-waste Management Using Blockchain based Smart Contracts," 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Bangalore, India, 2018, pp. 915-921, doi: 10.1109/ICACCI.2018.8554912.\

- [6] Chen, Mengjun, and Oladele A. Ogunseitan. "Zero E-waste: Regulatory impediments and blockchain imperatives." *Frontiers of Environmental Science & Engineering* 15.6 (2021): 114.
- [7] Dasaklis, Thomas K., Fran Casino, and Constantinos Patsakis. "A traceability and auditing framework for electronic equipment reverse logistics based on blockchain: the case of mobile phones." 2020 11th International Conference on Information, Intelligence, Systems and Applications (IISA. IEEE, 2020.

4. Annex

4.1 Annex A

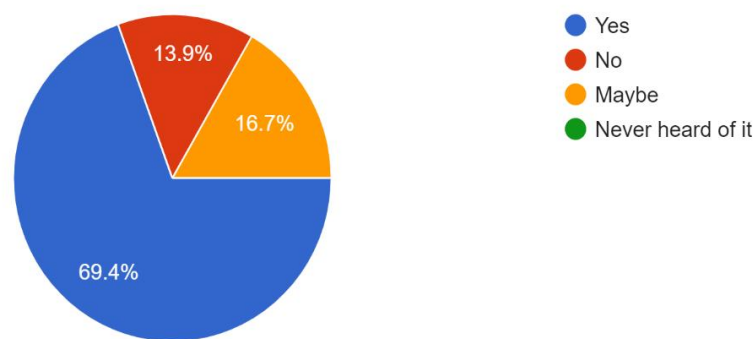


5. Appendices

5.1 Appendix A : Questionnaires

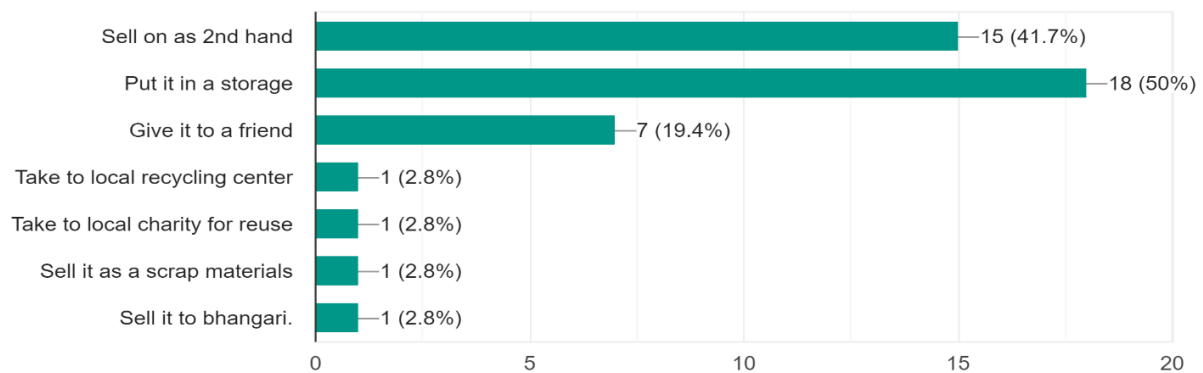
Do you know what is electronic waste(e-waste) ?

36 responses



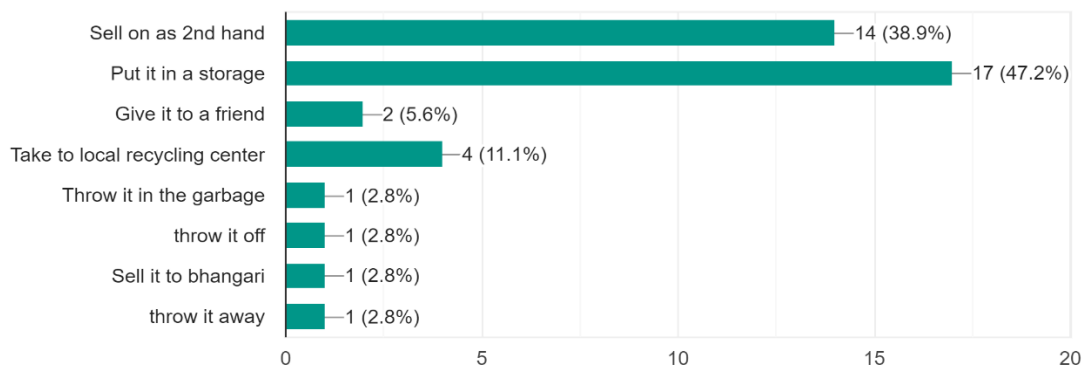
What do you do with working electronic/electrical products that you no longer use?

