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E-Waste Trading Zones and the Economy of Greening: Imbricating Computer Sourcing in the Pre- and Post-WEEE Directive Era

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Abstract

In the context of the environmental impacts caused due to the increasing volumes of discarded technologies (e-Waste), this article critically evaluates whether environmental policy, the Waste of Electronic and Electrical Equipment (WEEE) legislation in particular, can contribute to a shift in logic from neo-liberal growth to green growth. Drawing upon empirical research we show how three computer waste organisations evolve through the imbrication of pre- and post- policy logics in collaborative and heterogeneous ways to create an economy of greening. Extending the concept of a fractionated trading zone, we demonstrate the heterogeneous ways in which computer sourcing is imbricated, providing a taxonomy of imbricating logics. We argue that what is shared in a fractionated trading zone is a diversity of imbrications. This provides for a nuanced perspective on policy and the management of waste, showing how post-WEEE logics become the condition to continue to pursue pre-WEEE logics. We conclude that our research findings have important implications, more specifically, for how e-waste policy is enacted as an economy of greening in order to constitute the managerial and organisational adaptation needed to create a sustainable economy and society.

Keywords: e-waste, fractionated trading zone, imbrications, institutional logics, environmental policy.

1.0 Introduction

The UK Government's 2017 Clean Growth Strategy supports the on-going ambitions to further develop institutional contexts for green growth, through investment in sustainable business and job creation, at the same time as producing "a low carbon economy" (BEIS, 2017: 2). With the target of "zero avoidable waste by 2050" set and to be reached through "resource value maximisation and environmental and carbon impacts for extraction, use and disposal reduced" (ibid.: 16), the waste sector is receiving considerable focus. With waste juxtaposed as one of the barriers and solutions to a "low carbon economy", we critically evaluate whether legislation, the Waste of Electrical and Electronic Equipment (WEEE) in particular, can create a shift in logic from neo-liberal economic growth to a greener veneer in computer waste disposal organisations.

By analysing e-waste policy, we can gain a greater purchase on current attempts for more sustainable material use as outlined in the European Commission's 2018 Circular Economy Action Plan. Drawing upon empirical data gathered from three computer enterprises – Information Technology Asset Recovery Organisation, Recycling SME, and Repair and Reuse Charity (pseudonyms), we address the enactment of policy in relation to legislative changes that focus on green growth. In 2003, the EU created the WEEE Directive, which was transposed into UK law in 2006. WEEE aims to control Electrical and Electronic Equipment (EEE) through promoting the waste hierarchy – reduce, reuse, recycle, recover. A new logic was created – e-waste management, based on a set of beliefs that discarded electronic devices are harmful to the environment so unauthorised disposal should be

discouraged and devices recycled regardless of profitability (Kama, 2015). Through these sets of beliefs, e-waste disposal practices reduce occupational and environmental risks and at the same time preserve non-renewable resources. Previously, e-waste was managed according to a waste management logic - a set of beliefs focusing on the extraction of economic value from any profitable waste in order to address depleting reserves of non-renewable resources, without disrupting continued economic growth and consumption demands (Waste Framework Directive (WFD), 1975:194/39). The success of any policy rests upon how organisational actors interpret the instruction into their working practices. We demonstrate how pre- and post-WEEE policy logics create what we refer to as 'the economy of greening' which is still premised on economic growth centred models that create space for new opportunities and address ecological and social concerns by chance (Schulz and Bailey 2014; 277, 288). Its existence is reliant on the interconnection of the pre- and post- e-waste policy logics reproducing continuities in practices. Institutional logics imbricate in order to create an economy where organisations undergo change in order to mediate change, which has implications for reducing waste and new policy agendas. The logic of such an economy is that it has green economy ideals but retains elements of the past. Whilst there is no agreed definition, a green economy is conceived as a pathway to sustainable development through the adoption of more ecologically and socially balanced economic models (ibid.: 285; United Nations Environment Programme (UNEP), 2011; Wanner, 2015: 22).

