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Building capabilities among e-scrappers in informal electronic waste management: the case of the Nigerian e-scrappers

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This study examines the capabilities of e-scrappers developed through the constant interaction with electronic waste (e-waste). Video-based interviews were conducted with 29 male e-scrappers in Edo and Lagos States, Nigeria. Data analysis reveals that over time, e-scrappers in Nigeria are driven by aspirations not only of financial security but also of societal acceptance and recognition. Progressively, they have developed capabilities such as effective extraction methods based on individual abilities, market demand and the presence of an active social network, which have had a significant impact on the choices of the developed capabilities.

Keywords: aspirations; capabilities; e-scrappers; electronic waste management; e-waste

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1. Introduction

In many societies, electronic waste (e-waste) at its end of life is considered trash and destined for the garbage. Similarly, individuals who engage in informal recycling of e-waste are regarded lowly in the society. However, in the hands of recyclers, especially informal recyclers, e-waste comes to life and becomes a valuable resource for social interactions and environmental discourses. This study aims to clarify the dynamics by which e-waste bestows valuable skills on informal recyclers. Towards this end, empirical material collected from Nigeria in 2014, will be analysed to illustrate the social and environmental importance of informal e-waste management. The article will extend previous theoretical research on the materiality of matter by investigating the relationships of e-waste as matter to recyclers' bodies, skills and knowhow.

The Step Initiative (2014) defines e-waste as 'a term used to cover all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of reuse.' However, there is no standardized definition of the term e-waste, as its definitions, legislative and daily usages differ considerably among countries (EU Directive 2012; Tonetti 2007; Morgan 2006). High environmental standards and loopholes in e-waste regulations among developed countries make it easy for transboundary movement. Hence, e-waste is shipped in the guise of charity donations and second-hand goods to countries where environmental laws are easily circumvented. The complex composition of e-waste differs significantly by product, making it very difficult to manage.

In Nigeria where e-waste is received mostly as second-hand goods, the recycling industry has been operating since the 1990s enhanced as a trend by Nigerians' repairing culture (Author's fieldnotes, 2015). By 2010, the importation of second-hand (repairable) electronics, mostly originating from European and Asian countries, was estimated at 0.1 billion metric tonnes. Nigeria generates 0.22 billion metric tonnes of e-waste per annum domestically and is considered as one of the top three West African countries with the highest rate of e-waste generation (Ogungbuyi et al. 2012).

Among academia, the materiality of e-waste has gained significant attention in the social sciences and scientific disciplines of chemistry and engineering. This can be ascribed to the steady increase in the use of electronic devices as a medium of technological consumption and the challenges of managing the resultant e-waste. Scholars have focused on the local and international regulations governing disposal (Belenky 1999), chemical properties (Holmes 2009), environmental impact (Goodship and Stevels 2012), and economic value (Puckett, Westervelt, and Gutierrez 2005) that e-waste offers to both informal and formal recyclers. By formal recyclers, I refer to institutions that recycle e-waste with mechanized processes under legally approved conditions and strict environmental regulations.

Even though existing research has successfully highlighted the human and environmental benefits of formal recycling and condemned the practices of informal recyclers such as open burning, informal recycling continues to grow. The reason for this exponential growth is connected to the high economic value of extracted materials in e-waste (Byster et al. 2002), but it goes beyond that.

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Depending on the social context, e-waste proffers specific attributes, which the informal recycling sector recognizes.

Informal recyclers have continuously and erroneously been branded as global victims of a defective international recycling system (Zenga et al. 2013; Kiddee, Naidua, and Wong 2013). A major problem with this perspective is that it ignores the ability of e-waste to act as a skills acquisition resource for informal recyclers. In order to proffer any holistic solutions to sustainable e-waste management, it is important to address this problem by investigating both the external and intrinsic interaction of e-waste and informal recyclers.

This paper reveals that though the recycling of e-waste is a deliberate act, informal recyclers actually gain more beyond monetary benefits. Understanding how e-waste acts as skill acquisition is especially beneficial to environmentalist and policy makers especially those in charge of designing environmental and socially sustainable e-waste management system.

In Nigeria, informal recycling, as the main form of recycling, is a generic term comprising individuals who recycle all forms of waste (Author's fieldnotes 2015). Although they are sometimes referred to as scavengers, in this study informal recyclers who specialize specifically in manual dismantling and extraction of valuable materials from e-waste will be called e-scrappers, which is the term they use themselves. I choose informal recyclers specifically because they are socially and environmentally active in the management of e-waste in Nigeria.

From here on, this article is structured as follows: Section 2 discusses the theories of new materialism and the capability approach. Section 3 explains the methodology used in data gathering and analysis. Section 4 reveals the results gleaned from the data analysis. Section 5 discusses the environmental implications of studying this aspect of the interaction of informal recyclers and e-waste. The article ends with discussions and conclusion on the new materialism nature of e-waste and the processes of building capabilities among e-scrappers in Nigeria.