36 responses



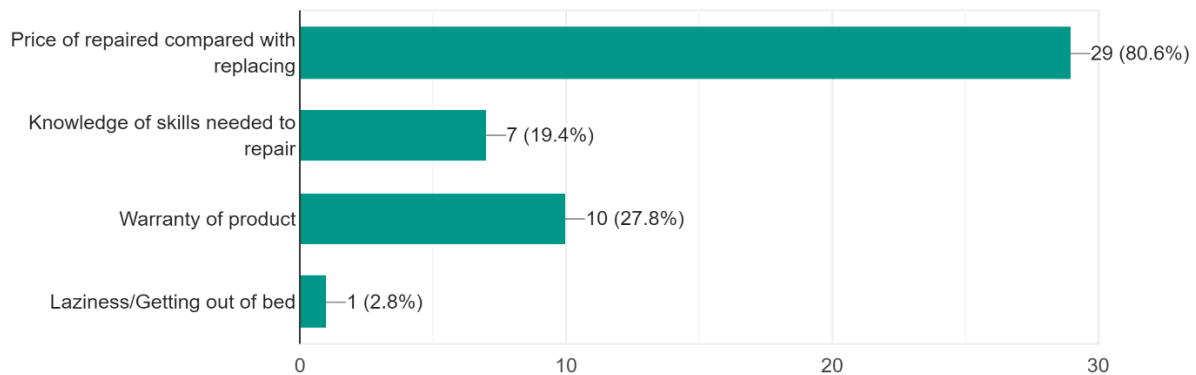
What do you do with broken electronic/electrical products?

36 responses

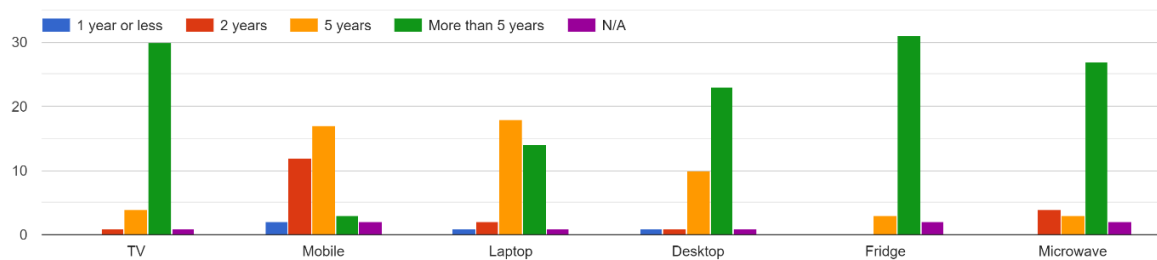


Which factors would affect your choice whether to repair an object or not?

36 responses

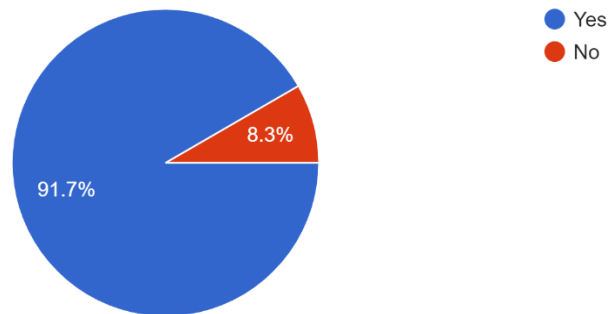


How long do you expect the following electronic/electrical items to last?



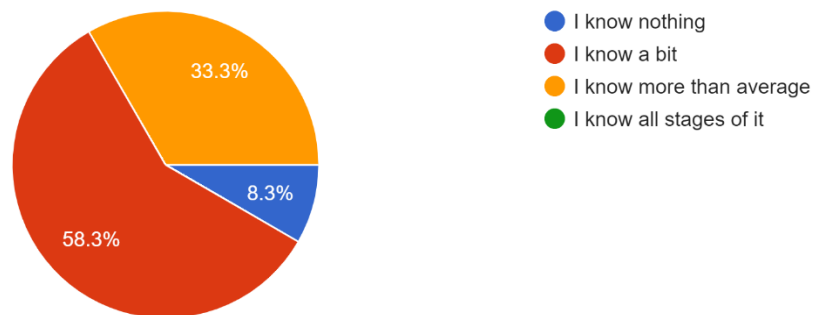
Do you think it's important to recycle electronics ?