In this paper, we argue that the implementation of waste policy, with an explicit institutional logic to promote the 'greening of the economy', does not just overturn existing waste management and organisational practices. Our contention is that when

examined at the level of management and organisational practices, the pre- and post-WEEE periods can be described as a particular type of "trading zone" (Galison, 1997: 783), that can be classified as "fractionated" (Collins et al., 2007). A fractionated trading zone is heterogeneous collaborative space for differentiated views and practices to be learnt, shared and developed. We further develop the notion of a fractionated trading zone by adding the concept of imbrication (see Hayes et al., 2014). Conceptually, imbrication pays attention to overlapping logics that have no *a priori* connection to each other. We utilise these ideas to illustrate the particularities and granular dynamics that comprise a fractionated trading zone for e-waste. Within this e-waste trading zone, what is reproduced are differentiated, diffused and fragmented imbricated logics that coalesce around the materiality of e-waste. The e-waste sector has particular boundary crossing qualities in terms of organisational interaction, communication and adaptation. For a fractionated trading zone to occur, the particularities of existing institutional logics get shaped through interaction with the emerging institutional logic of the green economy.

This paper's contribution is threefold. Theoretically, we extend the literature on trading zones and imbrication by considering how they can complement one another. Our focus on imbrication is a 'zooming in' on the managerial and organisational implications and dynamics of a trading zone. In other trading zone studies, this sort of fine-grained and close up analysis of imbricated logics is neglected (Galison, 1997; Collins et al., 2007; Finch and Geiger, 2010). Second, we add to the literature on imbrication by identifying a diverse range of imbricating logics that can be used to discern a more nuanced understanding of the translated effects of policy. Last, we ground these ideas in a relevant empirical context – that of e-waste management in

the UK, providing a deeper knowledge, over time, of specific actors' translations of policy into organisational practices.

We begin by introducing trading zones, institutional logics, imbrication and e-waste, or more specifically computer waste in the UK context. Our research findings emphasise the heterogeneity of pre- and post-WEEE responses and this led us to focus on imbrications within a fractionated trading zone. An overview of the research field, method and analysis then follows. After detailing our empirical cases, our discussion concentrates on differentiated imbrications we discerned. This article concludes by summarising the key findings and the contribution of extending our understanding of the e-waste trading zone's imbricated logics by offering our taxonomy of differing types of imbrication.

2.0 Connecting Trading Zones, Logics and Imbrications

Galison (1997) coined the term "trading zone" while researching communities of physicists. From his original focus on scientific cultures, the concept has been applied more widely to other sectors and interactions, such as markets in the making (Finch and Geiger, 2010). Originally contributing to Kuhn's (1962) paradigm incommensurability debate, Galison (1997: 783) writes that a trading zone comes about when

> "two groups can agree on rules of exchange even if they ascribe utterly different significance to the objects being exchanged; they may even disagree on the meaning of the exchange process itself. Nonetheless, the trading partners can hammer out a local coordination despite vast global differences".

The concept of the trading zone highlights the level and degree of communication, interaction, and learning and development between differentiated views and practices.

Collins' et al. (2007) develop the concept of trading zone, distinguishing four different types. For Collins et al, a trading zone is characterised by a community that has deep problems of communication yet still can be considered as communicating. Whilst Galison (1997) focused on the development of "inter-languages" to afford communication, Collins et al. broaden the understanding of trading zones along two continuums: collaboration-coercion and homogeneity-heterogeneity. From this they create four categories - adding fractionated, subversive and enforced trading zones to Galison's initial depiction of an inter-language trading zone.

Like all trading zones Collins' et al. (2007) identify, interaction does not result in unity. Whereas an inter-language trading zone is characterised by collaboration and homogeneity, the specific character of a fractionated trading zone is collaboration and heterogeneity in which differences remain ever-present. Nonetheless, the trading zone exists because individuals share a 'fraction' of each other's lifeworld: a fractionated trading zone is characterised by selective interaction, often through some shared material, symbolic and/or cultural resources. This produces enough of a consensus – whether that is through materials or other resources – for trading zone work to occur.

