ISS International
Institute of Social Studies

"Follow the E-waste"

'Bridging the digital divide' or 'dumping'; the state of e-waste in Ghana.

A Research Paper presented by:

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Ghana

in partial fulfillment of the requirements for obtaining the degree of
MASTER OF ARTS IN DEVELOPMENT STUDIES

Major:

Agrarian, Food and Environmental Studies
(AFES)

Specialization: (ESD)

Environment and Sustainable Development

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The Hague, The Netherlands
December 2015

Disclaimer:

This document represents part of the author's study programme while at the Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

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Acknowledgement

Thanks, honour and adoration be onto the Most High God, for the grace, life, strength and good health he bestowed upon me throughout my studies and this thesis as a graduate student. I am most grateful to God for this opportunity.

I would like to express my profound gratitude to our research supervisor, Dr. Mindi Schneider for her guidance, advice and also for being instrumental in focusing my attention throughout the training and realization of this study.

My fullest appreciation goes to Dr. Murat Arsel for his critical comments that have improved my study. Thanks to Lucky, my discussant for the detail feedback. I could not have gone this far, by the efforts of the dedicated lectures of the AFES major. Kudos!

I would like to express my heartfelt gratitude to my parents Dr. and Mrs. Ben Vas Nyamadi and my brother Seiji Nyamadi for the love, care and enabling me have a good education in Europe. May God richly bless you all, I pray for peace and love in your hearts.

Further thanks to all the AFES villagers, friends from Ghana and all over the globe for the love and friendship throughout the studies.

I big shout out to my very good friends Veronica Michito Mudimba and Miraji Mohammed Hassan who were very supportive during this final stretch.

Much appreciation goes to Evelyn Gakpleazi for the last minute kind hearted help. I really appreciate!

Lastly, to my families and friends, I say a big **THANK YOU** for your generous assistance, encouragement, financial, spiritual and emotional support throughout my study. GOD BLESS YOU ALL.

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List of Acronyms

AMA	Accra Metropolitan Assembly
BAN	Basel Action Network
BAN	Basel Action Network
CEPS	Customs Exercise and Preventive Service
CRT	Cathode Ray Tube
EEE	Electrical and Electronic Equipment
ENGO's	Environmental Non-Governmental Organizations
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
ISS	Institute of Social Studies
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
PCBS	Polychlorinated Biphenyls
StEP	Solving the E-waste Problem
SVTC	Silicon Valley Toxics Coalition
UNDP	United Nations Environment Programme
WEEE	Waste Electrical and Electronic Equipment

Abstract

Electronic products improve and intensify our lives in diverse ways, but their afterlives remain to an enormous point perceived to be an unsolved predicament. This study pursues to explore the travels of used e-waste imported into Ghana seeking to what extent they are reduced, reused and recycled? While seeking the social processes that determine these outcomes as well as contribute to the emerging literature in the field e-waste. The central goal of this study is to examine the nexus of whether sending used electronics to developing countries is often hailed to reduce the wide gap of technological advancement between the global north and the south or they are rather finding dumping sites to dispose of their used electronics.

The study uses the theoretical framework of commodity chain analysis to conceptualize the study. The study helped unpacked e-waste revealing that, it was not easy to tell what the clear cut of waste and value embedded in the nodes of the study. This study however, revealed the employment e-waste trade generates in the informal sector at different nodes of the electronic chain. The findings also noticed the socio-economic factors embedded in the e-waste trade. Furthermore, it discloses interestingly, the precious minerals and the value embedded in the chain. In conclusion the paper highlights the crucial role of e-waste in the informal sector and opportunities for further research on the subject.

Relevance to Development Studies

In this world of fast pace of globalization, the utilization of electronics in our everyday life is practically of importance to our existence. The effective management of the end-of-life of these products has not been fully been grasped by consumers and manufactures. This is primarily due to the fact that there is an emerging knowledge on e-waste in the field of waste management. The flow or transfer of e-waste from the developed countries to the developing countries and how it is being managed and policies governing it is an issue of concern for sustainable development.

Keywords

Chapter 1 Introduction

1.1 Setting the Scene:

> *Where should we start? As always, it's best to begin in the middle of things, in Medias res. (Latour 2005: 27)*

> Matters grow from the middle, and from many places, but one also has to start from somewhere. *(Law 2002:1)*

This study explores the travels of Used Electrical and Electronic Equipment (UEEE) often referred to e-waste imported in Ghana, However, for the relevance of this research, the study starts from the end-of-life of these UEEE which are exported to Ghana. This study considers the activities at the reverse end of the supply chain. It seeks to determine the extent to which these electronics turn to be percieved as "bridging the digital divide" or turn to be waste "dumping". Latour (2005: 27) and Law (2002:11) cited in Lepawsky and Mather (2010: 242) best explains the above quote and why it is important to start from somewhere or in the middle of things. This investigation does not take into account the manufacturing, distribution and consumption of electronic products aboard. But it good to start from somewhere.

The underlying assumption that is critically investigated is the dominant perception that sending used electronics to developing countries is a way of reducing the wide gap in the technological advancement between the global north and south, versus the claim that e-waste is another form of dumping. This 'dumping' occurs when the global north countries use turn some global south countries as disposal sites of their used electronic equipment as argued by ENGO's (Puckett et al. 2005).

This study aims to use commodity chain analysis of global production networks to follow and unpack e-waste use in Accra, Ghana. This will help identify the actors involved in defining and regulating e-waste and the extent to which UEEE are utilized or end as waste. It will also help unveil the social process which determine e-waste outcomes at the various nodes embedded in the e-waste chain. Thus to this end, the use of the Commodity Chain Analysis (CCA) as a framework will help to explore the activities at the "back end" or

the reverse supply chain of e-waste into Ghana. The research takes into account the initial entry of discarded electronics 'product activity' as it enters through the ports of Ghana and considers final outcomes. The process takes into account the different nodes of interaction involved in transformation or modification of e-waste through different nodes.

1.2 Background to the study

The growing rate of the electronics industry and the improvement in technology has led to a reduction in the lifespan of electronic equipment, which accumulates as used or discarded electronics (Yu et al. 2010). In general Waste Electrical and Electronic Equipment (WEEE) is often regarded as e-waste. Different descriptions by various authors commonly refer to e-waste as "old, end-of-life electronic and electrical equipment (EEE) or waste generated from any equipment running on electricity or battery" (Oteng-Ababio 2012: 2). This comprises of computers, microwave ovens, electric cookers and other equipment that have been discarded (Kuper and Hojsik 2008: 4). Nevertheless, EEE also contains toxic elements including mercury and heavy metals (Widmer et al. 2005: 436) which the reports from Environmental Non-Governmental Organisations (ENGOs) like Greenpeace International and the media have established the negative impacts of disposal on both environment and human health.

There have been growing concerns in the domain of disposal practices of these electronic products (Grossman 2007: 139), which has been attributed to the fast development in technology, which Widmer (et al. 2005: 437) assert that it has led to an approximate of 20-25 million tonnes of waste created worldwide annually. In 2010, 3 million tonnes of e-waste was accounted for by the United States of America (USA), while 2.5 million tonnes of e-waste was generated in the European Union (EU) (Torretta et al., 2013). On the other hand, in landfills in Australia, it was estimated that 234 thousand tonnes of e-waste was produced and with the growing population, it is anticipated to triple by 2020 (Robinson et al. 2009: 184). E-waste is absorbed into e-waste streams globally (Lundgren, 2012), which is estimated to grow at a rate of 4%, resulting in serious human health and environmental risk (Schmidt et al. 2006).

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The Basel Convention was established to set global standards for the movement and management associated with hazardous waste (Basel Convention 2011). The EU has also set standards and regulations for the movement and exportation of hazardous waste equipment from within the region (EU. Directive. (2002a). However, various institutions, exporters and buyers have made use of the loopholes in these regulations, and send UEEE to global south nations in Asia and Africa (Schmidt et al. 2006). These activities are done regardless of the strict laws of the EU on e-waste, which prohibit the unlawful export of hazardous e-waste (STEP 2011: 9),

Kuper and Hojsik (2008:4) has alleged in their report, *Poisoning the Poor* in which they expressed the notion of transferring old electronic equipment to developing countries is often hailed as helping to "*bridging the digital divide*" between the global north and south, but in reality "*dumping*" their unwanted equipment in developing countries. Various research reports by ENGOs have indicated 25%-75% of second hand goods imported to Africa cannot be reused (Basel Action Network (BAN), 2002a, 2002b; Toxic Link India 2003). They further expressed that tons of e-waste originating from the EU and USA end-up in the global south. This is often shipped and labelled as "*second hand goods*" to mainly Asia and Africa (Kuper and Hojsik 2008: 4)

The ENGOs (Greenpeace International 2005, Basel Action Network (BAN), 2002a, 2002b; Toxic Link India 2003) also published research reports indicating between 80% and 50% of e-waste labelled for recycling internally in the United States and Canada respectively, sometimes end-up being exported outside these countries. After it is exported, it ends up mostly in parts of Asia, Latin America and Africa. In the global south, e-waste ends up being processed manually, disassembled by marginalized communities (Kuper and Hojsik 2008: 4). They are dependent on these activities for their socio-economic livelihoods in different forms. In the marginalized communities the informal workers operate under poor working conditions and the use of rudimentary methods expose workers to various types of harmful conditions (Amoyaw-Osei et al. 2011: 49).

1.3 Statement of the research problem

Electronic waste is an emerging and a contested issue globally, as it comes along with business opportunities of accumulative implication globally (UNEP 2006). Managing the amount of this increasing waste stream is a complex task which requires handling in an efficient and cost effective manner with minimum environmental impacts. According to Sinha-Khetriwal et al. (2005: 493) e-waste contains some amount of precious minerals, which consist of gold, steel, copper, aluminium amongst other metals. Greenpeace International (Kuper and Hojsik 2008: 12) shows e-waste contains about 60% of metals, while about 2.7% were hazardous pollutants giving the high rates of pollutants in e-waste if improperly disposed, recycled or burned in a uncontrolled environment, it could pose some threats to both humans and the ecosystem at large (Schmidt et, al, 2009, BAN 2002: 9).

A country like Switzerland[1] has an effective management system for handling e-waste in the world as shown by Empa[2]. It consists of an effective management system which takes into account the collection, recycling, disposal and monitoring process in an eco-friendly manner (Sinha-Khetriwal et al. 2005:495). The growing quantities of e-waste necessitate such efforts in the management of e-waste, as compared to most of the global south countries that are still battling with the menace of e-waste (Agarwal et al. 2019; 198).

Historically, the trade of e-waste mainly took place in Asia, but recently the business has spread to other regions, particularly West Africa, which Nigeria and Ghana prominently are no exception (BAN[3], 2005). Accordingly, Brigden et al (2005: 55) argues that this e-waste which often ends up in developing countries poses a lot of risk because these countries have little or no regulation on recycling or disposal. He further claims that sometimes this e-waste enters into these countries in the form of aid or for trade purposes.

In Ghana, it is reported that e-waste is mainly processed informally at a scrap market called Agbogbloshie The e-waste workers engaged in some unsafe ac-

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[1] Estimated GDP per capita was US$39, 800 according to the World Bank Development Indicators.2004
[2] Empa- Swiss Federal Laboratories for Material Testing and Research.
[3] Basel Action Network (BAN), report in 2005 Exporting Reuse to Africa

tivities such as burning gadgets to process e-waste and this has posed both human and environmental impacts (Greenpeace 2008:4). The increasing awareness of the dangers of e-waste activities has led to the development of several studies on e-waste in Ghana, analysed from diverse viewpoints. Furhriman (2008) discussed e-waste as human rights violation in the framework of environmental justice. Asante et al. (2012) frames e-waste within the toxicology to study and reported on the health effects of e-waste works at Agbogbloshie. While in another study, the environmental impacts of e-waste was studied in Accra (Prakash et al., 2010|) amongst others.

