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A computer is a screen, is a cell phone, is plastics, is a microwave, is a copper coil… On the fluidity of electronic waste

Jennie Olofsson

Abstract: Informed by previous studies that employ Actor Network-Theory (ANT), this article discusses electronic waste (e-waste) as fluid objects. The concept of 'fluidity' or 'fluid' includes an object's ability to flow and thereby change shape, and therefore obstructs any attempt to explain e-waste in terms of a single state of being. Traditionally, fluidity has been used as a means to capture the changing characters of objects while they are being used. Elaborating on the notion of fluidity or the fluid in relation to e-waste serves both to expand previous understandings of fluidity to also encompass the status of objects as they are discarded, and to challenge traditional understandings of e-waste as the end point in the object's lifecycle.

> *"While the ways in which the pump works are many […] there are just as many ways in which it may fail" (de Laet and Mol 2000, p. 238).*

Introduction

Drawing on previous studies that employ actor-network theory (ANT), and specifically the studies of Marianne de Laet and Annemarie Mol (2000), John Law and Annemarie Mol (2001) and John Law (2002), this article discusses electronic waste (e-waste) as *fluid* objects. The concept of fluidity or fluid includes an object's ability to flow and thereby change shape. As such, it challenges current understandings about e-waste as a single state of being. This article seeks to extend the concept of fluidity to include, not only the operational state of electrical and electronic equipment (EEE), but also its afterlife, as items are discarded, disposed, and subjected to electronic waste management practices. Acknowledging e-waste in terms of fluidity challenges traditional understandings of e-waste as the end point in a product's life cycle. The afterlife of objects such as computers, televisions, cell phones and tablets, hair dryers, household appliances, earphones and batteries, is far from a single state of being, but rather consists in temporary assemblages and interlocking ideas as these products undergo different electronic waste management practices. Drawing on a written hearing from a Swedish electronic waste recycling company regarding the national implementation of the Waste Electrical and Electronic Equipment (WEEE) directive, this article sets out to explore some of the factors that determine the formulation of these temporary assemblages.

E-waste is the fastest growing waste category in the world. According to UNEP (United Nations Environment Program), between 20 and 50 million tons are produced annually worldwide; a number that is estimated to increase dramatically over the next years as digital technologies continue to proliferate across more and more devices. E-waste is also a complex waste category in that it includes computers, televisions, cell phones and tablets, but also hair dryers, household appliances, earphones and batteries. Each product contains diverse compounds of metals, elements, plastics and other materials, and therefore requires diversified and adaptive recycling methods. While e-waste is classified as hazardous waste because it contains contaminants such as lead, cadmium, mercury, beryllium or brominated flame-retardants, it also contains both valuable and scarce metals, and reusable components, that are in need of adequate treatment. This means that electronic waste is at once hazardous and valuable, both trash and a source of second hand raw material.

E-waste is also a continually changing waste category. As new and updated products are introduced, sold and discarded at an increasingly rapid pace, current processes of recycling are subsequently adjusted and adapted. This is, to a large extent, due to the fact that different products use different compounds and material resources, something that in turn requires different recycling practices. Not only does this demonstrate a highly flexible electronic waste recycling industry; it also shows that practices of recycling are constituent of current consumption patterns. Recent research (see for comparison Daoud 2011) also shows that the transition from a single PC per household to multiple devices per user requires a drastic expansion of electronic waste management. Ultimately, as e-waste is subjected both to gradual and geographically distributed processes of disassembly and – informal as well as formal – international trade (see for comparison Lepawsky and McNabb 2010), it is a spatial category in that its status – repairable, recyclable, burnable or forgettable – is (also) conditioned by its spatial location. Disposal, as Kevin Hetherington (2004, p. 159) has it, "is not primarily about waste but about placing". The spatial location of e-waste then, is vital to our understanding of it as trash, rather than objects of value.

The above text identifies some of the distinctive, yet malleable characters of e-waste. In order to better understand this simultaneous volatility and sturdiness, the concept of fluidity or fluid offers valuable insights to the afterlife of e-waste. Drawing on a written hearing from a Swedish electronic waste recycling company regarding the national implementation of the Waste Electrical and Electronic Equipment (WEEE) directive, focus lies specifically on the discrepancies between the regulations and categorizations set by the WEEE directive and the everyday work at the electronic waste recycling plants in Sweden. While these discrepancies might fuel conflicting understandings of e-waste, they also point towards its fluidity.