2. Theoretical approach

Societies, organizations and personal lives are ruled essentially by the information we get. How we process and utilize this information is dependent on the freedoms we have to choose from and the opportunities available to us. The combination of information, freedoms and opportunities is what Sen (2010) calls the capability approach. Sen defines capability approach as

> . . . a person's capability to do things he or she has reason to value. A person's advantage in terms of opportunities is judged lower than that of another if she has less capability – less real opportunity – to achieve those things that she has reason to value. (2010, 231)

Sen's original research work has been further developed by other prominent scholars such as Nussbaum (1995), Alkire (2005) and Robeyns (2005). A common agreement among these authors is that the capability approach centres on the freedoms and opportunities available to individuals and how these factors facilitate achievements. The freedom to access multiple opportunities is weighed and measured differently depending largely on economic factors, environmental policies and cultural habits. For example, Byster et al. (2002) discovered that left to choose between environmental degradation and financial stability, the informal recyclers in Guiyu, China, chose financial stability because it attended to their immediate needs at that time. The demand for specific raw materials also informed the capability sets they needed and developed to extract materials from e-waste. In this sense, acid bath was a common method for extracting gold among informal recyclers in Guiyu, but as it will be shown in the results, this was not the case among the e-scrappers interviewed for this study.

The capability approach has a deeper, richer application to economic and political issues. It focuses on availability of individual freedoms and agencies. Capability approach studies the complex interactions of social, economic and political factors influencing the choices and decisions available to an individual at a time (Nussbaum 2011). It is a conceptual framework for appraising individual well-being, evaluating social arrangements, constructing policies and initiating or recommending social change in the society. This study uses this approach as a lens into the social process of developing capabilities. Figure 1 illustrates this process.

The freedom to become an e-scrapper even in the presence of accessible white-collar jobs is a conscious decision e-scrappers make. Once this choice is made, the quality of information and opportunities available enhances the quality of capabilities and freedom an e-scrapper experiences. I argue that e-waste scrapping has evolved from single-purpose use, such as extraction of only gold or copper (Puckett, Westervelt, and Gutierrez 2005), to multiple uses usually involving all aspects of the e-waste device. This evolution is made possible by the active presence of the social networks such as importers of e-waste, technological advancements, information dissemination and environmental factors (cultural habits and policies). Though e-scrapping can be regarded as an intuitive practice, it requires some level of training. The training involved in e-scrapping usually occurs in the form of apprenticeship; a situation where a person learns under the tutelage of someone considered to be an expert. This apprenticeship model forms an important part of the social and environmental network e-scrappers require to sustainably remain in the business.

While the capability approach helps in understanding that e-waste facilitates self-development among e-scrappers in Nigeria, *the new materialism* highlights the enabling characteristics of e-waste that allows it to be

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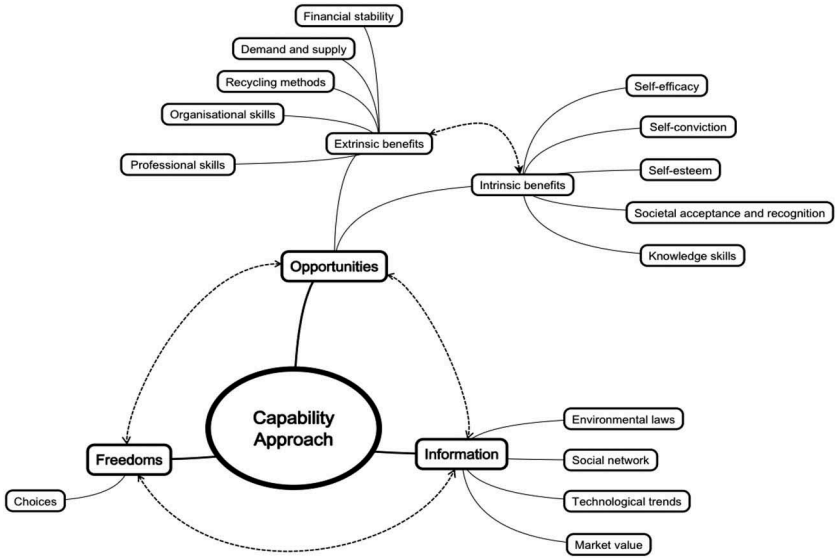

Figure 1. The capability approach framework.

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transformed into valuable means. According to Bennet (2010), matter possesses certain measure of '*thing power*', which becomes interactive within its immediate environment. 'Thing power' refers to matter's ability of 'things' to affect the very structure of economic, social and political life such that 'it (thing) and we (humans)' - are attracted to its consideration (Coole and Frost 2010). This interactive nature of matter forms the basis of new materialism, which considers that matter is reactive even in a perceived stationary condition. It has the ability to invoke and evoke specific reactions from its environment. In the case of e-scrappers, it presents alternative uses. This is in stark contrast to a general view, which regards e-waste as unclean and those who process it are not highly regarded. Utilizing the new materialism approach brings to fore the non-verbal interaction and relationship that exist between e-scrappers and e-waste.

By combining the new materialism with the capability approach, this paper aims to disclose the latent potential of e-waste processing as a means of capability development and, more widely, of personal and social transformation. The ability to recognize the productive power of e-waste is a set of skills that e-scrappers develop while working on the field. These capabilities are deliberately acquired on the job, either through apprenticeship or through self-training, and it further translates into a higher status, such as self-esteem, professionalism and societal recognition within the community. The conceptual toolbox of new materialism helps in elaborating the seemingly invisible interplay between e-waste and e-scrappers and makes it possible to reveal the capabilities that e-scrappers develop within the wider community.