However, Lepawsky and Mcnabb (2009: 2) suggest the exportation of e-waste to developing countries and the entire process involved is a complex situation rather than a linear one. The authors advocated the problem of e-waste should not only be perspective simply as "bridging" verse "dumping" of UEEE in the global south. Lepawsky and Mcnabb (2009:14) argued the problem of linearity in e-waste might be understood as the "moral geographies" of the international flows of e-waste. The authors explained that things could be understood in a morally ordering manner that might unveil social and uneven power relations in the e-waste activities in the global south.

This gap has been identified to contribute to existing literature on e-waste in the Ghanaian context. Therefore, the need to contextualize this study problem using a commodity chain analysis, to help understanding and identifying the different nodes of interaction involved in the e-waste activities is important. My study aims to focus on the back end of the chain or the reverse supply chain. Beginning from the initial entry of the "product activity" as it enters through Ghana by port. This process will help unpack the various factors and activities, which underlie the e-waste trade in the context or "bridging the digital divide" or "dumping" of WEEE.

1.4 Objectives of the Study

The purpose of this study is to examine the current social life of e-waste entry to the global south focusing on Ghana as a case study. The general objectives for this study are to:

- Identify and understand the processes that determine whether import-ed used electronics are re-used, re-sold or end-up as e-waste

- Assess the socio-economic factors that revolve with the used of im-ported electronics in Ghana.

1.5 Research Questions

There are sufficient studies and reviews on e-waste (UNEP et el., 2005) that clearly demonstrate the fact that, e-waste has a negative impact on both the environment and human health in Ghana, but a number of questions still re-main unanswered, including the following

- To what extent are the used electronics imported into Ghana re-used and to what extent do they become e-waste? And what are the social processes that determine these outcomes?

The **sub-questions** for the study include:

- Who are the actors in Ghana involved in defining and regulating e-waste, and how do they interact?

- What are the dominant discourses about e-waste, and who is defining them and what are the underlying logics and assumptions?

- How do social networks influence livelihood strategies for survival in the e-waste trade?

1.6 Relevance and Justification

In this technological age, the use of electronics in our everyday life is important to our existence, but the management of the 'end-of-life' of these electronic products have not been fully managed effectively. This is primarily due to the fact that there is an emerging knowledge on e-waste literature in the field of waste management. The export of e-waste from the developed countries to the developing countries and how its impact should be of great concern in devel-oping countries, whose marginalised communities depend on e-waste in di-verse ways. Hence, understanding the key concepts of e-waste management,

the various actors' involved and socio-economic relationships that revolve around it are of great importance to add to existing literature.

1.7 Research Process and Methodology

The study focuses on e-waste as "digital bridging" or "dumping" using Accra, Ghana the hub of e-waste as a single case. The reason for choosing Accra as a case study is that it provides the researcher with a clearly defined unit of observation to be studied (Accra, e-waste) and identifies all actors involved (Babbie and Mouton, 2001). Selection of (a) case (s) depend on factors such as a pragmatics, intrinsic interest, purposive (typical-extremely good or bad) and access (O'Leary, 2010: 176; yin, 2012). According to Yin (2012), case studies fall into three categories: explanatory, descriptive and exploratory. An exploratory case is mostly used to explain the phenomenon which is left unanswered in the research literature. This research considers, the selection of the case primarily on the fact that it is well-thought-out as a typical case (extremely good case). This is primarily because there have been significant environmental and health records at the site as well as majority of e-waste dealers present. Secondly, the choice was on the basis that easy access to better information and data, since some research work has been carried out but from different perspectives.

Respondent selection were done purposively. Respondents who participated in the study were drawn from the officials of Environmental Protection Agency (EPA), Accra Metropolitan Assembly (AMA), Customs Exercise and Preventive Services (CEPS) and e-waste traders or dealers Green Advocacy (ENGO) and some people in one way or the other who have been dealing with e-waste in Ghana. Care had been taken to identify informants (e-waste workers) willing to be interviewed. The nature of the study is an empirical one, which requires asking questions and observations to help understand real problems like issues of e-waste and observable patterns of trade. This is a qualitative study that used a combination of primary data using semi-structured interviews and secondary data, mainly scholarly journals, reports and ENGOs documents. The study also includes the various methods and techniques of data collection and analysis engaged in this study. This will be elaborated into the following sections below.

1.7.1 Secondary Data

The study engaged the use of secondary data, obtained from desk reviews of literature of existing reports and work related to e-waste. Google scholar was used to access scholarly journals, both published and unpublished articles as well as some policy documents. Some ENGOs websites such as Greenpeace International, Toxic Link India, Basel Action Network, Silicon Valley Toxics Coalition (SVTC), Solving The E-waste Problem, and News articles; the Guardian New and British Broadcasting Corporation (UK) which have been actively been reporting on e-waste. Additional information was obtained from the archives of the Ministry of Science and Environment and the Environmental Protection Agency (EPA) Ghana. The information attained was basically, historical, legal framework on e-waste amendment bill, binding treaties and conventions relevant to this study. This literature was reviewed to get a better comprehensive understanding of the study in the Ghanaian setting.

1.7.2 Primary Data (Interviews and observation)

The primary data collection for this study began on 1st July 2015. This was prior to a thorough best practices review of secondary literature to assist in designing the study that ended on 4th August 2015. The field work incorporated sampling techniques and data used was obtained on an individual basis through survey, interviews, questionnaire administration to identify the major social actors involved and assessed the extent to which used electronics were re-used and constituted waste. Purposive sampling was engaged in order to achieve maximum information about e-waste with key informants. The methods used were mixed method techniques, combining both qualitative interviews and observation to have diversity from informants.

Five questionnaires were pilot tested with different respondents to check its efficacy. The pilot tested sample questionnaires helped the study to ensure the research objective and questions were being addressed. Descriptive and qualitative skills were engaged in the study to summarize and analyse the collected data. This involved transcribing, collating interviews, and analysis them to gain

a deeper insight about the research objectives and addressing the research questions. This helped the study to achieve a desirable outcome.

Ethnographic approach was mainly employed during the research to observe and try to comprehend how e-waste travels from the ports of Ghana and the process it passes through. It involved 6 weeks of critical observation of the flow of e-waste operations and getting insight into the diverse ways of organising e-waste activities. This approach was used to trace e-waste from the port to ascertain whether UEEE was totally a waste or still functional (reuse). The main focus of ethnographic approach is to offer observable processes as a critical method of reflection on a problem to understand different cases in passive observation (Douglas, 1980: 54). One expert of ethnographic study commented that "the work that thought does is social… thought makes cuts and connections between actions" (Mosse 2004: 667).

Personal interviews and observations were used to ascertain the practices of e-waste workers. It enabled the study, to observe and document first-hand information on socio-economic activities and potential risk associated with processing e-waste during the different nodes of observations: retail, refurbishing, collection, dismantling and trading of some metals. Observations unlike interviews where data obtained was based on the perception of interviewees, produced data based on the observer insight and perceptual sense (Oteng-Ababio, 2012: 4). Thus this helped in the study to ascertain the practices of e-waste workers and how those practices were consistent with or deviated from the expected practices in the field. This approach helped in the view of "bridging the digital divide" or "dumping" between the expected practice and what is being done currently in the field.

The observations conducted during the study also allowed me to follow the e-waste from field at the port where they were off loaded from the shipping containers and also at the hub of e-waste market through various nodes. It was also used for accompaniment and to validate the data collected. The observation was carried out at the various nodes of study, which took account of the retail, refurbishing, collection, dismantling and disposal. This was very important because observations are not like interviews whereby data is attained from interviewees. The observation were used in the study help the research

process to ascertain the activities involved in the current practices of e-waste at the various nodes as compared to the general view of "bridging the digital divide" or "dumping" of e-waste in the global south as seen in the literature.

Furthermore, after the initial data collection period ended, additional key informant interviews were also conducted. Personal interviews with the Environment Health and Safety officer (EHS) at Accra Metropolitan Assembly and the head of solids at Zoom lion international (a private waste company, Ghana) to obtain additional information to suggest on how to deal with the current influx of e-waste trade in the country. Additionally, access to Customs database on world trade data which were not really available and could not be publicly accessed was negotiated with the relevant officials to access the data on inflow of electronics via the port of Ghana.

A total of 20 key informants were engaged in the primary data collection process. All the data were transcribed for analysis and consolidated into this study in November 2015.

1.8 Scope and Limitation

The phenomena of e-waste and negative effects on both environmental and human have been investigated in numerous literatures (Brigden, et al. 2005). Nevertheless, the current perspective on the state of information on e-waste regarded as "*bridging the digital divide" or "dumping"* complete waste or usable electronics still remain inadequate. This study does not endeavour to provide a comprehensive analysis of e-waste from different spheres (environmental, human, social, and economic impact etc.), nonetheless of a case study in the country, but only specific features relevant to the main research question. This study took place in a country where there was a lot of research done on e-waste but with the fast changing diverse conditions of development, economic activities and opportunities in the country some changes might have taken place. Notwithstanding these limitations, the research hopes that its findings and results will be beneficial for further studies on e-waste.

Another limitation was access to informants and inter-organization politics. The busy nature of the Environmental Protection Agency (EPA) senior officials (directors) at work due to their tight schedules during the period of my

research were encountered. However, most of the interviews were conducted with their deputies which had a limitation because it might not reflect the exact view of their directors. The integrity of the organisation was at stake and their responses were mainly subjective. Thus to overcome these biases, it was followed up by emails to ascertain the views from their directions in line with the earlier discussions. It was also emphasized that the study was for academic purposes and not for media publication which helped to minimise some bias. The study also interviewed (the e-waste and scrap dealers) but the main challenge was language barrier because most of them could not speak English but only Hausa (a local language from the northern part of Ghana). However, this challenge was dealt with by employing an assistant to translate the question from English to Hausa.

1.9 Organisation of the paper

This study is organised into five chapters. The first chapter gives an introduction to the research problem and gives some important information about this case study on e-waste. It also clarifies the research questions and methods that were used throughout the research. The second chapter analyses some existing literature on e-waste relevant to this study. It also introduces the commodity chain analysis as the conceptual framework that was used to conceptualize this study. Chapter three provides a detailed account about *'following the thing: e-waste'*. As study embarks on e-waste from the ports of Ghana, and ends up at Agbogbloshie site. The main hub of e-waste processing in the country, as the study tries to find, the final outcome of e-waste. The four Chapter provides a more in-depth look at the current socio-economic factors that revolved around the e-waste trade. It also analyses the different nodes and what factors add value from one node to another hence the continuity of the trade. Finally, the last chapter follows by concluding remarks on *"bridging the digital divide"* or *"dumping"* and possibly suggests gaps that future research can explore.

Chapter 2 Literature Review

2.1 Introduction

Several researches have been conducted on e-waste and their effects on both humans and the environment (UN, 2014:12). This section reviews research work in retrospect documented by various scholars, concerning e-waste and some debates relevant to this study. It identifies some definitions and theoretical framework relevant to contextualize the study. It also introduces the framework of commodity chains which was used to contextualize this study on e-waste. It also reviews recent publication on e-waste, highlights the current developments and discussions undertaken over the years in relation to anthropogenic activities with regards to e-waste.

According to Lepawsky and Billah (2011: 122), there are three main themes on the growing literature about e-waste discourse. The first strand examines e-waste from the standpoint of social and environment justice. (BAN 2002, 2005: Pellow and Park 2002; Toxic link India 2003, 2007, Greenpeace International 2008; lles 2004; Pellow2007). The *second* strand of discourse approaches e-waste from the view point of environmental toxicology and occupational health. (Clapp 1994; Neumayer et al. 2001). The third strand of discourse on the issues of e-waste takes the view point of engineering environmental management view besides apprehension with resources and energy flows in the manufacturing of electronics (Williams et al. 2002; William 2004) and the effective and efficient ways of the disposal of post-consumption of EEE. (Kahha et al. 2008a, 2008b). However ,there is a shared link between the three strands which is the primary assumption of potential result of the 'production-consumption-disposal chain" and which could be in some form of *waste*, either in effluent, toxic hazard or in any form of emission (Lepawsky, 2015: 149).