Because of the difficulties of communication and interaction, Galison's concept of trading zone emphasises the zone as much as the trading. Indeed, as Finch and Geiger (2010) suggest, if interaction is uncontentious there is simply trade not a trading zone. Adding the concept of imbrication to a trading zone helps us analyse the type, scale and degree of interaction, communication and boundary spanning activity between the logics within, giving a more nuanced account of imbricated logics as well as revealing the diversity of ways certain actors in the e-waste sector are responding to WEEE. As

we will show, a trading zone is comprised of institutional logics, with different kinds of constraints and possibilities, which are emergent in relation to how imbrication occurs within it.

Trading zones are comprised of institutional logics which can be defined as "socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (Thornton and Ocasio, 1999: 804). Logics are taken for granted ways of framing, understanding and acting in the world by actors: logics are "master principles" that simultaneously guide, enable and constrain social action (see Greenwood et al., 2011: 21), and, in so doing, provide a link between individual agency, forms of cognition and socially constructed institutional practices.

The concept of logics emerged because of the need to understand the way that individuals make connections, creating a shared purpose and unity within a particular field (Reay and Hinings, 2009: 629; Scott, 2008). Existing research has focused on dominant logics and how these are adopted to trigger institutional change (Randall and Munro, 2010; Reay and Hinings, 2009; Thornton, 2001; Thornton, Jones and Kury, 2005). However, few studies appear to focus on the coexistence of logics (Marquis and Lounsbury, 2007) or how they collaborate and co-mingle (Randall and Proctor, 2013). Despite advances in the institutional logics literature, it appears further attention is required to show how logics co-exist (Hayes et al., 2014; Introna and Hayes, 2011; Suddaby and Greenwood, 2009; Lounsbury, 2002), and interact in heterogeneous ways, something that we aim to address in our article. Therefore,

institutional logics are not separate from one another as they overlap, and through permeating each other, they create new ways in which logics trigger change (Hayes et al., 2014).

The concept of imbrication is similarly concerned with explaining durable patterns. Leonardi (2011) defines the term, from the Latin *imbricāt*, which denotes overlapping of parts in a sequence, (originally the placing of roof tiles, scales or leaves so that they overlap and interlock) without giving necessarily *a priori* privilege to one or another. Leonardi (ibid. : 151) writes that "the differences between the tiles in terms of shape, weight and position prove essential for providing the conditions for interdependence that form a solid structure". In the context of this study, imbrication denotes the arrangement of distinct elements in an overlapping pattern so that research can "better explain how the accumulation of the past bears changes on the present […] without resorting to deterministic language" (ibid.: 152).

Imbrication suggests that distinctions between institutional logics remain important yet also reciprocal, self-reinforcing and reinforcing each other. The concept has been deployed in a range of contexts to understand organisational communication (Taylor, 2001), risk and technologies (Ciborra, 2006), human and material agencies (Leonardi, 2013; Introna and Hayes, 2011; Leonardi, 2011), and space, place and digital networks (Sassen, 2008). Sassen (2008) describes the growing mutual imbrication of the non-digital and digital in relation to national territories, place and digital networks. Sassen's concern is to demonstrate how territorial and digital spaces are interdependent yet irreducible to each other. The "financial centers, which are after all located in national administrative territories, enable the global digital space for

financial transactions and its new temporal order. The centers are themselves transformed by this imbrication with digital networks" (2008: 383).

Sassen's deployment of the term imbrication adds to the institutional logic literature by showing how new institutional logics are enabled by existing ones in ways that can both transform and sustain an existing institutional logic: existing institutional logics enable, persist and transform during the emergence of new ones.

Leonardi (2011: 152) observes that imbrications create "organizational residue" which have "staying power". This staying power, which he describes as "infrastructure", is premised on the interdependency of institutional logics. In terms of institutional logics, infrastructure is the residual pattern of interaction created by imbrication when logics compete, collaborate or co-mingle. Institutional logics are themselves made up of previous imbrications; therefore the way in which an emerging institutional logic is viewed is connected to how imbrication previously occurred. In other words, established norms condition and enable how people imbricate emerging institutional logics.

