Understanding the Opportunities and Challenges in E-waste Management Practices in Dhaka, Bangladesh

Md. Rashidujjaman Rifat
$1^{st} Year Ph.D. Student$
Computer Science
University of Toronto
Toronto, ON M5S 2E4, Canada
rifat@cs.toronto.edu

Nirupam Aich
Civil, Structural and
Environmental Engineering
University of Buffalo
Buffalo, NY 14260, USA
nirupama@buffalo.edu

Hasan Mahmud Prottoy
Electrical and ELectronic
Engineering
Bangladesh University of
Engineering and Technology
Dhaka, Bangladesh
prottoy.bd@gmail.com

Syed Ishtiaque Ahmed
Computer Science
University of Toronto
Toronto, ON M5S 2E4, Canada
ishtiaque@cs.toronto.edu

Abstract

The post-use phases of technologies are getting increasing interest in Human-Computer Interaction (HCI) and Information and Communication Technologies for Development (ICTD). However, while repair and maintenance have gotten much attention in the recent years, electronic waste (e-waste, henceforth), from its generation to processing, has remained mostly understudied. We argue that studying e-waste, especially in the context of a developing country, can provide us with a fresh perspective of technical practices around broken objects and its relationship with postcolonial computing. In this paper, we report a selected subset of our initial findings from a three-months long ethnography at the e-waste markets in Dhaka, Bangladesh. Our findings reveal four phases of practices around e-waste– flow of broken artifacts; separation and extraction; material processing; and e-waste selling and dumping. We propose a set of research questions that call for exploring the skills and knowledge of e-waste workers, the environmental and health concerns around e-waste processing, and the potential of e-waste recycling in contributing to national economy.

Author Keywords

E-waste, electronics, repair, reuse, recycle, material processing

ACM Classification Keywords

H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous; See [http://acm.org/about/class/1998/]: for full list of ACM classifiers. This section is required.

Introduction

Along with the mainstream focus on design, adoption, and use, the post-use phases of technologies (i.e., breakdown, maintenance, repair, and recycling) are getting increasing attention in HCI, ICTD, and other related disciplines. Repair movements, such as the Right to Repair (https://ifixit.org/right) and Fixer Collectives (http://www.fixerscollective.org/) have also put forth the tensions, politics, and complexities surrounding breakdown, repair, re-use, and recycling. Repair, maintenance, and recycling practices have often been recognized as lenses to look back at the phases of technology design and use, and to reflect on the opportunities that post-phases of technologies provide to understand some of the core concerns of HCI including sustainability [3], interaction design [8], learning [10], and privacy and security [1]. Another strand of HCI literature has focused on reasons why people cease using a technology, reasons for retaining obsolete devices that constitute domestic wastes, the practices of reuse, remake and re-manufacture [11, 6, 9]. While the existing HCI literature explains why a proper understanding of the post-use phases of technologies is essential, especially for design and sustainability, it falls short in addressing the following two questions that we are focusing on: a) how does the life of a e-waste worker look like?, and 2) what are the skills and knowledge that are required for being a good e-waste worker. We situate both of these questions in the context of Bangladesh which represents a low-income country in Southeast Asia with long colonial history.

In ICTD, the post-use phases of technologies have been addressed in the context of developing countries to demonstrate the skills and knowledge that the repairers possess [2], to identify repair as a mode of connection between local and global technological practices [10], to propose repair as a lens for designing novel technologies [17], and to conceptualize privacy vulnerabilities through repairing practices [1]. Putting the "context" of technology use in the center of studying post-use phases of technology has been emphasized in western-centric studies as well [9]. Our current study on e-waste workers in Bangladesh extend and strengthen this line of scholarship by adding novel findings from the field.