2.2 What exactly is e-waste?

In general, electronic waste known as e-waste and also called Waste Electrical and Electronic Equipment (W)EEE) is a famous name given to electronic gadgets nearing or at the end of its productive life or have become obsolete. This is a generic word embracing various forms of EEE that are no longer of use or of value to its original users. Thus e-waste has several definitions. The interpretation of each definition depends on the usefulness of the electronic device. Many international organisations and environmental organisations, non-governmental organisations (e) NGOs have actively tried in drawing some definitions of e-waste. Some of these organisation include, Basel Action Network (BAN), Greenpeace International, Solving the e-waste problem (STEP), United Nations Program on Environment (UNEP) as well as several scholars have engaged in the debates of e-waste definition. However, the **Table 1**. below shows a list of selected definitions, in accordance to the EU WEE directive. However the classification below appears to stand in the course of becoming a generally accepted standard (Sinha-Khetriwal at al., 2005; 439).

Table 2-1 : Overview of definitions of e-waste

Reference	Definitions of e-waste
EU WEE directive (EU, 2002a)	"Electronic and Electrical Equipment (EEE) as devices that are dependent on Electronic current or Electromagnetic field in order to work properly and include Equipment for generation, transfer and measurement of such currents and fields".
Basel Action Network (Puckett and Smith, 2002)	"E-waste encompasses a broad and growing range of electronic devices ranging from large house devices such as refrigerators, air conditioners, cell phones, personal stereos, and consumer electronics to computers which have been discarded by their users".
OECD (2001)	"Any electrically powered appliance that no longer satisfies the current owner for its original purpose".
SINHA (2004)	An electrically powered appliance that no longer satisfies the current owner for its original purpose".
STEP (2005)	E-waste refers to ... the reverse supply chain which collects products no longer desired by a given consumer and refurbished for other consumers, recycles, or otherwise processes waste".

However, the United Kingdom (UK) Environmental Agency (EA) defines e-waste as according to their end of life usefulness. It considers a gadget as useful and not waste when still repairable, can be given away for value, can be traded in for a brand new type, given for aid commitments, sent out for refurbishing or reimbursed to a retailer in agreement by means of the organizations return policies. Therefore, an equipment could be considered as e-waste, based on the above explanations or situations by the agency (Environmental Agency 2012)

Additionally, the United States of America (USA) Environmental protection Agency (EPA) classifies e-waste by the use of categorization. The agency categorizes e-waste according to non-hazardous waste which include electronic waste and scrap metals meant for recycling and non-waste which comprises all products and commodities intended for recycling for instance circuit boards, scrap metals, Cathode Ray Tube (CRT) and glass (Tonetti, 2007)[4]. Paradoxical-

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EPA published the final results of its study "Electronics waste management in the United States" in July, 2008. The consumer electronics covered in the EPA's analyses are televisions, personal computers (desktops, laptops, computer monitors), hard copy computer peripherals and cell phones. Robert Tonetti, EPA Office of Solid Waste, presentation of materials, "EPA Regulatory program for E-waste," October 2007, available online http://www.epa.gov/waste/conserve/material/ecycling/docs/e-wastegs.pdf. Although not defined in law or regu-

ly, the EPA also takes into consideration discarded CRT monitors as "hazard-ous households waste" (Morgan 2006): but then considers CRTs reserve for testing or recyclable parts of out-of-date equipment (functioning and fixable electronics) and other scrap materials also known as secondary scrap such; steel, plastic, copper etc. labelled as "commodities" if they are not discarded, speculatively accumulated, or left insecure from harsh weather conditions as well as other damages. Emphatically, the EPA policy states outmoded electron-ic equipment are not taking into consideration as waste, up until a focused conclusion is agreed addressing their continuous functionality henceforth the use of non-waste as showed in the definition directly above is valid (Tonetti 2007).

Furthermore, the e-waste is often denoted as the end-of-life products. The end-of-life products are generally considered by its original users to be non-usable. Some of these equipment often have both material value and non-materials values. According to Fleischmann (2001) and Flapper, Numen and Wassenmow (2005) refers to end-of-life equipment as "products with no other residual value than material values". However, Babu et al. (2007) also defines e-waste as "any obsolete equipment that is dependent on electric currents or electromagnetic fields in order to work properly, including equipment for the generation, transfer and management of electric current".

However, from the analysis of the above literature, the various shortcom-ings of definition of e-waste has no clear consensus on whether the term e-waste should be germane to refurbishing equipment, resale and reuse items or cannot be used for its proposed use. Notably, electronic equipment contained substances in such as mercury or PCBs which is not critically inclusive in defin-ing what would be considered as e-waste. Thus, due to the general use of the buzz word "e-waste" and diverse constitute, approaches and ways and means of discarding differs significantly as supposed in the definitions. For instance the EPA defines e-waste is seen to be challenging basically since it does not seek for a clear definition of the difference between electronic equipment seen as toxic e-waste and those considered as not toxic e-waste. This leaves a loop hole to be exploited by actors who actively engage in the exportations, recy-cling or e-waste management. Irrespective of these differences, a basic ground for the various definitions is that e-waste comprise of electronics equipment which are no extensively considered of use to their original users and therefore discarded. However for the relevance of this research e-waste will be referred to as discarded obsolete or non-usable while UEEE will be for reusable equipment.

The EU Commendably, has a precise and all-inclusive elaborate approach to e-waste management. Some key actors in the consumption and disposal of e-waste are certified and regulated. The European Parliament legislative Reso-

lation, in this report, "recycling infrastructure" refers to the collection, transportation and processing of e-waste for reuse r recycling.

lution draft, an excerpt which subsequent evaluation amendments states undoubtedly:

The purpose of this directive is to contribute to sustainable production and consumption by, as a first priority, the prevention of WEEE and, in addition, by the re-use, recycling and other forms of recovery of such waste, so as to reduce the disposal of waste and to contribute to the efficient use of resources and the retrieval of critical raw materials. It also seeks to improve the environmental performance of all operators involved in the life cycle of EEE, for example, producers, distributors and consumers and, in particular, those operators directly involved in the collection and treatment of WEEE (European Parliament, 2001).

This directive takes into consideration, Sustainable e-waste management as an integral part of environmental management. Redclift (2013: 298) situates it as, "the environment is most times understood in relation with the functions it performs which is replicated by the social practices and commitments of human societies. The environment is occasionally neglected in the social practices such as the "getting and spending" habits that characterize modern complex societies". Nevertheless this directive touches on the lifecycle or chain involved income and employment are somehow linked to the tendency of consumers to the level of end-of-life. This is reflected in the quantity of waste and life cycle of the WEEE in question generated, which some definitions did not capture comprehensively. Thus from cradle to cradle design[5].

Furthermore agreeing to Sachs (2001: 7), "consumption can be addictive; it does not only increase as the level of income increases, but goods which an originally experienced person perceived as luxuries are regarded as necessities". Hence, to successfully address the presence of e-waste in the environment, it is essential to acknowledge the trending patterns of consumption by consumer in the environment as a whole. Notwithstanding this, it is pretty dejected of the management practices carried out by most of the claims of e-waste definitions which only address parts of the consumption partners by the definitions presented earlier.

2.3 E-waste as dumping

> *…What is common to the utmost number has the least care bestow upon it. Everybody thinks chiefly of his own, barely at all of the common interest (Aristotle, politics, Book 2, III)*

Research on e-waste hit the frontline recently. The press and ENGO's were among lots to bring this emerging issues to the spotlight (Lepawsky, 2014: 5). UNEP[6] (2010: 5) estimates about 20-50 million tonnes e-waste is generated in mainly the developed countries annually which is expected to increase substantially in the forthcoming year. The mass production of e-waste was also

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[5]This is sometimes referred to as C2C or regenerative design. The basic idea is a product design model which, which suggest a holistic economic, industrial, social framework that seeks to create a system that are only efficient but inclusively an essentially waste free. "Cradle to Cradle" is designing a product, instead of cradle to grave, their "end-of-life" grave is transformed into a new cradle meaning the materials would be used for manufacturing of new things. (McDough and Braungar, 2002: 1-25).

[6] The United Nations Environment Program (UNEP)

forewarned by Arensman (2000) to electronic manufactures as a developing issue which the industry needs attention. His publication *Electronic Business* along with *Exporting Harm* by BAN (2002) were citied in a UN brochure (Schwarzner et al. 2005). This report in the UN pamphlet became popular reference in the grey and scholarly e-waste literature as important facts and figures distributed in support of leading activist, academic and news broadcast representations of e-waste. Notwithstanding this facts and figures stated by the report, there has been a growing concern by the US Environmental Protection Agency. Brigden et al (2005: 55) notes

e-waste is the fastest growing segment of the overall waste stream at 3-5% per annum; global of e-waste is estimated to be between 20 and 50 million tonnes, and between 50 and 80% of e-waste is exported rather than recycled domestically in the USA.

Greenpeace International (2002), SVTC[7], BAN[8], STEP[9] among others also established facts and laboratory results indicating in developing countries the effects of WEEE on both humans and their environments. In 2008, Greenpeace International again, published *toxic tech* reports of high quantities of old appliances aimed to re-use or recycle have created high volumes of e-waste in parts of Eastern Europe, Asia and Africa amongst others. Additionally, Swed-Watch (2009) reported on the regulation of e-waste, most countries in the global south, especially in Asia and Africa lack proper legislation which allows the influx of e-waste. BAN 2002; Toxic Link India 2003; and Greenpeace International 2005 investigations reveals between 50 to 80 percent of WEEE in North America ends up been exported to overseas to mainly Asia, Africa and to other developing parts of the globe. The ENGOs reported e-waste, is being dumped from USA, Canada and Japan (Oh and Thompson, 2006; BAN/SVTC, 2002; BAN, 2005). This act undermines the wellbeing of ecosystems and environmental unjust.

Furthermore, SVTC and Greenpeace International (2012) disclose highly toxic samples from various dump sites of e-waste processing from China, India, Nigeria and Ghana. They reported high levels of many toxic metals that accompanied e-waste. Which included toxicology, labelled evidence of ownership, ethnographic documentation water and soil analysis. Thrown from these techniques, soil and water samples from the study contained high toxic levels such as metal lead, chlorobenzenes, antimony, cadmium, PCBS, DEHP, DBP and phthalate. The elements presented were noted to interfere with the sexual reproduction system as well as the human brain (Kuper and Hojsik 2008: 8). BAN, Toxic Link India and Greenpeace using a combination of the above techniques, were able to track back EEE from Canada, US and other countries in Western Europe (Basel Action network, 2002a). It was reported that high level contaminations of chlorinated dioxins, well known to cause cancers were found in the samples. The results were not different from other dump sites in major dumping sites in India, China, Pakistan, and Nigeria among others (SVTC, 2002). This evidence discloses serious repercussion on human health and the environment by the actions of the developed nations by dumping WEEE in developing countries (Sinha-Khetriwal et al. 2005:10).

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[7] Silicon Valley Toxics Coalition (SVTC)
[8] Basel Action Network (BAN)
[9] Solving The E-waste Problem (STEP)

Evidence in 2009 from Ghana noted, imports ended up to about 215 000 tons and per capita of 9kg imports. New products summed up to 30% of the imports while second hand EEE comprised of 70%. It was estimated that 15% of EEE imported was completely broken. They are outdated, broken or re-paired/refurbished. (Amoyam-Osei et al. 2011: 123)

Although North American and EU countries have signed and ratified the treaty of the United Nations Convention (1992) export of hazardous waste from these countries to the developing countries, there are still records of these e-waste movements (Basel Secretariat, 2010). Greenpeace (2002) established facts from China, India and Ghana, the export of e-waste is due to lack of environmental standards.