3. Method and data

The system of manually dismantling and extracting valuable materials from e-waste known as 'e-scrapping', is a very practical and visual process. It requires extensive knowledge of valuable materials and various techniques for material extraction. Capturing this visual process requires an ethnographic approach such as videography (Tuma, Knoblauch, and Schnettler 2014). Approaching potential interviewees was quite easy as my camcorder was the reliable ice-breaker. At these locations, the sight of a camcorder meant I was there for either repairs, resale or purchase. The interest in my camcorder started off conversations that would have otherwise been difficult and aggressive. I chose to interview only individuals who were involved in e-scrapping full time and were willing to allow me capture the process on camera, audio and on-site note-taking.

Altogether, 29 male e-scrappers between the ages of 18 and 55 years agreed to be observed and interviewed in their natural settings contingent on my ability to be unobtrusive during the actual e-scrapping process. The interviews were carried out in Benin City, Edo state, Ikeja Computer village, and Owode market in Lagos state, Nigeria in 2014. The e-scrappers in Benin City, Edo state, carried out their activities in a residential street-turned-marketplace. Residents were also traders in an intriguing blend of plastics, electronic parts and building materials. Ikeja Computer Village, on the other hand, is an Information and Communications Technology (ICT) accessories market situated within the Otigba community. It is a competitive market under The Computer and Allied Products Dealers Association of Nigeria (CAPDAN). Besides the sales of IT accessories, the market also offers repairs of electronic devices. Owode market is a steel market situated at Mile 12, Lagos. It houses over a 1000 sellers of steel products; 150 of which were e-scrappers.

The sites were chosen based on their geographical locations for electronic importation activities. Edo state is a civil servant state, which is in sharp contrast to the industrialized and populous Lagos state. Thus, electronic consumption and subsequent e-scrapping activities also

differ considerably especially in the volume of extracted materials. E-scrappers are very mobile; therefore, the snowballing method was employed which in turn also helped to eliminate non-e-scrappers.

Female e-scrappers were conspicuously absent; perhaps it can be attributed to the prevalent heavy lifting of acquired e-waste. The interview was conducted in the local *Pidgin English* dialect and later transcribed into English during data analysis. Using *Pidgin English* helped to create comradeship and a relaxed atmosphere where the presence of the camera became part of the activities. The right to publish results from the data was received from the e-scrappers both on camera and in written form.

The data used in this article is chosen from among the 29 interviews carried out in 2014. It is based on the research questions and the specificity of the interaction between e-scrappers and e-waste. The video data was sequentially analysed using Heath's methods (Heath, Hindmarsh, and Luff 2010). To present the results gleaned from the data analysis, transcripts, sequential images (Heath, Hindmarsh, and Luff 2010) in form of vignettes (Jarzabkowski and Kaplan 2014; Michaud 2014) and video clips depict the influence of environmental and social policies on the capabilities developed by e-scrappers. For privacy sake, pseudonyms are used instead of real names and the faces of the respondents are either removed or blurred from the videos and pictures.

Due to insufficient research on this aspect of e-waste, it is necessary to state here that majority of the information in this study is derived from fieldwork.

4. Results

Over the years, e-waste management has taken a new, interesting turn in Nigeria. With the increase in demand for valuable materials by manufacturers and the public awareness on dangers of open burning, e-scrappers have developed aspirations and built capabilities. The financial stability and the desire to be recognized as active positive participants in the society play a significant role in the way e-waste is handled. The presence of an active environmental law agency such as Lagos State Waste Management Authority (LAWMA) and Edo State Waste Management Board (EWMB) also defined the nature of e-scrapping practices.

Data analysis revealed that of the 29 interviewees, 24 of them possessed basic and/undergraduate education with the highest qualification being a bachelor's degree. The other five interviewees have been trained in the sale and repairs of electronic devices. The interviewees were previously employed in other professional endeavour such as computer engineering and electronics repairs before becoming e-scrappers. Initially, increase in financial status and stability was the deciding factor but as they got more involved, other intrinsic and extrinsic benefits (see Figure 1) which are interrelated also surfaced.

For instance, e-waste provides economic opportunities for Chuks and his family. The constant demand for extracted materials ensures that he has a stable source of income. Chuks confirmed during the interview that he had gained a lot of knowledge through e-scrapping. By sight, he is able to determine what type of materials exists in an e-waste device. He believes that e-scrapping is very sustainable financially and educationally (Allen and Wood 2006) because there will always be a high demand for it. Below is an excerpt from the interview:

Interviewer: So what have you gained from e-scrapping?
Chuks: alot, so much. I know so much about e-waste. Where they come from. There is quality e-waste and not so quality e-waste.
Interviewer: really, how can you tell?
Chuks: *(laughs)* it is not something I can explain to you. Its a secret *(grins)* but I can tell by looking at them. You know, I get so many but, I have to know which one is quality and which one is low quality. It helps my business.
Interviewer: so what is not so quality e-waste?
Chuks: well *(looks thoughtfully at me)* … not so quality e-waste does not bring good money. *(clearly, he was not ready to delve deeper)*
Interviewer: Do you think this is a sustainable business?
Chuks: yes, it is. As long as there is e-waste, business continues.