Beyond HCI and ICTD, the impact of e-waste has been extensively researched in other disciplines. Statistical reports on e-waste generation, processing, and business often appear that provides overview worldwide as well as focus on particular regions [12, 4]. The health and environmental concerns surrounding e-waste have been reported by several studies (see [7, 13, 14, 5], for example). While these studies mostly identify the weaknesses in e-waste regulation policies worldwide in processing and dumping, they seldom offer an in-depth understanding of the sources of risks, the human factors around such risks, and possible workarounds. In our study, we focus on the fact that policies do not always work in the wild, especially in low-income settings. Additionally, we focus on the resource scarcity such as the lack of space for keeping disposable e-waste in the e-waste shop, unavailability of proper dumping sites, etc. that have not gotten much attention in literature. By going forward with this study, we intend to investigate health and environmental risks of e-waste, and develop a deeper understanding of infrastructural politics in Bangladesh.

Methods

We have conducted our initial study to understand the ecologies around e-waste in Dhaka, Bangladesh that has given us insights into e-waste generation, management, and material processing. The study is a combination of a three-months-long ethnography and three separate e-waste processing workshops. The study took place in four different sites in Dhaka that are popular for e-waste business and material processing: Elephant Road, Nimtoli, Islambag, and Zinzira. Elephant road e-waste market is in the heart of Dhaka city that is located by the side of a road full of computer and electronic retail stores. The shops in the e-waste market have a bidirectional relationship with the surrounding electronic stores. The electronic stores generate a large amount of material wastes during assembling of PCs and other electronics. They sell those material wastes to the e-waste market, while the e-waste shops supply them with cheap electronic parts extracted from e-wastes. Nimtoli e-waste market is the biggest one of all the e-waste markets that we have studied. It accommodates large-scale e-waste businesses that perform activities ranging from buying e-wastes to processing materials in large scale. Small-scale e-waste businesses that confine their activities within purchasing, separating, and extracting electronic parts and materials are also there. Islambag houses factories, that are buyers of plastics in large lots from e-waste markets. Those factories process plastic materials. Zinzira is well known for metal processing– the workshops here buy metals of different kinds, melt them, and use them for making utensils, wires, machinery, etc. In addition to the e-waste markets and material processing factories, we have also studied several "out of a market" e-waste shops.

The first author has visited e-waste markets, observed the activities that take place in the markets, conducted unstructured and semi-structured interviews, and ran three "e-waste processing workshops". The workshops included various tasks of e-waste processing – breaking down an artifact, identifying and telling the names for electronic parts, separating and extracting electronic parts, and sorting out the materials that are not 'profitable'. The participants of our ethnography and workshops included e-waste collectors, shop owners, repairers, and workshop laborers–all of whom were collectively called "Bhangaries". Following the custom of our field, we will use this term, "Bhangaries" in this paper to collectively refer to the people involved in e-waste business. All our participants were male, aged between 18 and 60 years. The study generated more than six hours of audio recordings, more than one and a half hour of videos, fifteen pages of field notes, four biographies, and more than seven hundreds photographs. The interviews were conducted in Bengali, recorded, and translated and transcribed into English. A qualitative analysis that is similar to the inductive analysis [15] informs us to characterize electronics flow and the activities in e-waste management in Dhaka, Bangladesh. The following section describes the findings from the interviews and recycling workshops.

Findings

Flow of Electronics Artifacts

Our study aims to track the journey of a broken electronic artifact from the moment it breaks down to the moment when the components of it are embedded into a separate new entity. Hence, in the sections that follow, we describe the flow of electronics artifacts (and their components) from repairing to re-manufacturing. Thus we also document our findings of separation and extraction of electronic parts from artifacts, material processing of e-wastes, and dumping of "unused" parts of the waste artifacts.