2.4 Rethink the problem e-waste.

According to key scholars like Lepawsky (2015) it is high time to rethink of e-waste differently rather than what has been portrayed by ENGO's. Basel Action Network (BAN 2002), Greenpeace International (2005) and Toxic Link India (2003) reported e-waste in terms of exporting toxic waste from global north to the developing countries. Specifically, US, Canada, Europe among other countries have been the major actors involved in e-waste export. The ENGO's further reported the toxic and hazardous working conditions of the workers and their environment due to e-waste processing.

However, research on the geographies of e-waste is in the early stages as Lepawsky and Mcnabb (2009) note in *Mapping the international flows of e-waste,* amongst a number studies have attempted to trace the international flows of e-waste. Evidence from diverse range of sources demonstrated by Lepawsky (2015), Lepawsky and Billah (2011), Lepawsky and Mather (2010) et al., they noted holistically that the greater part of e-waste imports are not garbage. Conversely, in the process of their research have opened various alternatives even though, minor but has brought about elucidation and rethinking of the past, present and possible future of e-waste. Their proof advocates that such trade and traffic are structured in regionally in methods that do not easily comprehensively agree with the dominant e-waste storyline (Hajer 1995).

In a case study demonstrated by Lepawsky and Mather (2010), it shows evidence of rethinking of e-waste in a study *Rethinking circulation and exchange through e-waste.* They argued using a commodity/value chain and global production networks (GPN) to map out their claims (Lepawsky 2010: 243). Among all the stuff shipped to Bangladesh, they could barely discover anything called waste. Nearly the whole process had value for everything. The objects, parts of component and materials that were assembled, disassembled and reassembled had value. Plastics, metals, electronics chips, glass were broken down and sorted. They had value which they exchanged for money (Lepawsky and Billah 2010: 242).

Even though Bangladesh is a beneficiary of e-waste from Canada, the journey and process of e-waste in Bangladesh transforms into meaningful value. In addition, similar case study was conducted in India by Sinha-khetriwal et al., (2005: 498). Furthermore, in West Africa documented by Manhart et al. (2011) 70% of the total imports of used electronics were recorded in Nigeria as functional or repairable gadgets. The country has recorded 100,000 tonnes of

e-waste imported illegally. The EEE are mostly tested and resold in a ready market to consumers (Ogungbui et al. 2012: 3). In another study, about 30% of used electronics were not functional (e-waste). Later, more than half of the estimated e-waste were refurbished and some components were valued and sold both international and locally. The results were achieved using export data and fieldwork as seen in the work of Ogungbui (2002).

Lepawsky and Mather (2011: 243) critises clearly the linearity in commodity chain analyses. This was supported by their argument "production and exchange systems are not linear, as the framework seem to imply, but are characterised instead by circuit, networks and meshwork of economic activity". They used e-waste in their study to contextualize the study. This was to counteract the famous storyline of ENGOs to rethink of e-waste.

The publications of ENGO's also recognised the fact that, those involved in the transfer of hazardous waste of electronics especially, computers had tried justified their action (BAN 2005:7). Due to lack of financial resources in developing countries, much of the growth in the ICT sector needs to be fuelled. The importation of second hand electronic equipment from highly industrialised countries to developing countries is a major factor. As a result many businesses have emerged and there are consumers who are willing to purchase these UEEE.

While the scholarly literature argued the rethinking of e-waste as useful commodity which has some inherent value rather than see it as waste (Lepawsky and Mather 2011), they also pointed out the non-estimated and undocumented amount of the informal sector involved in the e-waste trade. They noted that e-waste could also be seen from a socio-economic perspective view. Lepawsky and Mcnabb (2010) advocated the flow of e-waste as not linear but involved interconnected networks which function.

From this point of view, both the scholarly literature and ENGO's publications on e-waste have recognised some actors inherent in the trade of e-waste. Despite the existence of the convention[10] on transboundary movement of hazardous waste, the trade continues but barely pointed out the gaps in treaties and conventions as a contributory factor linking the trade.

2.5 The digital divide

Broadbent and Papadopoulos (2013: 8) state that the ability of a person to gain access to used computers and internets plays a very vital function in social life such as education, and employment. Many scholars including, Norris (2001) describes the "digital divide" as multidimensional in nature which encompasses divergent views: The *global divide* mainly presents the different views of the rightful use of technology (internet) between the developed and unindustrialized nations. The *social divide* refers to the investigation of the information gaps between the rich information and the poor information in the respective nations. The *democratic divide* discusses the digital resources to engage,

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[10] Basel Convention on the Control of Transboundary movement of hazardous waste and their Disposal. A treaty designed to control and minimize the transboundary movement of hazardous waste.

mobile and participate in public life in relation to nations to gap between nations who use this or not (Norris, 2001).

Cambell (2001) and Hilbert (2011) also provide some central definitions of the "digital divide". They define it as "a situation in which there is a clearly identified gap in the access and use of information and communication technology (ICT) platforms" (2001). Every now and then this gap is expressed as the use of ICT grounds as an opportunity of having or not having access to ICT as expressed by (Chon, 2001; Cronin, 2002). Sedimo et al., (2011) also argues that digital divide not only mean 'a problem of access to ICT but also the gainful use of ICT'

Nevertheless, the literature does not clearly give a single definition to 'the digital divide", there are many elements to take into account which make it a complicated notion, as the digital divide cuts across many fields and disciplines as demonstrated above. In the relevance of this research, the study seeks to emphasise on the global digital divide[11] as a divergence of both access to and use of information and communication technology between the global north and south nations (James, 2009).

2.6 The global digital divide, the reuse of electronic as a factor

Based on the literature by (James, 2001; Kissling et al., 2012; Vallauri, 2009; William et al., 2007) bridging the global digital divide by the re-use of old or discarded or obsolete electric equipment is the world's known practice found by some development partners as providing aid to developing countries. The re-use of personal computers is one of the most relevant electrical and electronic equipment (EEE) used for information and communication technologies (ICT). The re-use of computers aid to provide reasonable access to information, it also plays a vital role in the educational system as well as helpful in commercial and local businesses developed for its use (Kissling et al. 2012; William et al., 2008). The price gap between the used computer and brand new computer is perceived to be far more expensive with the global south which encourages the use or purchase of perceived high-quality re-used computers (William et al. 2008:12).

It is also argued by Intlekofer et al. (2010: 6) that the end-of-lease computers are increasing bases of re-use computers. It noted the estimated lifespan or an economic value of a computer of three years loses its value in developing countries, but of a higher value in developing countries which sometimes go through re-used, repaired, or refurbished or recycled or sold for value before finally disposed of. Likewise, large firms are doing philanthropic Corporate Social Responsibility (CRS), which they consider the end of life of their elec-

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[11] The digital world general characterized by the global north is seen to have easily access to the internet as well as a corresponding increase in the devices to access information as seen (International Telecommunication Union report, 2011). It states as at 2011& billion of the world population, 65% in the developing world have no access to internet and computers while the global north have 35% of access and use of internet.

tronic equipment as giving aid by re-using computers and other appliances to developing countries. The beneficiaries' of these electronics are re-used by individuals, in schools, homes, businesses and also in offices (Kissling et al. 2001).

In view of the above the *global digital divide* as explained by James, 2001; Kissling et al. 2012; Vallauri, 2009; Willian et al., 2007, the use of computers and access to internet is a prominent factor of bridging the gap between the global north and south. As other scholars like Hargittai (2003) termed it as the use and meaningful access to those who understand digital technologies and vice versa. In this regard of "*bridging the digital divide*", one major reasoning of shipping EEE by highly industrialised nations to developing nations is best explained. However, the ultimate aim of trying to build a bridge over the global digital divide is to reduce the wide gap to use and access of electronic has been on going to some years now. This sometimes seen in the shipping for obsolete electronics such as computers to the less privileged nations as reported by developing partners and developing nation states. The notion of bridging the digital divide is of sound reason but this the used electronics are inherently hazardous or toxic elements or component which cannot be handled by their beneficiary in some 'poor' communities or developing countries (Puckett, 2005) which is not comprehensively addressed.

In retrospect, Greenpeace International (2008), BAN (2010a) and Brigden et al., 2010 documented some countries in a study case in the light of bridging the digital divide exposed the toxic waste inherent in extending electronic support to the third world. Decreasing environmental and human health were reported as a result of WEEE. However, the global south also derived gainful benefits from the aid of used computers and electronics by international development partners or NGOs. The used of electronics, one way or the other benefits public schools, hospitals and some government places since there are inadequate funs to cater for all the needs of the developing world (Miller, 2012: 105).

2.7 The concept of Commodity Chain.

One unique conception that has the ability to bring many varying perspectives together is that of the "commodity chain". The frequent research topics by political scientists, social scientists, economists and environmentalists among many others which covers the developing process of globalization could be captured by this concept. As viewed in the process of transportation, communication and technological transfers to indigenous, countrywide, regional and global markets.

Frequently engaged by the World-Systems theorists, the 'commodity chain' concept came into existence around the 20th century as a method for the analysis of localized to globalized interconnected set of networks. It takes into consideration the development of a universal partition of labour. The commodity chain could be referred to as "a set of economic actors and activities involved in the creation of a good or service" (Grossman-Thompson and Lake 2012). The concept of commodity chain analysis as constructed by Hopkins and Wallerstein (1985) to explain a 'network of labour and production processes whose end result is a finished commodity in which there are producers of

inputs to others and users" (Gibbon and Ponte, 2005:74). Thus this definition shows that different players or actors are connected before a final product is used. The connections exist between the final commodity and the social and geographical processes involved in the flow or transfer or production (Hopkins and Wallenstein, 1985).

They conceived of something which they called for a much better conventional term "commodity chains". What they discussed by such is as follows: take an ultimate consumable item and trace back the set of input into that culminated in the item- the prior transformations, the raw materials, the transportation mechanism, the labour input into each of these material processes, the food inputs into labour. This link set of processes we call a commodity chain. If the ultimate consumable were, say, clothing, the chain would include the manufacture of the yarn, etc., the cultivation of the cotton, as well as the reproduction of the labour forces involved in these productive activities. (Hopkins and Wallenstein, 1985:128)

Some scholars like Bair, 2008 argued that the concept of the "commodity chain" may be a bit misleading, intention been is not linear, but instead functions further as a network of relationships that as held together by intertwining systems of production, distribution and exchange.

2.8 Global Commodity Chains

International Institute for Sustainable Development developed the methodology of Global Commodity Chains Sustainability analysis (GCCSA), is comparatively a new count to commodity chain analysis. According is Eugster, Huabo, Jinhui, Perera, Pottas and Yang (2008: 2), "the basic element of the GCCA consist of an analysis of market structure and trends, and analysis of social and environmental impacts along the global supply chain, and analysis of the global supply chain structure and governance and, finally, policy recommendation. The GCCSA effectively links and relate sustainability impact to supply chain decision making structures and public policy".

This could takes into consideration the bulk size and complexity of the Electrical Electronic Equipment (EEE) into diverse phases. The most visible phases are manufacturing, distribution (trade), consumption (use) and end-of-life (disposal o reuse) as GCCSA requires to break down the commodity chain into four phase (Eugster et al., 2008).

But for the relevant of this study in development studies, Global Production Network (GPN) approach framework will be used. The GPN have been proven to investigate the variety of socio-economic activities from textiles (Gereffi 2002: Dolan 2007; and Gereffi and Frederick 2010) and most important to this study electronics by (Gibbon 2001; Lepawsky 2009; Lepawsky and Mcnabb 2010; lles2004) midst others. Although the GPN has critiqued by Leslie and Reimer (1999: 403) in the debates of value theory as seen in lles (2004: 80). The Global Production network approach was noted by Bair (2005) to offers a comparatively direct routes of mapping and analysing the different dimensions in the organisation of economic undertakings. According to Gregson et.al (2010a), it also emphasises the route in which a specific good is presented in the distribution of value within the chain in diverse economic activities. This framework suggestions grounded to specificity in globalization, examining a specific actor, or in a sector in localisation (Henderson et.al 2002: 442.).