Societal perception of e-scrapping is that of a dirty and low-wage menial job only practised by individuals on the low strata of the society. But as Chuks implied, he has gained a lot of self-confidence and self-efficacy dealing with e-waste. Buyers of extracted materials require efficiency when dealing with e-scrappers as reflected in the interview excerpt:

Interviewer: how do family and friends treat you knowing the job that you do?
Chuks: oh, they have no problem with it. As long as I bring money home. I make a lot of money you know… *(smiles)*
Interviewer: is money the only reason?
Chuks: oh… no, I have a lot of knowledge, you know… and people from China, USA, those foreign people who buy from me, they want to know that I can deliver quality. When I provide good quality for them, they bring more jobs and contacts too. Everybody around me knows I do business with foreign people and I deliver good materials. So they respect me… a lot.

Chuks relies on his social network for carrying out his e-scrapping. Figure 2 displays the typical social network of an e-scrapper.

The social network plays a pivotal role among e-scrappers. As shown in Figure 2, formation of social network is centred on e-scraping activities. The process by which

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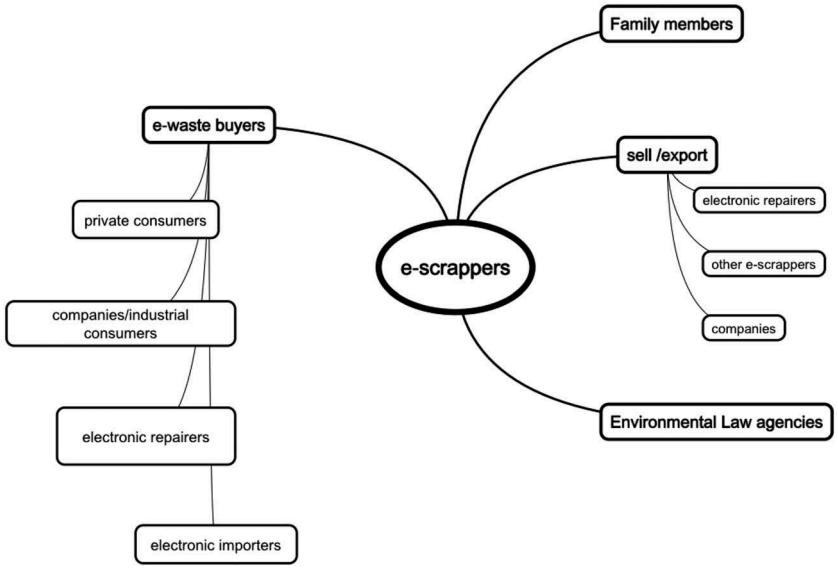

Figure 2. Social network of e-scrappers in Nigeria.

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e-scrappers recognize the vibrant nature of e-waste, industry news, pricing strategy of extracted materials, foreign exchange rates, what manufactures are buying as well as what is trendy in the market are very valuable information for the e-scrappers. This information is easily obtained from their social network, which is comprised of fellow e-scrappers, electronic dealers and importers, private consumers, companies, family members and environmental law enforcement agencies. Family members serve as moral support and fulfil the emotional and psychological need of being useful, responsible citizens. Being responsible citizens means the e-scrappers could provide for their families financially, adhere strictly to the environmental laws and are socially accepted as contributors to the well-being of the society. E-scrappers either employ e-waste buyers or rotate the acquisition process of procuring e-waste from private or corporate electronic consumers among themselves.

Extracted valuable materials are then sold or exported to other companies who utilize them for reproduction of goods and services. E-scrappers depend highly on both the companies they acquire e-waste from, and those they sell extracted valuable materials to, for trendy news on e-waste. Because e-scrapping is a very competitive market, the demand for specific e-waste parts also requires specific extraction skills. This tends to increase competition among e-scrappers and hoarding of information in some cases. There is, however, a need to achieve balance because in as much as the e-scrappers desire the competitive advantage of hoarding information, they also have to collaborate and share trade secrets if they were to gain an edge (in terms of pricing and environmental regulations) over companies who buy the extracted materials from them. The environmental law agencies such as LAWMA and EWMB ensure that e-scrapping activities do not breach environmental laws.

To learn the trade and build a viable, efficient social network, e-scrappers are willing to learn trade secrets from their peers. They are independent enough to decide what capabilities they need to develop in order to be successful. E-scrappers are a well-organized, close-knit group, who depend strongly on the social network they have created to remain active players in the e-scrapping of e-waste.

4.1. *Extraction methods*

Demand by manufacturing companies for specific material extracts determines the method of extraction employed by the e-scrappers. Unlike their counterparts in Guiyu, China (Leslie et al. 2002), for instance, the e-scrappers in Nigeria do not engage in acid baths or open burning because the environmental law agency (LAWMA) prohibits them to do so; roadside dumping of leftover e-waste is also discouraged. Where offenders are caught, a hefty fine and sometimes complete closure of their business are enforced. This restriction helps to categorize e-scrappers according to their method of extraction and what valuable material extracts they obtain from e-waste. There are three main methods of extraction, namely the systematic, the smashing and a combination of both. These are discussed in detail below.