Repair

When an electronic device breaks down [8, 11], most people in Bangladesh go to the repair market for repairing that. There are non-brand and multiple-purpose repair shops in Dhaka and elsewhere in Bangladesh. The repairers are often informally trained to repair electronics through apprenticeships [2]. With their local crafts and skills, these repairers build a sustainable repair market in Bangladesh [10]. In most cases, the tools for repairing electronics come from other broken devices and imports from abroad. The electronics that come to the repair market either go back to the users if the problem is fixed, or become e-wastes that are later used by the repairers for fixing other electronics until that loses all technical functionality and becomes an e-waste.

Recycle

Electronics that come to the repair market or the e-waste market are treated similarly in the beginning. The first thing that both repairers and "Bhangaries" do is, try to make the device functional by identifying and fixing minor problems. However, repairers exhibit more skills than "Bhangaries" in this step. If repairers and "Bhangaries" fail to repair a device, they break it down to extract its smaller electronic components for fixing other devices. Though repairers have knowledge and skills to readily use those parts, "Bhangaries" often accumulate those parts and sell those to a repair market. Moreover, this type of re-using electronic components is different from what are typically meant by re-use, remake, or re-manufacture [11].

After extracting useful components, repairers usually sell the rest of the device, which is no longer useful for them, in the e-waste market. E-waste markets take the next step. They further systematically break the electronics and separate "materials" from the devices. The common materials are metals of different kinds including copper, steal, tin, plastic, rubber, etc. The e-waste shops either process these materials themselves in order to reuse them, or they sell them to the factories that commercially process those to produce raw materials for other products. There still remain other materials that are not "useful" for bhangaris or factories (for example, glass, board). Such "useless" materials are thrown to the dumpsters.

Re-manufacture

Re-manufacture–the complete reconstruction of an electronic artifact by manipulating its parts–has been the least recognized practice in both e-waste markets and repair markets as it needs advanced skills. However, this is not absent from the markets, though. We have seen several cases of re-manufacturing computer monitors, mobile phones, and refrigerators, all taking place in the electronic repair markets. We intend to understand this practice with sufficient depth in the future iteration of our fieldwork in Dhaka.

Separation and Extraction of Electronic Parts

The e-waste market is a major supplier of both electronic components including diodes, ICs, transistors, batteries, etc., and copper, zinc, iron, plastic, etc. as raw materials. When "Bhangaries" are not able to make an electronic device functional, they extract and separate electronic parts and other materials from the devices. The veteran e-waste business people and their associates do this job. When a shop has so high loads of their work that they cannot give enough time to the extraction, the stores hire people on a contract basis to help the shop in extraction work. There are skilled or semi-skilled people that float around the market who can be hired by a shop for such tasks. The skilled e-waste extractors train the newcomers how to break electronics and separate the materials and electronic components. The newcomers also learn the basics of e-waste

business through this process. Through such apprentice-ship, newcomers learn art of a systematic and quick break-ing of electronics and of extracting materials in a way that the other components of the device do not get damaged.

After removing all "useful" components from the body of a broken electronic device, the "Bhangaries" start separat-ing the materials of different kinds from its body. During the learning process, they get familiar with the electronic artifact as a whole and it's parts that are sources of materials within the electronic artifact. This informal knowledge of electron-ics includes many situated understanding of the structure and behavior of the components that are used in building an electronic device. For example, they learn that copper comes from inside of wires, most of the body of an elec-tronic artifact is actually plastic, the wire-covers are made of low-cost rubbers, the monitor fronts are made of glasses, power suppliers have several parts that have iron, among many such.

"Bhangries" do not sell the separated materials instantly. Instead, they accumulate them in the shop. They use small boxes for storing small electronic devices, and large boxes or sacks for non-electronic materials. When they think that they have enough of the parts or materials to sell, they sell electronic components in the repair market and other ma-terials to the processing factories. Some e-waste shops have their own processing factories, too, or they partner with some other factories in a joint business.

Material Processing
The phase of material processing starts from the same electronic stores that buy e-wastes, and process and ex-tract materials from them. The extraction and separation need experiences so that the materials are prepared for storing and shipping efficiently. Otherwise, it becomes difficult for the e-waste stores to keep them in the limited amount of spaces.