Fluidity

The works of de Laet and Mol (2000), Law and Mol (2001) and Law (2002) offer groundbreaking analyses on fluidity as a means to capture the changing characteristics of objects while they are used, including temporary breakdowns, and acts of maintenance and repair. This said, less attention has been given to how the fluidity of any object also encompasses its status as discarded and outdated by newer models. De Laet and Mol (2000, p. 238) acknowledge the multiple ways in which an object – in their case, the Zimbabwe bush pump – might work, at the same time as they also note that ”there are just as many ways in which it may fail”. While this statement recognizes the multiple ways in which any object might fail and thereby alter its area of use as well as its material compound, focus remains on the operational state of the pump, not its afterlife.

Extending the concept of fluidity or fluid to the afterlife of objects facilitates recent research on e-waste (see for comparison Grossman 2006; Gabrys 2011; Maxwell and Miller 2012) as it adds an understanding of its liveliness and continuous mutability. The work of de Laet and Mol is particularly valuable in that it shows how obsolescence is not a single point-of-no-return where objects are simply discarded, forgotten and rendered immutable. Instead, obsolescence is part of their fluidity. For example, while we may harbor radically different understandings of Electrical and Electronic Equipment (EEE) and Waste Electrical and Electronic Equipment (WEEE), it is important to remember that the shift from functional to obsolete is but one in these objects' lives. Drawing on the work of Law and Mol (2001, p. 614), "there are no great breaks or disruptions. Instead there is a process of gradual adaptation". Adaptation is equally evident when studying e-waste management in Sweden, and in particular, the respective electronic waste recycling plant's concurrent implementation and interrogation of the Waste Electrical and Electronic Equipment (WEEE) directive.

Examining the fluidity of electronic waste

The Waste Electrical and Electronic Equipment (WEEE) directive, incepted among EU members in 2002, mandates e-waste recycling in that it aims to 1) prevent the emergence of e-waste, and 2) increase reuse, recycling of material and other types of recycling in order to decrease the disposal of e-waste. The Extended Producer Responsibility (EPR) is currently part of the WEEE directive, and as such it holds producers of electrical and electronic equipment responsible "for the environmental impacts of their products' life-cycles [...]" (Sander et al, 2007, 1). Subsequent to the introduction of the WEEE directive a growing number of actors have emerged, providing solutions for managing the increasing stream of e-waste. While the WEEE directive concerns all the member states of the European Union, the implementation differs between nations. In Sweden, the WEEE-directive is executed through *EÅF* (*Elektronikåtervinningsföreningen*) and *El-kretsen*: two business sector service companies that collect and recycle discarded electrical and electronic equipment. The aim of EÅF and El-kretsen is to help their members – the producers of electrical and electronic products that operate within the Swedish market – to implement the EPR. The e-waste that is collected, either in retail stores or at waste disposal sites, is later shipped to electronic waste recycling plants in Sweden for further treatment.

In order to facilitate adequate recycling, and more specifically, to estimate degrees of 'recyclability' for obsolete electrical and electronic equipment, the WEEE-directive currently divides obsolete electrical and electronic equipment into ten categories[1] or fractions[2]:

1. Large household appliances
2. Small household appliances
3. Information technology and telecoms equipment
4. Electronic and electrical tools
5. Consumer equipment
6. Lighting toys
7. Leisure and sports equipment

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[1] Informed by the work of Susan Leigh Star and Geoffrey Bowker (1999, p. 325) e-waste management is scaffolded by acts of classification, in themselves "a key part of the standardization processes that are themselves the cornerstones of working infrastructure".

[2] In the revised WEEE directive that will come into effect in August 2018 e-waste is divided into six fractions, something that also points towards the emergence of these fractions as the result of a material-discursive interplay.

8. Automated dispenser
9. Medical devices
10. Monitoring and control devices

Drawing on this division of Electrical and Electronic Equipment (EEE), each member state in the European Union pursues measurements of the percentage of each fraction that is recycled. While this categorization serves to facilitate recycling of e-waste, in that it renders measurable the percentage of each fraction that is recycled each year, it also reduces e-waste to (ten) static entities. It does not take into consideration the gradual and geographically distributed processes of sorting and disassembling whereby e-waste is divided into additional fractions. Upon arrival to the electronic waste recycling plants, the components that constitute, for example, large household appliances (plastics, metals, copper coils, circuit boards, cables) are quickly mixed with components from monitoring and control devices, something that obstructs any attempt to measure the percentage of each fraction that is recycled each year. Put differently, the components that constitute computers, televisions, cell phones and tablets are in many cases similar to the ones that are found in hair dryers, household appliances, earphones and batteries.