4.1.1. *Systematic extraction method*

The systematic method involves the careful extraction of valuable material extracts with the use of basic tools such as pliers, screwdrivers and tweezers. The aim is to preserve every part of the e-waste with minimal destruction. This method is usually used on desktop computer devices and laptops. According to Oga S. who was a respondent interviewed at Ikeja Computer village, Lagos, e-scrapping for a high priced motherboard meant careful and systematic extraction which does not involve heat or smashing in anyway. Unlike his

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counterparts in other parts of the state, his goal was to limit breakage of material extracts as little as possible.

Oga S. has been e-scrapping for over 3 years. He is married and in his late 40s. Oga S. is self-taught. He was a successful electronic engineer before he got introduced to e-scrapping during an acquisition trip. He learnt by what I refer to as e-waste-osmosis which implies that he learnt by immersion, on-the-job, and also by watching others who have had more work experience. Oga S. specializes in e-scrapping computer CPU. His major extract is motherboard and computer casings, which are made of steel materials. His clients are major electronic and steel manufactures mostly from China and India. Due to the strict requirements from his clients, Oga S. has developed a systematic way of e-scrapping which reduces waste (see video excerpt on Figshare.com). This skill ensures impurities such as plastics are eliminated from the extraction process, thus providing him with high pricing advantage. He further explained why systematic extraction was important:

Interviewer: Oga, why do you loosen it carefully, why are you not breaking it open likethe others do?

e-scrapper's colleague: *(snorts)* Ha ha, this one is a silly question that you ask.

Interviewer: No, not really, because the guys working on handset, they break, they don't loose.

e-scrapper's colleague: can't you see the nut? Can't you see the nut? *(points angrilyat the half scrapped computer CPU on the pile)*

Oga S.: *(smiling)* This one... it will not be easy to break. Even if you break it, it will not come outside unless you loosen that screw *(points to a screw)*, it will never come out. *(He takes in a breath and tries to explain again)*. This very one, you have to remove the motherboard; you have to use screwdriver to remove the screw first before you can take the board out. Even if you break it the board will never come outside

To demonstrate further, he proceeded to show a little of his extraction process as reflected in Figure 3 (also see video excerpt on Figshare.com).

Figure 3 shows the extraction process employed by Oga S. during e-scrapping at Ikeja Computer village where over 20 e-scrappers carry out their activities independently of each other. Sometimes, they would collaborate; for example, helping an electronic repairer find a particular motherboard or steel frame. It is interesting to see the delicate balance of cooperation among the e-scrappers. They tend to hoard information but not so much that it would be detrimental to their overall business success.

Oga S. carries out his e-scrapping using manual methods. His tools include screwdrivers, pliers, soldering iron, hammer and bare hands. On very busy days, a desktop monitor serves as his chair and his lap serves as support for the device he is e-scrapping. Despite the inadequate facilities, Oga S. enjoys what he does, not because it was the only option available to him, but because he has a flair for electronics. E-scrapping provides financial security for him and his family. It also affords him the opportunity of being an active, responsible member of the society. Being responsible meant he could financially provide for himself and his family and could contribute meaningfully to his immediate social network. This was very important to him. Additionally, strict adherence to environmental laws such as clean workspace meant that he could continue his e-scrapping in that environment.

4.1.2. *Smashing extraction method*

Smashing extraction involves the use of mallet or hammer on e-waste. The aim is to retrieve certain parts that are hidden in smaller e-waste. Like the e-scrappers, manufacturing companies are also specialized in acquiring certain valuable extracts from e-waste. These valuable extracts, which are usually found in very compact devices and require some measure of smashing to extract them, include copper, aluminium and gold. They are often used for reproduction of goods such as jewellery. Quantity is very important to this category of e-scrappers because valuable extracts are bought in kilograms.

Figure 4 shows Ajayi, an e-scrapper in Owode market, Lagos state extracting copper, aluminium and steel from e-waste. The process involves the use of hammer, mallet and chisel to break the e-waste device before prying away the desired materials with hands. Ajayi has been

Figure 3. Systematic extraction of motherboard from computer CPU. Source: the author.

Figure 4. Smashing extraction process (also see video excerpt on Figshare.com). Source: the author.

e-scrapping for over 6 years in Lagos, Nigeria. He learnt via apprenticeship for 2 years before starting off on his own. After extraction, he sells the valuable extracts to manufacturing companies mostly based in Nigeria. His volume of extraction depends on the availability of e-waste and the demand of manufacturing companies. Ajayi acquires e-waste from private consumers, industries and manufacturing companies who import e-waste solely for extraction.

4.1.3. Mixture of smashing and systematic extraction

This method involves both smashing and systematically extracting valuable materials from e-waste. It is a method expertly utilized by Olu who was once an engineer and has been e-scrapping for less than a year. He was a repairer of flat screen TV, monitors and other electronic products before becoming an e-scrapper. Realizing the lucrativeness of e-scrapping, Olu converted to the process full time. He is self-taught because of his background but picked up some trade secrets from other e-scrappers along the way. Olu is an e-scrapper specialized in steel. He scraps all forms of e-waste as long as it has steel in it. He also sells motherboard panels if they occurred in his e-scrapping process. Olu's method of manual e-scraping was both smashing and systematic extraction. Depending on the type of e-waste, he uses smashing mallet, pliers, bodily support, screwdriver, bare hands and hammer. This extraction method is shown in Figure 5 (see also video excerpt on Figshare.com).