For the purposes of our article, the institutional logic of the 'economy of greening' enables the logic of the 'greening of the economy' while simultaneously maintaining (material aspects) and transforming the former's (symbolic) features. Similarly, we argue, that the computer waste organisations we researched are the conditions for the implementation of the WEEE legislation. They are changed in various ways by this law, but these changes often reinforce particular existing logics. "The products of prior imbrications lay the groundwork for continued organizing in that they provide

the routines and technologies that people can use to structure their actions" (ibid.:).
What this means is that past imbrications already exist, thus current institutional
logics are themselves the result of imbrications.

A central feature of the contribution of imbrication is in terms of its use in analysing
interaction of institutional logics over time without resorting to a deterministic
framework. Imbrication helps us understand how the accumulation of the past bears
on the present (ibid.). Sassen (2006) argues although there is a simultaneous
interdependence, this does not produce hybridity (see Glynn and Lounsbury, 2005 or
Thornton et al., 2005). By contrast, each logic maintains its own identity and
irreducible character. Specifically, imbricated institutional logics are a potentially
productive way to understand the coexistence of logics.

Despite the increasing use of imbrication, one dimension that appears to be lacking is
the idea that highlights the differentiated interconnections of institutional logics and
how they might become pre-requisites for each other's existence (Hayes et al., 2014),
within a particular type of trading zone. Understanding trading zones, alongside logics
and imbrication, emphasises two features. First, the specificities of a trading zone are
opened up for analysis, extending existing ways of analysing trading zones. This adds
additional richness to the different ways actors interact, in our research, around e-
waste, extending the conceptual disunity of interaction and communication that
Galison (1997) discerned. Second, it allows us to connect institutional logics and
imbrication to a more nuanced understanding of trading zones, featuring the diversity
of ways that scale and time is enacted in different types of trading zone. Our focus is

on the heterogeneity of imbrications within a fractionated trading zone: differentiated imbrications that occur over time and across organisations.

3.0 E-waste, Computers and the Pre- and Post-UK WEEE Era

In 2016, 1.6 million tonnes of e-waste was discarded in the UK; this is the equivalent of 24.9 kilograms per person (Baldé et al., 2017). The waste sector has been forecast as a growth sector with the potential for creating 15,000-25,000 jobs (Sadauskas, 2015), and economic growth in the region of £23 billion (WRAP, 2017). One category listed in the e-waste legislation is discarded IT and telecommunications equipment (EU WEEE, 2003; 37), that make up 7% of e-waste, contain critical non-renewable materials such as gold, silver, copper and platinum as well as hazardous substances including cadmium, lead, mercury and phosphors (Hieronymi, Kahhat and Williams, 2013), making e-waste a rich site for value extraction. In addition, IT waste poses security risks too, as equipment such as computers can store confidential information. The WEEE Regulation (2006) actively encourages the marketization of e-waste, and its component parts, triggering organisations to adopt alternative methods to achieve their aims.

Before the transposition of the UK WEEE Regulation, computers were handled in accordance to waste management legislation that attempted to encourage EU member states towards a 'recovery and recycling society' (WFD, 1975). This encouragement was due to the growing awareness of "the limits to growth" regarding resource scarcity (Meadows et al., 1972), coupled with the research undertaken by the Economic and Social Committee concerning land, air and soil degradation. Created in the era of the European Economic Community (EEC), the pre-existing 'waste

logic' focused on establishing common markets creating economic and social cohesion (Bache et al., 2011). According to the 1975 WFD:

"any disparity between the provisions on waste disposal already applicable or in preparation in the various Member States may create unequal conditions of competition and thus directly affect the functioning of the common market; whereas it is therefore necessary to approximate laws in this field, as provided for in Article 100 of the Treaty [… and] effective and consistent regulations on waste disposal which neither obstruct intra-Community trade nor affect conditions of competition should be applied to movable property which the owner disposes of or is required to dispose of under the provisions of national law in force. [In addition..,] Member States shall establish or designate the competent authority or authorities to be responsible, in a given zone, for the planning, organization, authorization and supervision of waste disposal operations […;] the recovery of waste and the use of recovered materials should be encouraged in order to conserve natural resources" (WFD, 1975: 194/39 - 40).