36 responses



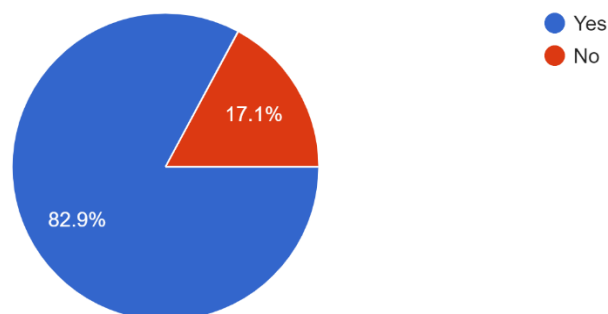
How much do you know about the materials used in electronic/electrical products?

36 responses



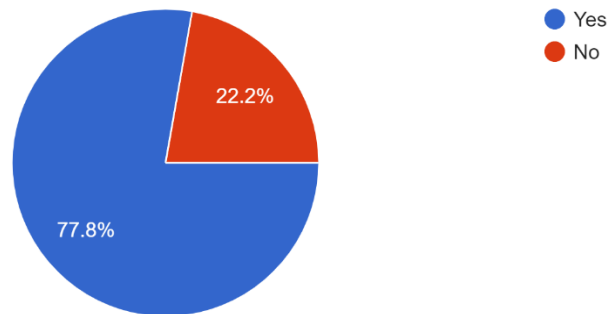
Do you know that improper e-waste disposal is harmful to the environment?

35 responses



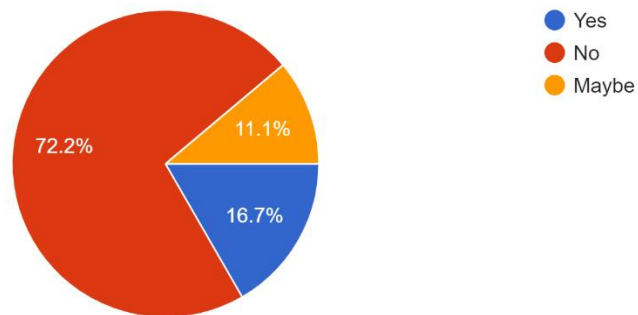
Are you aware of the health risks associated with e-waste?

36 responses



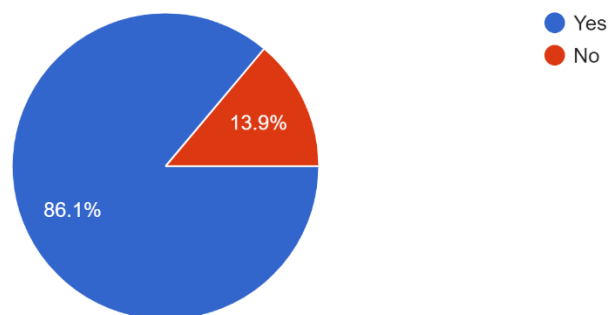
Have you received education on e-waste before?

36 responses



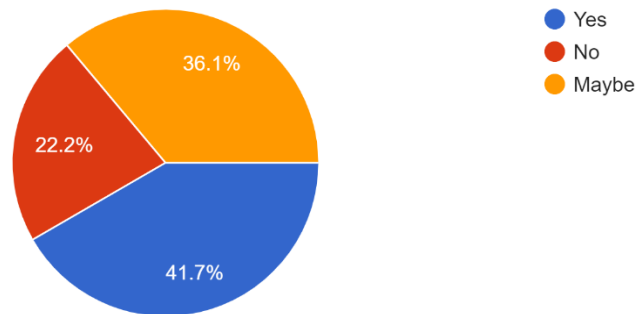
Would you want more education and awareness about e-waste?

36 responses



Would you be willing to pay a token in order to have someone effectively dispose your e-waste?

36 responses



If you have any comments regarding the issue of e-waste and how it affects you, please feel free to leave them here. Thank you!

9 responses