Figure 5 shows Olu unscrewing a piece of plastic from a steel extract on the left side of the image and smashing an e-waste device on the right side. The workspace is very large compared to other e-scrappers. Olu requires more space because his extracted steel is larger in size. On the floor at his feet is the steel mallet for smashing larger steel. Olu is very particular about removing plastics from his extraction because manufacturing companies who purchase from him could make monetary deductions if any plastic is found within them. Olu reveals this in the transcript.

Interviewer: What has e-scrapping taught you? What have you learnt?

Olu: *(grins)* this is just like any other business. *(he pauses to gently extricate a piece of motherboard panel from a steel frame)* There is nothing really special to learn. But when companies request for steel, it must be steel. They will make monetary deductions if they find plastic or any other material in it. That is what I have learnt. Also there are companies who need the plastic but not steel and they are very particular too. Every company is very specific.

This specificity from manufacturing companies has also made Olu very meticulous and careful in buying electronics for e-scrapping. The extracted steel is smashed to compress them; afterwards, they are weighed in kilograms and then stored in bags before transporting to manufacturing companies. Extracted steel can be very heavy and towing it all by himself is usually demanding. It is also very capital intensive but Olu is happy because he does make considerable profit from this business. Additionally, he is also happy because he believes he is contributing meaningfully to environmental sustainability by adhering strictly to the environmental laws of the state. However, a major constraint for Olu is transportation. It

Figure 5. Systematic and smashing process of extraction. Source: the author.

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costs a substantial amount to transport extracted materials to the companies and to take the leftover waste materials from the e-scrapping process to the dump sites. Olu wishes the environmental agents will provide a proper disposal network system that may help to reduce transportation costs. His costs are so high because he works with larger e-waste products, but this is, however, not typical for every e-scrapper hence a holistic disposal network system would have to take this into consideration.

4.2. Knowledge skill

E-scrapping is a sophisticated process which also requires a high level of economic and management skills. For the e-scrappers, it was interesting to discover that they found the act of e-scrapping very invigorating and rewarding. Besides the financial reward, the other intrinsic and extrinsic benefits were a welcome unintended bonus. This was shown in the interview with Eke, who has been e-scrapping for 7 years. Unlike Oga S., Eke learnt e-scrapping through apprenticeship. He specializes in motherboard and steel extraction from computer CPU and DVD players. E-scrapping has presented new learning experiences for Eke. Through e-scrapping, he has been able to recognize different parts of materials in e-waste just by sight. Recognizing valuable extracts is a necessary skill in e-scrapping. It helps to encourage quality buying, fetch better pricing, eliminate loss and expand the range of mineral extracts from e-waste.

Interviewer: So each motherboard fetches different prices? *(Eke nods in affirmative, his attention on the motherboard pieces at his feet. He had an amused smile on his face)*.
Interviewer: How do you know which motherboard is which?
Eke: *(smiles fully)* This one now, is a DVD. We call this one DVD. *(Points at the motherboard panels lying at his feet. They looked quite the same to the novice eye)*. We call this one, panel for television, but this one is a DVD. So, it is not the same price. Two of them are not the same price, they are different, different prices. It is easy for me to recognize them in e-waste because I am used to it. For you, that will not be easy.

Eke relies solely on his ability to recognize different motherboard types based on their characteristics because there are no facilities or equipment available to test and categorize material extracts. Depending on the environmental conditions, this ability is made possible by the dynamic and constantly evolving nature of the e-waste sector. Industry news was also important to him. Knowing which valuable extract was in demand helps him reduce the waste he gets from his e-scrapping and also what kind of e-waste he should invest in. Eke's extraction process was also very systematic. The aim is to limit the damage of the e-waste parts to the barest minimum. He acquired this systematic extraction process from buying working computers and taking them apart. The level of knowledge gained from e-scrapping is revealed during the interview.

Interviewer: What kind of knowledge have you gained from this business?
Eke: *(wide grin)* A lot! Through this business, I know how to handle computer. I can handle computer, I can repair, I know what a capacitor is, many things, all those things, I learn a lot.
Interviewer: But did you attend any computer school or training?
Eke: *(shakes his head)* No, I did not attend any computer school; I learnt everything here. Sometimes, I buy a working computer, open it up and then use it to fix another one. That is how I learn.

Eke enjoys the dynamic nature of his e-scrapping activities and the societal recognition it provides. But there are also risks involved such as buying 'bad e-waste' (e-waste containing inferior materials in them). Eke has contacts abroad who ship computers to him. Sometimes, the computers can be of low grade, which reduces the value of the extracts he may get for them from manufacturing companies.

Interviewer: what kind of risks do you experience in this business?
Eke: *(shrugs)* yea, they are numerous. Sometimes, I may buy this one (*points at a computer*) 500 naira (2.23€), when I reach company I will sell it for 400 (1.79 €) or 300 naira (1.34€). That is a loss. So it's a risk because, maybe the price I bought it will not be the same price companies I am selling it to will pay for it. Each motherboard has different price value (*cost variation*).

Cost variation was a big risk for Eke as well. Companies he sold to were very particular about the quality of the extracts. This specificity also manifested in the interview exchange with Olu and Mohammed.