The GPN framework would be used for electronic chain analysis of e-waste in my study. This framework will be used to show the end-of-life of e-waste, considering the social and environmental impacts surrounding the electronic waste business at the local level. As the interest of this research only takes into consideration the end-of-life of the chain.

Electronics waste could be envisaged as a long and complicated path as seen in the works of Lepawsky and Mather, 2010. From manufacturing in the periphery, to consumption in the core, and travels back again through continents for reuse or disposal in the periphery. Some ENGO's such as Basel Action Network (2006) and Green Peace International (2008) term it as externalized 'harm' from these products usually occurs on two levels. The first is the production processes and finally the disposal processes involved in e-waste. This is due to the changing patterns of these electronics to edge consumers to always go for the latest available technology in the market. And this contributes to the annual mounting up of e-waste at various parts of the world especially in the global north.

This study, using GPN as a frame for this study will make it possible to analyse the follow of network and trend of e-waste in Ghana. These used electronics will be conceptualized with the framework as part of commodity chain that stretches from points of entry (the port of Ghana) to consumption (reuse) and finally to disposal. What happens at the end of the chain of e-waste as another "productive activity" is what the study will explore. Thus the activities involved are the back end of the commodity chain will be used as a way to contextualizing the study of e-waste into Ghana.

Chapter 3 : Following e-waste

3.1 Introduction

> *Where is it produced? What happens to it after it is gotten rid of?*
> *Where does it go? We tried following it (Lepawsky and Mather*
> *2010:242)*

The ideas of this chapter was motivated by the study of electronic waste voyages by Lepawsky and Mather (2010) their article *From Beginnings and Endings to Boundaries and Edges: Rethinking Circulation and Exchange through Electronic Waste*. This section uses commodity chain as a framework to situate the study. The section was also inspired and influenced by the works of Cook (2004) on "*follow the thing: papaya*". Based on this study, a high number of the respondents acknowledged the fact that e-waste activities are inherent by both human and environmental problem. Most of the e-waste dealers acknowledged, almost every component, gadget and material of WEEE had value. The respondents' also pointed out the fact that not everyone in Ghana can afford brand new electronics hence the continuity of the trade. However there was no clear distinction of waste from value from the ports of Ghana, thus everything had value. 'Node' in this study refers to the movement of e-waste to a different stage within the chain.

> *…if we accept that geographical knowledge through which commodity systems are imagine and acted upon are from within are fragmented, multiple, contradictory, inconsistent and, often, downright hypocritical, then the power of a text which deals with these knowledge comes not from smoothing them out, but through juxtaposing and montaging them…so that audience can work their way through them, along the way, inject and make their own critical knowledge out of them.* (Cook and Crung 1996:41)

3.2. Following E-waste

Once upon a time, a hypothetical story is told of a laptop that was manufactured in China. It made its way to America. A Dutch tourist found it affordable and bought it. He transited through Heathrow airport with it. He studied with it for two years. Coffee accidently poured on it and got broken. He had to dispose of it. The municipal collected it. It was resold for proper disposal to a company. The company collected it amongst other electronics. Some which are still functioning, can be repaired and reused. While others are damaged and other parts useful. After travelling through continents, its journey has not yet ended. The electronics were then shipped to parts of Asia and Africa. In West Africa it found itself in the ports of Ghana.

> *Matters grow from the middle, and from many places. But one also*
> *has to start somewhere (Law 2002:1)*

Here I start my journey. It was a bright sunny day on the first Monday of July, 2015 out, as I embarked on the quest of e-waste at the main Tema port of Accra, Ghana. I decided to *follow* e-waste. Huge ships stocked with lots of containers of all kinds of goods arrived at the port. The cargo containers arrived from Germany, Korea, Netherlands, and Switzerland among others at the port.

As I walked around in search of my interest, I met lots of onlookers at the forklift machines as it offloads second hand items from a container. They were mainly electronics. As, I watched closely the labels on the containers which mostly read shipped via Antwerp, Belgium were of loaded to importers of the various items as they stood in the hot sun.

Figure 3-1rival of e-waste at the ports of Ghana

Figure 3-2*Arrival of e-waste at the ports of Ghana*

The electronics were sorted by hand after it was offloaded from the containers. The workers included young boys in their youth. Some women were also helping to sort the electronics. They comprised mostly laptops, computers, mobile phones, sound systems, television sets, scanners, printers, fridges among others. Some second hand clothes were also separated from the electronics. The workers picked the items carefully to prevent cuts on their fingers since some workers had cuts on their hands. The young boys carried the heavy fridges and cookers. Some were packed in cargo trucks and some were sold instantly at the port. There were already buyers. Some of the electronics were sold untested. It looked like the prices of half of the goods in the containers labelled from *United Kingdom* were negotiated by middlemen at the port. Money was exchanged for the goods. The importers and middlemen valued and sold out most of the electronic goods. The middlemen transported the goods to town. They were resold. Hardly, did I see something sorted as waste in the container, after observing three containers from different locations. Nothing was put aside without value. What then is '*waste*'? Almost every electronic object was valued.

3.3 The e-waste importers and middlemen

Figure 3-3 The e-waste importers and middlemen

….most of the second hand electronics goods that arrive from the port come mainly from five countries in a hierarchy, United Kingdom, United States of America, Italy, Germany, and France. Their value and quality are much higher. Currently, most of this EEE imported by Wholesalers for business purpose are taxed. I prefer buying from these countries. The second hand goods come from lots of countries but not only the ones mentioned above". The 'goods' are mostly bought by 'borgers' [12] whole import wholesale items. We buy them in bulk and reuse them our clients. These middlemen prefer to buy electronics. Imported tables and chairs do not sell fast. (Interviewee 1: 30/06/15).

Kay[13], as everyone knew him has been a middleman for more than 5 years. Explaining where the goods come from. Which countries he prefers to buy from? What the market demands for specific goods? He also explained the increase of import taxes on their goods. He used to keep his prices moderate for business. His work is to call and negotiate for goods with the wholesalers. The middle men were also known as suppliers. They supplied to retailers. They also try to maintain relationship with their big retail clients. It was necessary for business. He has his workers who help him transport the electronic goods to retailers in the market outside the port. The middlemen, monopolise everything at the port. Not everyone can walk into the port to buy in singles from the wholesalers. Since the wholesalers do not have ample time for barging with individuals. Wofa Kay, the middle man, explained, his client's goods mostly came from three main countries. Huge volumes of electronic goods were bought. They were transported from the port to the market centres.

The electronics of highly significant values include personal computers, laptops, mobile phones, fridges, cookers, air conditioners. They had ready market to be sold for good price. The middlemen dusted these electronics. The work was done by his workers. Young boys who brush the dust of these electronics. They was dusted to make them look attractive for pricing. As he received many phone calls from his retail clients for supplies. Ready market for goods. The EEE were then sold to retailers in the market at different locations.

3.4 The e-waste retailers

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[12] Borger is a term widely used in Ghana to refer to Ghanaians living in abroad, but often come down to do business frequently in used goods.
[13] All names used in this study are anonymous

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igure 3-5: The picture displays UEEE by retailers. Source: Author's field work (2015)

He pointed out a huge stock of UEEE. Sitting in a corner he went on. Business is good. It could be pathetic if there were no people to buy. Customers buy them. Customers usually buy mostly demand at the end of the month, after salaries are paid. Gas cookers are on high demand now. Because of power cuts in the country. But electric cookers are also moving fast. The fridges upon arrival do not take a month to get finished. The washing machines also move gradually. The flat screen TV set is also another hot cake in the market. For computers, some guys also come to buy them. Laptops are mostly bought by university students and some workers. Some small business also prepare desktops and also in their homes. The mobiles phones are all sold out. I kept a Nokia phone for a customer who placed an order. The workers are also helpful and the customers like them for their service. Interviewee 2: 30/06/15.

Abu a retail shop owner. He employed about 20 workers. The retail shops were busy places. Some of the electronics were tested and categorised. The functional electronics were separated from the non-functional ones. The functional ones where going for a higher price. This depends on the type of item. The non-functional ones were also sold really cheap. Mobile phones, washing machines, dish washers, fridges, air conditioners and cookers for example, were bought in bulk from middlemen and were sold at much higher prices on the retail market.

The untested equipment were going cheaper because, of the risk of it not being functional. Most personal computers were handled with care. They mostly had much higher value. The retailers sometimes engage the services of an informal technician. Their work was to assemble parts of computers, home theatres and other complex electronics. The functional ones were separated. A Nokia mobile tested could cost 50 Ghana cedis (US$14.89) while the untested went for half the price 25 Ghana cedis (US$7.45). The workers employed by the retailers were paid very little money. Their work involved the movement of the goods from cargo cars and offloading. They were kept in retailer's storage rooms.

The workers were paid less than 4 cedis (US$1.1) for a day. Most of them had no protective clothing to protect their hands and toes. The retailers were mostly interested in the tested electronic goods. Which will be displayed quickly for costumers. The retailers at a point engage quite a number of people

when supplies come. They were mostly young boys, under the age of 17. The guys helped to talk to consumers. They also helped in carrying the goods to customers. They sometimes get little tips from customers.

The non-functional electronics were kept separately. The retailers sometimes sell them without testing to customers who prefer to take the risk to buy them. This is because they were cheaper than the tested ones. Some of the non-tested electronics were sold to repairers refurbished. Almost everything at the retail point was sold depending under which category it is placed. *What could be waste at this point since everything was sold and exchanged for money? The services involved were been paid for. I kept following the thing.*

3.5 E-waste refurbishing

Our work is very important in the use of electronics. Not all the electronics from abroad that arrive at the ports are working properly. Most require some servicing to be done to function properly. Others need some component to be replaced to function properly. Customers who buy from retailers sometimes brings their non-tested equipment to be fixed. My business depend on them and they also depend on our services. We charge customers a fee after your item has been repaired. But the non-functional items, some components or parts are taken off to be replaced or reused to make them function properly. The previous month about 200 to 500 different equipment were fixed and sold out. More than half of the items are usually sold out.
*Interviewee 3: 30/07/15.*

Kofi is an informal technician. He has one of the largest refurbishment shops. Refurbishers engage in activities that sometimes make non-functional electronics function. He offers repair services. They sometimes buy in large quantities from retailers. The retailers sell non-tested appliances for both customers and refurbishers. The non-tested appliances are less expensive than the fully functioning ones. They buy the items at very low cost. Kofi with the help of his 15 apprentices test the items. The items are tested with electricity and battery depending on the source of power. Some of their work involves replacing non-working components to enable items function properly. Some electric gadgets require replacing the power cable. Others need to be serviced. Some items only need to be blown with air to remove accumulated dust particles. Some items such as buttons are fixed to make them functional.

Kofi trains his apprentice who usually do the bulk of the work. His business usually involves moving around to retailers to buy non-functional equipment. He repairs a wide variety of items. Their work also involves dismantling of equipment to enable it to be fixed, especially, cookers, fridges, sound systems, washing machines, dish washers, desktop computers. Other parts of the electronics are also assembled.

This refurbishers are sometimes very innovative. They could convert some of this electronics items into other commodities. A computer monitor could be converted into affordable television sets and video games monitors for children. They usually make alterations to the internal circuit board. This allows them to receive TV signals. The video games are sometimes connected to computers to enable it run on a gaming software.