Many shop owners also own factories in a convenient loca-tion with lower rent, usually outside of the city, where they process materials in a larger scale. In such cases, the shop owners ship the materials to their factories for processing. In other cases, the e-waste shops sell the materials to the wholesale buyers, who process the materials in special-ized factories. Several places in Dhaka are well-known for processing materials, where there are small and mid-sized stores and factories that process different materials. For example, Islambag is known for processing plastics, while Zinzira has many factories that process metals. The pro-cessing factories usually maintain a good relationship with the "Bhangaries" who supply them with the materials.

Dumping
While some e-waste shops that are affluent enough to af-ford large spaces to store goods, most stores are tiny, and the "Bhangaries" struggle to find space for storing their goods. So, the "Bhangaries" pursue an optimum strategy to decide what electronics and materials they will keep for business and what they will throw out. We found that the e-waste market treats some extracted electronic materi-als as "less profitable". For example, glass that comes out from monitors have little value to them. The market value of such less profitable electronic parts and materials is low also because there are no processing factories for them. In addition to the less-profitable electronics, certain materials are "not usable" at all. Bhanagries dump these electronic components to the nearby dumpsters. During the study, we have seen a tension among Bhangaries while sharing the information about dumping materials. Later, we came to know that there have been a number of visits by the media journalists to the e-waste markets that were followed by re-ports that expressed their concerns for the environmental

hazard arising from the dumped e-wastes. We will further explore this area in the next iteration of our fieldwork.

Research Questions

From our initial study, having been familiar with the e-waste flows and market ecologies, as well as material processing that connects to the e-waste business, we plan to conduct our next round of fieldwork around the following research questions:

- A rich set of skills and knowledge is required for efficient breakdown of electronics, extraction of electronic components, separation and processing of materials, and overall, sustaining the e-waste the business. How is this unique set of knowledge formed, shared, and propagated among Bhangari communities?

- E-waste handling and processing policies have long been concerned about environmental risks and health issues. While many countries, and regions collectively, were successful in putting together policies that worked effectively (a policy overview is listed here [16]), others are struggling in mitigating the risks, many of whom are just getting familiar with the issues as the amount of e-waste generation is increasing. However, the risks have not yet been adequately characterized in the context of a weak infrastructure and constrained logistic supports of a developing country. Our question in this vein would be, what are the nature and extent of environmental and health risks that arise from the stages of electronic parts extraction, material processing, and unregulated dumping of e-wastes in third world countries? This question may eventually contribute to policy recommendation to mitigating the above-mentioned risks.

- Our study on the seemingly stable e-waste market makes several implications: 1) e-wastes market may become a base for recycling, re-purposing, re-fabricating, and material processing and contribute to building a local industry in Bangladesh. In our study, we have seen sporadic entrepreneurial activities of such kind, which has room for growing further. The informal market activities, with proper recognition and characterization, can rise to a re-fabrication industry, for example. 2) The e-waste market that contributes to the culture of reproducing and repairing broken devices eventually helps in reducing imports of technologies from overseas. Here we are asking the question: what and how are the scopes of entrepreneurial opportunities surrounding e-waste businesses that use local infrastructure, resources, knowledge, and labors? We will try to find the answer to this question using a lens of postcolonial computing.

Conclusion

This paper hence proposes a long-term study on the practices around e-waste in Bangladesh that has only been started through a preliminary fieldwork. Our study has demonstrated the need for further research on e-waste practices in Bangladesh that can reveal many interesting aspects of electronic waste management including the scopes of recognizing the skills of "bhanagries" and institutionalizing them, combating the environmental and health threats in e-waste treatment, and creating an opportunity for entrepreneurship and empowerment through technical practices in Bangladesh. Further study will be conducted for acquiring an in-depth knowledge in each of these areas in future.

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