4.3. Professionalism skill

For Mohammed, an 18-year-old e-scrapper who has been e-scrapping for over 5 years, e-waste was a valuable means to achieving professionalization. He is a college student and he initially did e-scraps mainly for financial reasons. But as he progressed, he has been able to develop accurate recognizable skill needed to extract copper, aluminium, steel motherboard panels and brass from densely packed e-waste such as table fan. He can tell what

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materials are found in specific electronics and what he terms 'good' and 'bad' e-waste by sight.

Mohammed employs a mixture of systematic and smashing extraction process which can be an intense exercise. For a novice, it could be very dangerous but for Mohammed, it seems very easy due to his long acquired experience. The extracted materials are sorted in bags and then weighed before transporting to manufacturing companies.

During the interview, Mohammed revealed that e-scrapping has helped him develop accounting skills. This was validated when a fellow e-scrapper called him the accountant in the group (see Figure 6 and interview transcript).

> *(While watching Mohammed at work, an e-waste buyer passes by. Mohammed points at him and explains)* these are the people we give money to buy e-waste for us. When they come back from the market, we check our calculations and pay back balances.

Mohammed and his colleagues are very organized. Mohammed keeps accurate records of their transactions and makes contact with buyers in Lagos state. He also ensures that the leftover waste from their activities where properly disposed according to environmental laws. Mohammed commands respect from his social group. When asked what his family thought about his e-scrapping ventures, he replies:

> . . . they respect me, since I am not stealing. I do what I have to do to survive. I work to survive. They do not have any problem with me.

Besides the respect he commands, Mohammed is happy that he is useful to himself and the society. He reveals that he has learnt a lot in e-scrapping. The ability to negotiate price is very important as it could improve profit margin. He explains:

> . . . we give money to buyers and send them to the market. If for example they buy a load of e-waste for 300 naira (1.34€), we could sell it to people here for 800 (3.57€) naira. But if we go to Lagos, we could sell it for 920 naira (4.11€). It is more profitable in Lagos and we sell per kilo". *(Smiling widely, he continues)* I get to meet people a lot. I travel to Lagos in some cases and meet with foreigners. It is very good to meet others who also do what we do. I also have to know what the companies want to buy. It is very good.

E-scrapping for Mohammed is very lucrative even though it is a temporary venture for him. He wishes however that he could gain access to better equipment for e-scrapping as it ensures efficient productivity. Through e-scrapping, Mohammed is slowly getting close to his dream of becoming an accountant as well as been financially stable for himself and his family for he spends most of his earnings on his education.

4.4. Organizational skills

As important as record keeping is to the e-scrappers, the ability to properly organize acquired e-waste and extracted materials is imperative. Workspace is often very limited and shared among the e-scrappers. Extracted materials are stored on bare floor and open air forcing the e-scrappers to quickly process acquired e-waste for export thus releasing space. Interestingly, there are no visible tags to indicate which pile of e-waste or extracted materials belong to a particular e-scrapper (see video excerpt). But the spaces are shared in such a way that e-scrappers recognize where their piles end and another begins. Alabi, an e-scrapper at Owode, Lagos state, explains further:

> **Alabi**: *(smiles)* it is easy to know which of the pile here is mine. We trust ourselves and we also keep record of how much we buy per day and how many kilos we have after weighing.

5. Environmental implications

E-scrappers play an active role in preventing a substantial amount of e-waste from entering the local landfills. By scouting for e-waste at source (companies, private consumers, etc.), they help to separate e-waste from the

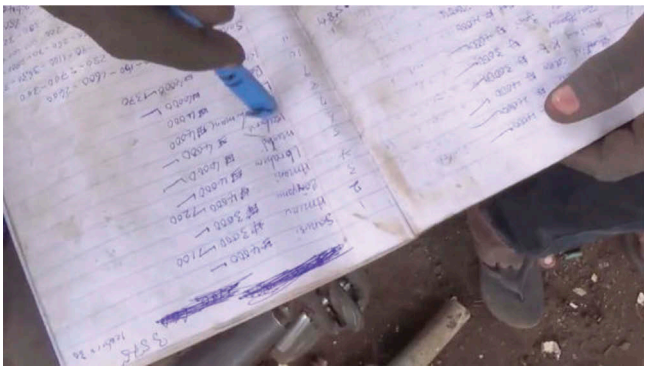

Figure 6. Mohammed discussing his accounting records. Source: the author.

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mainstream waste thus minimizing ground water/land pollution. As already mentioned above, they also try their best to observe environmental laws, by not burning the leftovers, for which they also seem to take pride in.

While this may be regarded as a welcome development, the methods by which e-scrapping is carried out do not eliminate hazardous materials from polluting the immediate environment. Extraction is done on the bare floor and the process releases harmful materials into the air and soil, thus posing a great threat to humans and organic and inorganic organisms. Valuable materials are removed but the leftovers which usually contain some amount of harmful materials are not removed from the ground. Bare floor storage exposes extracted materials to weather elements. Rainfall gradually leaches eroded materials into the ground. Some of the sites visited had water puddles and are susceptible to flooding. Though material extracts are usually transported to manufactures within one to two weeks, it is environmentally unfriendly to expose them to the open air. When asked if they experienced health problems, the e-scrappers revealed that apart from occasional body ache from heavy lifting, constant mobility, and headaches, they had no major health issues.