Personal interviews during the fieldwork confirms that the non-repairable items are separated from the repaired ones. The non-repairable items are sold to scrap dealers for a reasonable price. The price depends on the type and size of the item. Hardware were sold. Scrap dealers were everywhere searching for goods to buy. Almost everything at the refurbish shops were mostly sold out. *I wonder what waste with these electronics is since everything is been valued and changed for money. I kept following the thing.*

3.6 The scrap market Agbogbloshie (location and processing of e-waste)
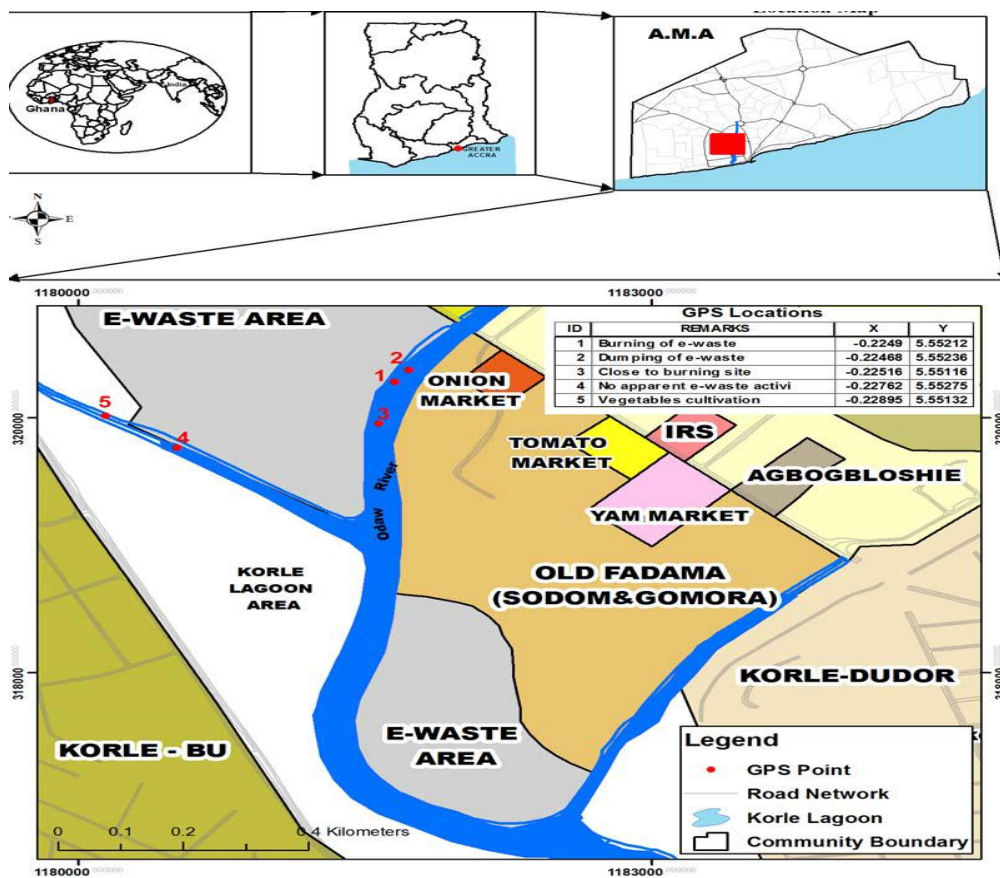
3-6 A map of Agbogbloshie scrap market

Figure 4 The map of Agbogbloshie e-waste area. It also displays the map of Africa, Ghana and Accra. **Source**: Amankwaa (2014:4)

The map above displays Agbogbloshie scrap market situated in the central business district of Accra which has grown into a slum settlement over the years. The site deals with all kinds of scrap which comprises non-repairable electronic and old electronic equipment. The site has over the years grown steadily into a famous recycling centre. It serves as a final processing grounds for dismantling after collection for massive tons of e-waste every month. These

e-wastes are further broken down apart to recover copper and other metallic components that are sold. The strategic location of the site in the central business district, allows the scrap dealers to install small shades which serve as small workshops for the trade (recycling). Thus, to this background, Agbogbloshie has become the central hub of the informal collection and dismantling of e-waste area in Ghana. Despite there are small scrap yards, Agbogbloshie is the main market in the Ghana. There are social and economic factors that drive the existence of this market. Below is a map of the processing site of e-waste in Accra.

3.6.1 E-waste collection

E-waste collection is mostly carried out by young boys. They are mostly known as scrap dealers, mostly between the ages of 8 to 25. They move around with their carts. They buy all kinds of equipment. From plastics to metal. They can buy a monitor for 5 USD[14] more or less. They sometimes buy small parts in sacks. The sacks are carried on their shoulders. They move from retailers to refurbishers in search for condemn[15]. They usually buy everything which is rejected or non-functional for reuse or for selling to customers.

Ali Baba is a famous scrap dealer as who buys unusable items from people. 'This our work no bi easy oh. From one shop to other. Asking and looking everywhere. Sometime we go house to house. Sometime we go the refuse dump to look for condemned goods to buy. We buy from everybody. We buy from condemn old fridge, condemn car parts'. We negotiate and buy'. He explained the cheaper the item the more profit you make. On a good day some give some items free. But mostly they are bought. Sometimes some good customers call me to buy….. Interviewee 4: 01/07/15.

The scrap dealers who move from place to place in search for 'condemned' items. They sometimes go to homes. Others go on dumpsites in search of it. At homes they bought old appliance which were non-functional. Some include freezers, old computers, monitors, electric irons and TVs. Monies were exchanged for the condemned items. While some good people gave out the 'condemn' for free. They carry the condemn items to their small shops for dismantling. *I followed them to the small shops. These items were kept in their shops until they find value for it.*

3.6.2 Dismantling e-waste

I arrived at the dismantling shops. An area called Agbogbloshie. This is where most of these activities take place. Dismantling mainly, is the separation of valuable materials from any 'condemned' item collected.

Breaking and removing parts is my job here. Removing electronic chips, electric wires and metals. Sometimes the glass is broken and it could harm one. Some care needs to be taken. But after all the work you can have some money. It better than nothing my brother. Interviewee5: 05/07/15.

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[14] Cedis is the currency used in Ghana. 1 cedi is equivalent to 2.50 USD.
[15] 'Condemn' is a term used for non-functions items by scrape dealers.

Electronic components and conductors (gold plated terminals), printed circuit boards with integrated circuit chips, have been known to have valuable metals which include palladium, silver, gold, copper and tantalum. The recovery of these metals require professional skills and sophisticated equipment, but the unavailability of these equipment for the e-waste dismantlers to result to crude ways of recovery. Using low-skills or handmade tools, these precious metals serve as motivation for the worker to dismantle. At shops, they were busy separating the plastic from the metal parts. The young boys used screw drivers to loosen the joints. They were more interested in the metallic parts which had higher value than plastics. The use of rudimentary tools such as spanners, screwdrivers and hammer retrieve metals were visible everywhere. Others used spanners to loosen bolts and nuts while some used hammers to break parts. The dismantlers break apart the various components. This seems to be the dirty part of the work. There is much noise everywhere and smoke in the air.

Their work is driven by the value of materials contained in the e-waste. Precious metals, such as copper, silver and circuit or electronics boards. The values of these hidden materials is a powerful source of incentives for dismantling. The work is done with or without any form of technology or even any consideration of their health and environment. The practices involved in the recovery of valuable materials at the site include: smashing of TV and CRT monitors for copper recovery, loosening or breaking open circuit or electronics boards and burning of insulated wires to recover the metal wire. Some burned the electric wires in the open air, others burnt of metal-embedded in plastic parts to separate the plastics. This was seen at the site when *following the thing: e-waste* by personal observations.

The different parts were further sorted and cleaned. Some brushed to get dust from it or washed them. The copper was ready to be sold out. Sometimes equipment which have plastic covers or protect them is also burnt. They were burnt to get rid of the rubber and enable them have access to the metallic parts. The separation is sometimes assisted by women and children. The women and children help in the sorting. Plastics, glass, metals and electronics chips are sorted out separately. The parts are confined to one central point by all scrap collectors and dismantlers. The components are based on what is valued in the market most for higher prices. They are weighed and metal trading was carried out. The components were sold to dealers for local use or export. Material recovery is a major activity in the value chain which inspires the e-waste economy to flourish. *I was hoping to find waste. Even the condemn are exchanged for money. I kept following the thing.*

3.7 The e-waste: Agents who buy value metals.

As I observed the way things are being processed and various activities carried out. I interviewed an agent. (E-waste buyer)

The exporter, the blacksmith and some agents are the main people who buy these goods. Exporters come with their cargo trucks to buy mainly metallic parts and electronic chips with the board. They also buy aluminum and copper sometimes. They also buy some metallic car parts. They usually target China, Korea and Europe. They are conveyed to their yard for export. The metals are

weighed and sold; I kilo is about 6.25 USD. The more kilos you make, the more money to make. When the electronic chips are cleaned and brushed well. They also make good money. When business is bad, the metals are sold to local companies who engage is metal smelting. But the export companies pay better than the local companies.

The blacksmiths also came to buy. The usually buy silver, brass, copper and aluminum. They prefer to buy them from here. They get them cheaper. The copper and silver are used for making ornaments. Necklace, earrings, anklets for people. Students mostly buy from them. The aluminum is processed into basic cooking wares. Sometimes into pans, bowls, ladles, spoons and buckets. From the interview with the agent however the aluminum is in small quantities and therefore, companies do not buy them.

Some agents come to buy plastics and glass wares and resell. They sell them to companies. They are sold to recycling processing firms in Tema industrial area. The plastics are processed into washing bowls, tables and chairs. They are made in different designs and shapes which are affordable. They are usually sold in the market.

3.9 The e-waste worker

Personal observations during the fieldwork confirmed that, e-workers were visible at every stage within the chain. From the port, the workers helped in the loading of EEE into cargo cars. They usually work in the open sun. Most of the workers hardly wear protectively clothing. They usually have to load more trucks to make enough money. They are paid about 2.50 USD each per truck loaded. Sometimes, the workers at this stage have to clean some of the equipment for the middlemen. They sometimes carry heavy equipment like fridges and cookers in turns. They carefully carried them as sometimes, the sharp edges cut their palms. Some also carry the items on their heads.

The amount of labour power increases as one moves along the UEEE chain. The retail shop involves a lot of activities. They engage in washing and testing for functionality. The workers are mainly young boys. The machines include, dish washers, fridges, air conditions and cookers which are washed and tested. They are washed with detergents and water. Soft brush is also used for cleaning delicate items likes PC's. They washed all the dirt and stains from them. They used their bare hands with brush. They sometimes used sponge to wash delicate parts. They were usually washed, cleaned and stains removed to look attractive for pricing. Other parts were put together to make them complete for functioning. After the day's work they earn something small for food. As low as 3.75 UDS. This information was obtain from a personal interview after the day's work with a scrap dealer.   *Interviewee 6: 04/07/15.*

3.10 The e-waste consumer

I love to buy my electronics from the second hand. I bought my Sony TV, HP laptop, and my LG home theatre for reuse. He paused briefly as he began speaking again. Even my IPhone which I have been using for 2years now. Furthermore my electric cooker which is going strong was from the UK. They last longer than the brand new China products in the market. The second hand items mostly used in the US and Europe last longer than the Asian ones.

Because I bought my wife a new Samsung from the shop did not last for long. Not even six months. My friends also got the same experience with new goods. Beside second hand goods are more affordable than the new items. A Personal Interview with Kojo, an e-waste consumer/customer. Interviewee 7: 06/07/15.

Second hand electronics are exchanged for cash from retailers and taken home. Informal instructions on how to operate them are given. They are carried home for use. Ben revealed second hand electronics are affordable than brand new goods. They last long than the new ones. They are of good quality. They also have high which meet international standards. The message is carried by word of mouth by customers who have tried and tested the use of these second hand items. They encourage their friends and relatives to purchase them. Rather than always spending money repairing new items all the time.