The categorization of e-waste has therefore caused confusion among Swedish electronic waste recycling companies as they routinely manage e-waste, not as distinct entities, but as fluid entities, comprising a range of different components. In a report from the Swedish Environmental Protection Agency*: WEEE-direktivet i Sverige. En utvärdering med framtidsstudie* (2009) the electronic waste recycling company Stena Technoworld raises concerns regarding at which stage of the disassembly process the percentage of a particular fraction should be measured.

> ”Återvinningsföretaget Stena Technoworld tycker att det är otydligt var i återvinningssystemet mätningen ska ske. Det är också omöjligt att spåra återvunnet material till respektive produktkategori” (Naturvårdsverket, rapport 5969 2009, 16).

> ”The electronic waste recycling company Stena Technoworld experiences a vagueness regarding *where* in the recycling system the measurements shall take place. It is also impossible to trace recycled material to the respective product category” (the Swedish Environmental Protection Agency, report 5969 2009, 16, my emphasis).

Hence, what appears in the WEEE directive as ten clear-cut categories, fractions with determinate properties that include particular products and not others, are in fact situated assemblages of fluid material that come together under a limited amount of time and for specific purposes (economical[3], environmental). The fluidity of e-waste

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3 While not elaborated on in this article, it is worth noting that the amount of fractions is subjected to change, also due to the economical interest of potential customers (i.e. buyers and retailers of, for example metals, plastics and components). For example, if large household appliances are profitable to disassemble (as in, if retailers are willing to pay for some of its components) more effort will be put into disassembling. For a discussion on how recycling of electronic waste is part of an estimation of the market value of different materials, components and fractions, see Olofsson (forthcoming).

thus makes it difficult to estimate degrees of recyclability for the respective fraction as it is continuously changing. For example, while a CRT television formulates a distinct entity when it arrives at an electronic waste recycling plant, it is – upon the initial treatment – divided into funnel glass, copper coil, plastic housing, circuit board, speakers and waste (waste being for example the clips that hold the funnel glass in place). As e-waste is subjected to gradual processes of disassembly, simple measurements such as the percentage of a particular fraction that is recycled are thus obstructed, something that begs the question of *where* in the recycling process the measures should be taken. Recalling Stena Technoworld's response, concerns of *where* in the recycling chain to estimate the percentages of a particular fraction that should be recycled, and also *how* to trace recycled material to the respective product category are indeed valid. The above example shows that the boundaries of e-waste "are not solid and sharp" (de Laet and Mol 2000, p. 252) but rather continuously established and interrogated. As Law (2002, p. 91) has it, "objects are an effect of stable arrays or networks of relations".

Concluding remarks

This article has proposed that the rejection of the static notions of objects – as seen for instance in the studies of de Laet and Mol (2000), Law and Mol (2001) and Law (2002) – must also encompass discussions regarding their status as discarded and outdated by newer models. Using the term fluidity adds to recent research on e-waste an understanding of the liveliness and continuous mutability of e-waste. The mobility of e-waste obstructs any attempt to explain it in terms of a single state of being. As e-waste undergoes practices of sorting, disassembling and recycling, it also adapts to the local circumstances of the respective waste recycling plant, including its capacity to process e-waste, but also potential retailers, legal regulations and economic interests. While the emergence of new fractions is necessary for adequate treatment – placing copper coils there, plastic housings there and circuit boards there – it also challenges processes of categorization, as seen in the WEEE directive. This said, "The fluidity [...] does not imply that it [e-waste, my note] is vague or random; that it is *every*where or *any*thing" (de Laet and Mol 2000, p. 237). Rather, e-waste acquires a stable shape within a certain "network space" (Law and Mol 2001, p. 611), and then as a temporary interlocking, a momentary coming-together of material and compounds.

The concept of fluidity or fluid allows for an understanding of how e-waste, as it is transferred between and within electronic waste recycling plants, retains its status as e-waste (as opposed to, for example, household waste) at the same time as it allows for division into different fractions. This in turn allows for a survey of the reciprocity between an object and its surroundings. E-waste, paraphrasing Law (2002, p. 99) "holds its shape in a fluid manner". In sum, elaborating on the notion of fluidity in relation to e-waste serves both to expand previous understandings of fluidity to encompass the status of objects as they are discarded, rejected and disposed, *and* challenges traditional understandings of e-waste as a life-cycle end point.

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