6. Discussion and conclusions

6.1. *Discussion*

The capability approach questions what people are actually able to be and do with the freedoms and opportunities available to them. It focuses on encouraging the freedom of choice for people so that they are able to develop the capabilities needed for attaining a quality life (Nussbaum 2011). This raises some critical questions. What does 'quality life' imply in the context of Nigerian e-scrappers? Is the availability of freedoms and choices a necessity for building capabilities? Quality of life is relative (Banister and Bowling 2006). It depends largely on a number of factors such as cultural and social norms, social network and economics. For the e-scrappers, their quality of life is defined by the relevant role they play in the society.

One of the key observations of this study is that e-scrappers are able to recognize the extended value of e-waste beyond financial gains. As such, they develop certain valuable skills, which have a huge impact on their quality of life. In Nigeria, e-waste is currently considered as fit-for-garbage and e-scrappers are likewise not regarded professionally. However, for e-scrappers, e-waste is not useless or a waste. It is not only a means of livelihood; it is also a medium of attaining social and economic recognition in the society. It is a valuable tool for acquiring capabilities in different specialized areas such as extraction methods, and recognizing and categorizing e-waste parts.

The vibrant nature of e-waste makes this recognition and categorization possible for the e-scrappers. The ability of e-waste *'thing-power'* (Bennet 2010; Coole and Frost 2010) to present itself in different valuable forms and the subsequent demands by companies requesting for particular parts of valuable extracts ensures that different skillsets or 'capabilities' (Nussbaum 2011) are developed. This in turn creates specialization and diversity among the e-scrappers.

As revealed in this article, freedoms and choices are a necessity for building capabilities. Contrary to popular belief of poverty being a major driver, the e-scrappers examined in this study lead professional lives. As shown in Section 4, for Oga S., the freedom to choose to become an e-scrapper is born out of the lucrativeness of e-waste and the educational opportunity it offers. Even though financial gain was an initial motivator, the formation of an active social network, which is centred on his e-scraping activities, propelled the formation of new capability sets. Financial stability became an added bonus as he strived to remain relevant in the business. Industry news on what is trendy and the prevalence of eager buyers of valuable extracted materials ensured that he became innovative in his e-scrapping activities.

As indicated by the interview responses from Olu, Eke, Alabi and Mohammed, professionalism, societal recognition as responsible citizens and active participants in environmental sustainability are strong driving forces for developing new imaginative ways of recycling e-waste. The effective implementation of environmental laws also determines the method of extraction, which in turn pushes the e-scrappers to engage in environmentally friendly practices and also find markets for various parts of e-waste; thus maximizing their economic value and improving the knowledge on e-waste. Although e-scrappers strive to obey environmental laws, more can still be done to reduce the leaching of hazardous materials into the environment.

6.2. *Conclusions*

E-waste at its end of life is commonly regarded as trash doomed for the garbage. Similarly, individuals who engage in informal recycling of e-waste are regarded lowly in the society. However, in the hands of recyclers, especially informal recyclers, it comes to life and becomes a valuable resource for social interactions and environmental discourses. This study has been able to clarify the dynamics and processes by which e-waste bestows valuable skills on informal recyclers through the presentation of results gleaned from fieldwork data.

By utilizing the theoretical and conceptual toolbox of both the capability approach and new materialism during data analysis, this article has revealed that the change in perception of e-waste as valuable matter beyond financial gains is highly related to the e-scrappers' attainment of certain valuable skills. These skills significantly influence e-waste management and the societal role of e-scrappers in Nigeria. Reflectively, the results of this study indicate the holistic analytical tools which capability approach and new materialism offer to the study of e-waste management.

It is evident from the results in Section 4 that the erroneous belief of e-scrappers being global victims of a

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defective international recycling system needs revisiting, especially among academics, policy makers and the media space. As reflected in the interviews carried out and analysed in this study, the capability skills developed and the new materialism nature of e-waste indicate that the current global e-waste management discourses need a reappraisal.

E-waste is not just a commodity for e-scrappers in Nigeria; it is a means to achieving a level of total personal development. It is the vehicle by which capability sets are developed and aspirations are met, not just at the economic level but also socially and psychologically.

E-scrapping helps e-scrappers develop a sense of positive well-being, stability and professional status in the society. The acknowledgement that they possess valuable productive skills helps to foster innovativeness in management of e-waste.

Proximity to effective social network, such as family and fellow e-scrappers, influences the formation of aspirations (Sen 2010; Nussbaum 2011). Recognizing such information and fully utilizing it also depends on the self-esteem and self-conviction of the e-scrapper. E-scrapping requires a certain level of self-confidence. Until recently, the Nigerian society saw e-scrapping as a menial, dirty job and practitioners were treated as such. Even though the e-scrappers are slowly gaining strong recognition as active players in environmental sustainability, they still lack the necessary standardized infrastructure for long-term efficient extraction processes.

The government also needs to formally recognize e-scrappers as active actors in eliminating e-waste from the main waste stream. With the growth in electronic consumption, e-waste has come to stay and organized activities of e-scrappers indicate that they have slowly moved from being informal to formal recyclers. It is only a matter of time before the society sees them that way.

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Supplemental video data

The underlying research materials for this article can be accessed at https://figshare.com/articles/Building_Capabilities_among_E_scrappers_in_Informal_Electronic_Waste_Management_The_case_of_the_Nigerian_E_scrappers/2062476 Figshare.com

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