Ben made known the types of electronics he recommended mostly; fridges, electric or gas cookers, electric irons, TVs, personal computers, micro waves and sometimes home theatres depending on the brand of the product. They look really nice. Their services are good. The sound system produce best quality sounds. It sometimes help in parties. Everybody enjoys the beat and quality of the sound that comes from my system. The new desktop are not so cheap. But the second hand ones are affordable. Some of these electronics are bought as gifts and presented to people on occasions. And after some years of use it is sold. The scrap dealers are always around to buy them.

3.11 The e-waste

E-waste spread to different parts of the world. It is usually exported from the global north to the developing nations. E-waste follow the colonial trails of the global north countries. Famous among the developing nations are Columbia, Bolivia, China, India, Pakistan and Bangladesh. But in recent times, e-waste has found its way to Africa (as the study shows). Due to the labour intensive and hazardous components of e-waste. It is out source to companies or individuals who find alternative use for them after they have been discarded. It gains grounds in these developing countries in African countries like Kenya, Morocco, Nigeria, Liberia and Ghana. In Ghana, there is a huge demand for second hand items. Ghana has cheap labour which is engaged in the processing and sale of the e-waste informally (source). Taxes are paid for the importation (CEPS 2014), which brings some amount of revenue to the country. The e-waste is valued, priced and sold for reuse. Some broken gadgets are repaired or refurbished and sold. The second hand EEE for ready market include a wide variety of electronics.

Based on the personal interviews with Environmental Protection Agency (EPA) officials e-waste is used to refer to end-of-life electronic and electrical equipment (EEE) or waste generated from devices that use electricity, dry cell or battery. These include; laptops, computers, mobile phones, television sets, DVD players, rice cookers, etc., that have been disposed off by the original users. The EPA generally, groups e-waste into three different groups as 'white goods', 'brown goods' and 'grey goods'. Comparatively, the grey goods are more complex to be recycled due to their toxic makeup, which has been classified by the EPA of Ghana. The Environmental Protection Agency (EPA) au-

thorities emphasised the harmful content of e-waste. Comprising more than 1000 harmful substances present, which include elements like mercury, cadmium, PCBs, among others. *Interviewee 8: 08/07/15.*

Furthermore, It was also discovered by the scrap dealers' association that, e-waste has been categorised into three main groups; which are large house hold appliances such as ovens, gas cookers, washing machines, deep freezers, and refrigerators. The second group of appliance is what was called information technology (IT) and telecommunication such as laptops, personal computers (PC), projectors, monitors. The third group of items was labelled customer equipment which includes LCD, television sets, etc.

At the scrap yard this is further broken down and grouped differently. After the equipment has been used for some few years by individuals at home it is disposed off. It is dismantled and grouped; transformers, circuit boards, fluorescent lamp, electrical wires, plastics, metals and compressors amongst others. Interviewee 9: 10/07/15.

The field observations revealed that Used Electrical and Electronic Equipment imported (UEEE) that are imported into the country include: computers, photocopiers, sound systems, televisions, dish washers, electric cookers, electric irons, electric kettles, freezers, telephones, microwaves, refrigerators, toasters, washing machines, vacuum cleaners, electric heaters, air condition unit and   These items are sold. They are used as standard equipment at home throughout the country. There are no standard for the importation of electronic equipment. Thus the influx of EE.E in the name of 'reuse or recycle'.

3.12 The e-waste routes

WEEE usually arrives at the ports of Ghana from the Diaspora; from North America, Europe and some Asian countries like Japan and Korea. In the past they arrived as foreign aid. But of late WEEE is seen as purely business, bought and sold from places. Like the UK getting WEEE from UK which is of "European standard" is seen as high quality standard.

The WEEE are bought from wholesalers by middlemen. They are resold to retailers. At the retailers they are tested, washed, dusted, repaired, and resold to customs. The non-functional ones are resold again to scrap dealers. They engage in collection and dismantling. They extract the valuable parts. The precious parts go through checking, weighing, trimming, wrapping and exchange. The metals, plastic, silver, aluminium, copper, e-chips or boards are exchanged for money. The dismantled parts making mostly diasporic business or trade. Some valued parts are also traded in the local market but mainly export. They go by sea. They make their way back to the Diaspora. They are reprocessed into other items, mostly in China and some parts of Europe.

Chapter 4 De-fetishizing E-Waste

This chapter uses a combination of primary and secondary data to describe the current state of Waste Electrical and Electronic Equipment (WEEE) in Accra after *following the thing: E-waste.* First three sections exclusively refer to the analysis of the findings on e-waste. First of all, the socio-economic features of both customers and workers who engage in EEE and how it enhances the e-waste business is discussed. The second section discusses employment and labour potentials embedded in the chain of e-waste business. The third section discovers creating and capturing value in e-waste. Thus this section discusses what is waste? and what is its value as it moves from one point to another. The fourth, covers the role that social networks have played in the livelihood strategies of the e-waste workers in the node of collection and dismantling in the informal sector. Lastly, the environmental impact of the activities of e-waste workers engaged in the dismantling nodes and their effects on human health.

4.1 Driving Socio-economic features of customers

The study reveals the driving socio-economic factors inherent in the UEEE business at various nodes. They emphasised consumers who earn high income preferred to purchase a new computer or electronic device, while a middle-income earner are distributed into two different fragments. The first fragment consist of middle-income customers who pretend to imitate high-income earners through credit schemes and purchase new computers or electronics. The second feature consist of middle income customers who purchase second-hand computers or electronics. The last group of customers are the low-income earners. They access used or refurbished computers or electronics equipment from entrepreneurs. They buy second-hand electronics and rent them to customers for special occasions such as parties or funerals for short time for a fee.

Cost of an electronic item is a significant deterrent, particularly for people of low-come, but also regarding the services provided since less expensive gadgets have emerged that compete with computers in providing a specific service. This was indicated in the interviews, for example using a mobile device to access internet services rather than buying a new expensive computer. However, UEEE trade is carried out successfully because of the huge economic and social diversity of the Ghanaian society. Thus these characteristics of the diverse groups of people in the economy encourage the trade in UEEE.

4.2. Driving socio-economic features of informal recyclers

It is important from the interviews conducted from the field to assess the socio-economic driving force of the 'scavengers' (collectors and dismantlers). Despite the lucrative nature of their work and the embedded harsh environmental and health conditions they still engage in this form of work. When asked if scavenging was lucrative, almost 90% of the respondents who were scavengers agreed it was profitable. They agreed there was an available market

for electronic waste. What makes it possible to scavenge as a means of liveli-hood. Even though, about 10% of them disagreed, their responses reinforces that scavenging was profitable and important as a source of income. This was expressed by one of the respondents during the process of questionnaire ad-ministering. There is ready market for the scavenged e-waste despite the haz-ardous component. Some electronic repairers, middlemen, electronic importers and refurbishers doubted the process exposed them to hazards. However, giv-en that the informal activities of e-waste trade are unregulated in Accra, there is a strong driving force of income generation embedded in the nodes of the electronic chain.

4.3. Employment and Labour potentials of UEEE

The findings reveal some important implications of e-waste in a commodi-ty chain analysis. It shows the employment and labour potentials inherent in the trade of e-waste. This was clearly shown by the use of the commodity chain of Global production networks. The process reveals the significant amount of the human labour actively engaged in the sorting of electronic items. The division of labour plays an important role in the domain of what is waste and value at each level as they are defined and practised within different nodes of the chain. The division of labour plays an important role in the pro-cessing of e-waste in the country as seen during the field survey. The pro-cessing of e-waste imported into Ghana, takes into account the whole e-waste processing chain including the activities of middlemen, traders, refurbishers, collectors and dismantlers as well as the buying agents.

After the collection of old or non-usable electronics from the various places, the dismantling of e-waste occurs mainly at the scrap market. Using the employment and labour potential inherent in the system, this could be used to assess the social impact of e-waste chain. It could be seen that from the study, that the importation of used electronics generates employments for the infor-mal sector. The process employs the activities of collection, transportation, reuse, retailing or marketing, sorting, segregation, repairing or refurbishing, dismantling and metal recovery that are done manually in Ghana. The process-es employ and pay the use of labour actively engaged. It was noted in personal interviews that about 20 employees were engaged in refurbishing and disman-tling nodes of the e-waste chain. However, e-waste trade is a vibrant one which sustains between 121,800 to 201,600 people in the informal sector (Prakash 2010:42).

The informal divisions of labour plays a significant role in the transfor-mation of what is waste and its movement from place to place within the chain. The skills or services used by labour play contributory role of e-waste transformation within the nodes and their roles in determining what waste is at one place relative to value to another place. Research by ENGOs (Greenpeace international 2005, Toxic Link India 2003 and Basel Action Network 2002a) have displayed the labour processes involved in the processing of e-waste. Their studies have demonstrated that processing of e-waste puts people and their environment at high risk of economic insecurity and toxic contaminations of their environment (Lepawsky and Billah, 2011). Despite the working condi-tions of the informal e-waste workers in Ghana, they strife to survive and thus

Category	Refurbishes	Collectors	Recyclers/ dismantlers	Total
Employed in Accra	10,000 - 15,000	4,500	6,000	14,500–21, 000
Employed in Ghana	14,000 - 24000	6,300	9600	20300–33,600
Dependent on refurbishing and e-waste processing in Accra	60,000 – 90,000	27,000	36,000	87,000-126,000
Dependent on refurbishing and e-waste processing in Accra	84,000 – 144, 0000	37,800	57,600	121,800-201,600

Source : Prakash et al., (2010: 43)

the trade continues to exist. The table 2 below shows the estimated number of some actors employed in the e-waste trade.

4-1 An overview of the number of people employed in e-waste trade

4.4 Capturing and creating value in WEEE

Through the use of commodity chain, the study reveals along how value is created and captured in the e-waste trade. The study demonstrated how value is extracted from e-waste as displayed along the various nodes. The above picture clearly shows some form of value which exist or is created after the disposal or after the disposal of a computer at the dismantling node. This could be related to the socio-economic importance for people and place transforming WEEE to valuable commodities as e-waste travels from one place to the other. This could be clearly be seen in the reuse, repairing, refurbishing and dismantling nodes. The main actors involved in the chain effect change within

4-2 A list valuable items in a dismantled computer
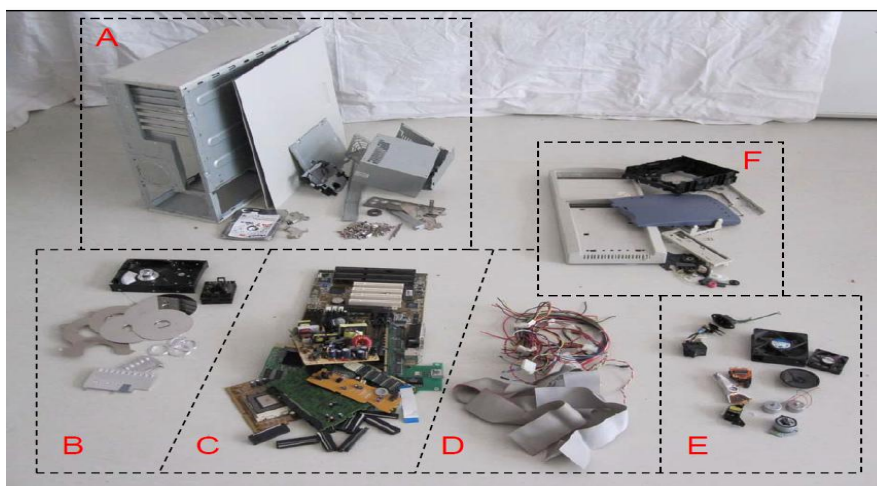
the chain through a rbitrary opportuni

Figure 4-1. Displays the value of a dismantled computer. A=Scrap metal, B=Aluminum scrap, C=High grade metal fragments, D= Copper wires, E=Low grade copper fractions, F=plastic fractions

nities

where used electronics could be sold for a higher price or at a lower cost. Some activities within the chain, such as refurbishing by adding value to a non-functional gadget by repairing it or reassembling it to a new equipment as by shown by converting desktop monitors to a new commodity replacing some components and using it for video game monitors or TV. Similar example was noted by Lepawsky and Billah (2011:131) in a study in Dhaka, Bangladesh.

Furthermore, dismantlers at the Agbogbloshie scrap market, engage in different forms of activities to dismantle e-waste. Some of their activities involved processing to recover and separate valuable parts of equipment from non-valuable parts. This is a lucrative business since some parts are in good condition and have both local and international market value. The dismantlers sometimes retrieve valuable metals. When gathered in a good quantity, a reasonable amount could be made. Below are some of the market price value for metals found in e-waste metal recovering. They are mostly bought by agents who deal in export.

4-2 shows the hidden values in electronics

Local and International Scrap Metal Prices Metal	Agbogbloshie Market price per Kg in USD	International Market price per Kg in USD
Iron	0.21	0.30
Copper	3.91	6.11
Zinc	0.93	2.33
Aluminium	0.78	1.80
Steel	0.78	0.67
Brass	3.13	5.78
Gold	n.a	48,834.97

Source: *Author's field data (2015)*

4.5 Social networks embedded in e-waste trade

Awumbila et al. (2008) emphasis the substantial role of migration in the livelihood strategies. This was reflected in the responses of the e-waste workers in Accra mainly at Agbogbloshie. The workers are mainly involved in helping middlemen, retailers and refurbishers mainly in the collection and dismantling nodes of the e-waste chain. The responses from the questionnaire reflected only one -e-waste worker was born in Accra out of ten respondents. Five respondents indicated that they moved from the northern part of the Ghana in search of better opportunities of work. The survey discovered some Nigerians who were also involved in the collection and dismantling nodes. Four of them were Nigerians. They indicated they moved into Ghana in search of greener pastures at the scrap market. Both groups of respondents indicated they used ethic and familiar networks to establish themselves in the scrap business. Furthermore, personal interviews revealed most of the men who came from Northern Ghana worked as apprentices under masters.

When asked how they got into this collection and dismantling business at the Agbogbloshie, some of their responses were:

My brother brought me from Tamale (Northern Ghana) to work for him in the scrap market. That was four years ago, I was working for him with four other guys. We moved around with our small truck that we pushed. We leave early in the morning in search of 'condemn' items. At the end of the day, we all give the items to our master.

Interviewee10: 12/07/15.

One of the guys called Seidu said his uncle brought him to his brother for him to learn the job. We dismantled all the items together. His uncle was one of the Muslim leaders (Iman). He buys and sells spare parts at the market. He has his own shop. We also learnt from him. My brother was the master. We were then registered with the scrap dealers association. But now I work for myself after I learnt the trade from him to start my own business.
Interviewee 11: 12/07/15.

It was also deduced from the interviews that the relationships at the scrap market was mutual support in times of financial need. According to the workers at Agbogbloshie that were interviewed, it was a common practice to borrow money for business when the need arises. This was revealed, when asked about the financial setbacks of their work. The scrap Dealers Association sometimes help with financial matters. They also represent the workers especially in times of settling disputes with city authorises.

According to COHRE (2004), it was noticed that it is not a common practice for rural migrants to settle in urban spaces with familiar people from their own region. A similar, study by Meagher and Yunusa (1996) discovered that there was increased ethnic union between southern Nigerians who moved to northern Nigeria for work. Also in Ghana, it was reported by (COHRE, 2004), many people moved from northern Ghana to Accra due to conflict between the Dagomba, KonKomba and Nanumba ethnic groups in 1990s. Most of them came to Accra and settled around the Agbogbloshie area. They settled in the area because of the famous yam market in the area which was mainly operated by the northerners.

Even at the formal e-waste management company, someone must recommend you to the supervisor before one could be employed. The same thing happens with the retailers who hire technicians to repair the broken down gadgets for reuse. This is the quality of social networks currently at Agbogbloshie for people to find work and access to financial resources.

4.6 Environmental impact of e-waste activities

4-3 Environmental activities at the scrap the market

Figure 4-3 Environmental pollution by some dismantlers. Source: Authors field work (2015)

Field observations at the Agbogbloshie site where most of the e-waste recycling and dismantling was enough to reveal the gross air, soil and water pollution. This is caused by the activities of the scavengers as I followed the UEEE. The observations showed the visible thick black smoke in the area because of burning, noise and dust from their activities. This confirms a similar study where survey sampling of health metals and toxic substances in soils and ashes (Brigden et.al., 2008; Oteng-Ababio et al., 2014b), air (Caravanos at al., 2011), blood and urine (Amankwaa, et al., 2014) at the scrap market in Agbogbloshie showing that pollution from recycling activities pose some amount of damage to the environment and health of workers. Extensive studies show similar trends of pollution reported in the Guiyu region of China. Another study at the Agbogbloshie site reported a positive correlation of heavy metals in the soil and the surrounding plants. The samples demonstrated significant levels of toxic substance in the environment (Asante et al., 2012). This also might have negative impacts on human health as shown in the study in Guiya, China. According to Basel Action Network (2005: 17),

Critical analysis of the e-waste chains reveals the inherent environmental and health pollution with the dismantling node of the chains where e-waste recyclers used crude methods and activities, such as burning parts to recover copper, thus during the process emitting fumes into the environment and polluting the air they also breath. These could be extremely polluting and likely to be very damaging to both the environment and human health.

Chapter 5 Conclusion

5.1 Introduction

This study sought to give a critical examination of the influx of e-waste into Ghana, asking whether e-waste is "bridging the digital divide" as some authors argue, or is another example of "dumping" from the Global North to the Global South. Through a commodity chain analysis, the study took account of the activities of the actors in Accra who influence the circulation of the e-waste trade and the associated socio-economic factors it involves.

The central goal of the study is to examine the nexus of whether sending used electronics to developing countries is often hailed to reduce the wide gap of technological advancement between the global north and south or whether they are rather finding dumping sites to dispose of their used electronic equipment in the context of Accra, Ghana. This study used a unique approach of a commodity chain analysis of Global Production network which to a certain extent unveils the social relations that underlie the continuous e-waste trade in Accra. This approach helped to follow the e-waste as it moves from different nodes while examining the socio-economic activities embedded in the electronic chain.

Thus to this end, the main research question which guided the study *was to extent are used electronics imported into Ghana re-used and to what extent do they become e-waste? And what socio-economic processes that determine these outcome*s? However, this study could not answer these questions exhaustively, but it has provided some useful insights on e-waste.

5.2 Summary of Major Findings

The findings of the research reveal that in 2011 when Ghana achieved a middle income status the importation of technological aid by donor agencies reduced (Oteng-Ababio, 2012). This was taken over by the importers. This second hand electronics served a lot of importance in the informal sector. The study shows lots of EEE are being used after they are imported into the country. It was observed, that equipment labelled as non-function or "condemn', as it moves from one node to another, becomes a source of value.

E-waste trade creates employment opportunities for people in the informal sector who actively engage in used electronic trade within various nodes of the electronic chain. Even though the UEEE offers Ghanaians the opportunity to purchase and use gadgets, most of them are in due course disposed of between two to five years of use. The UEEE imported are helpful, based on customer's socio-economic capacity, who cannot purchase the brand new gadgets. Refurbishers with the electronic chain helped repair broken gadgets, fixed or replaced components to enable broken equipment function properly.

Furthermore, along the collection and dismantling nodes of the electronic chain, it takes account of the end of life of WEEE also known as 'condemn'. What is supposed to be e-waste are not waste, they are dismantled and valuable metals, electronic chips among others are recovered from the e-waste. The crude methods of dismantling electronics results in some form of pollution of

the environment and is hazardous to human health. The metals recovered have good market prices on both the local and foreign markets if exported. The role of social network was visible within dismantlers which helped workers in diverse ways to stay in business. It should be acknowledged, that both skilled and unskilled labour played important roles as e-waste moves from one node to the other. However, under the limitations of this study, hardly did the investigations in the field came across stock piles of WEEE which absolutely had no value or use. Most of the e-waste had value for reuse, and some parts were dismantled or broken down which was exchanged for money. From this research, there was no huge significant clear cut waste of no value.

5.3 Conclusions

The importation of WEEE into Ghana has become a lucrative business in the informal sector. This is also due to lack of economic power to purchase brand new electronic items for use. Secondhand electronics are made available through informal e-waste trading for customers who are not economically strong to purchase brand new gadgets for use. The e-waste business makes available electronics affordable for people in both the formal and informal sectors, thus in a way helping "bridge the divide" with the use of electronics.

Under the limitations of this study, e-waste usually result after these second-hand equipment imported into the country are used for about two to five years by customers. This fact also depends on the type of equipment. But, after some years of use, this e-waste are collected from house to house by scrap dealers for dismantling and extraction of valuable metals. It should be acknowledged most of the WEEE imported into the country are not a complete waste. Almost all of the WEEE has value and can be reused or used to fix other components of other equipment which might be broken down.

This study has attempted to assess e-waste within the contest of "bridging the digital divide" or "dumping" as it evaluates the current status of e-waste in Accra, Ghana. The use of commodity chains helped explore to what extent used electronics imported into Ghana are re-used and to what extent they become waste. The findings of this study somehow contradict the dominant storyline by ENGOs in which they mostly picture e-waste as being "dumped" in developing countries such as Ghana. The study agrees that anthropogenic activities in the dismantling nodes of e-waste create some adverse environmental and human health impacts.

The current situation in Ghana is therefore not the influx of e-waste that is pictured as "dumping" into the country. This study contradicts the classical research by ENGOs such as Green Peace International that regards developed countries as exporting technological equipment with the intention of bridging the divide, but finding possible ways for disposing of their hazardous waste in the global south. The current situation of e-waste in Ghana could be analysed based on the field data as a bit more of "bridging the digital divide" rather than "dumping", since the e-waste trade has some inherent beneficial reuse of EEE as opposed to the dismantling which exposes workers to hazards and has negative impact on the environment which is caused by the crude ways of recycling. However the findings of this research agree with Lepawsky and Billah (2014:157), who suggest a rethink of e-waste differently rather than agreeing to the dominant storyline of ENGOs. He states that "a richer approach to the

geographies of e-waste would add questions of reuse, repair, refurbishment and material recovery to the issue of trade flows and their environment effects".

There is a need for an interdisciplinary research approach in the field, as activist, government; manufacturers are debating on a sustainable management approach to e-waste. One important perspective for future research would be on issues on child labour, cost effectiveness and quantitative approach from a business point of view. This could further contribute to the emerging literature on e-waste.

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Appendix

List of key informants

Name of participants	Designation	Date of Interviewed
1. Ken	Importer	30/06/15
2. Kay	Middleman	30/06/15
3. Kojo	AMA	01/07/15
4. Kwame	CEPS	02/07/15
5. Seiji	Refurbisher	02/07/15
6. Dennis	ENGO's	04/07/15
7. Allahji	Masters student	05/07/15
8. Jeffery	UEEE retailer	07/07/15
9. Kingsley	E-waste: Customer	07/07/15
10. Emmanuel	Customer	08/07/15
11. Abu	collectors	10/07/15
12. Issac	E-waste dismantler	12/07/15
13. Joshua	Agents	12/07/15
14. Johnson	EPA	14/07/15
15. Christian	e-waste dismantler	15/07/15
16. Raza	CEPS	20/07/15
17. Uncle Ben	UEEE Retailer	21/07/15
18. Musa	E-waste Collectors	23/07/15
19. John	Blacksmith	25/07/15
20. Mohammed	E-waste disman-tlers	30/07/15

Anonymous names are used in the interview list.