These policy extracts highlight the ethos of waste management concentrated on generating competitive advantage selling recyclables, through governance via legislation, and managed through public administration. Until the WFD (1975) the relationship with the natural environment was one that was viewed very much as an externality, as historically, waste legislation would consider economic and social benefits above environmental ones (ibid.; Bache et al., 2011), with waste being symbolic of a means to an end.

In the late 1990s, when the European Commission first discussed how to handle EEE waste (Commission of the European Communities, 2000), a change occurred in computer waste management. These sets of beliefs were created in the era of the European Union (EU), where the environment started playing a more prominent role. The WEEE Directive states:

"the achievement of sustainable development calls for significant changes in current patterns of development, production, consumption and behaviour and advocates, inter alia, the reduction of wasteful consumption of natural resources and the prevention of pollution […and] Member States shall ensure that any establishment or undertaking carrying out treatment operations obtains a permit from the competent authorities, in compliance with Articles 9 and 10 of Directive 75/442/EEC [Waste Framework Directive] […In addition].

> Member States may choose to implement certain provisions of this Directive by means of agreements between the competent authorities and the economic sectors concerned provided that particular requirements are met […plus] Where appropriate, priority should be given to the reuse of WEEE and its components, subassemblies and consumables. Where reuse is not preferable, all WEEE collected separately should be sent for recovery, in the course of which a high level of recycling and recovery should be achieved. In addition, producers should be encouraged to integrate recycled material in new equipment." (WEEE Directive, 2003; 37/24-29)

The new type of green growth is supposed to focus upon the triple bottom line of social, economic and environmental considerations (UNEP, 2011); driving towards creating a win-win scenario between environmental protection and economic growth, managing for sustainability was the newly found ethos. The governance of e-waste was undertaken in the form of licencing legislation (see The Waste Management Licencing Regulation 1994 for the transposition into UK Law, for a more detailed explanation of the licencing requirements) and industry accreditation standards started to appear, giving guidance on best WEEE disposal practices (e.g. Defra's Best Available Treatment on Recovery and Recycling Techniques, 2006) and International Standards Organisation (ISO) data security (British Standards Institute (BSI), 2008). However the management of e-waste began to have a wider remit than just public administration. Partnerships were created between government and non-government bodies to allow for discussion and influence of policy; examples include the Producer Compliance Schemes, WEEE Advisory Board, Environmental Heritage Service, Environmental Industry Commission and the Industry Council for Electronic Recyclers (Author 1, 2012). Moreover, awareness campaigns hosted by governments, private, public and third sector organisations were undertaken to provide incentives for financial remuneration for the old equipment, using take back schemes (BIS, 2014). The shifting relationship with the natural environment was one of interdependence, as e-waste now symbolised an end in itself, as the discarded product is a resource (Kama, 2015; Neyland and Simakova, 2012). However, as Adam (1998:

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113) suggests, environmental policy "can only be created in the context of a 'higher authority'" which is not to undermine the EU's primary goal of economic growth and in addition "only environmental issues that fit into already existing schemes have a chance of getting on the EU's environmental agenda".

Insert Table 1: Summary of Waste and E-waste logics

4.0 Researching e-waste

The data in this article was drawn from a wider investigation exploring the incorporation of e-waste legislation into the working practices of six different organizations in the UK Computer Waste Management field (Author, 2012). Data was generated from ethnographic engagement, specifically taking inspiration from Czarniawska's (2004) mobile ethnology following an "action net […] assemblages of collective actions, connected to one another because they are perceived within a given institutional order, as requiring one another" (Corvellec and Czarniawska, 2013: 5). A mobile ethnology allows a researcher to study the work of individual people who move around (Czarniawska, 2004), in an attempt to acknowledge the speed at which organized activities take place and the messiness of institutional arrangement (Author, 2018).

This approach is relevant to our research as we are exploring the enactment of policy to stimulate change and development towards green growth, and for some a transformation away from a singular focus on economic growth. Some scholars, such as Lindhqvist (2000), put forward a compelling argument that the WEEE legislation is a mechanism to finance collection and recycling, however, policy often has multiple

goals and is often internally contested. Adopting an action net perspective allows the researcher to understand "what is being done and how this connects to other things being done" (Czarniawska 2004: 784), in our case the sourcing of computer waste that highlights alternative goals of policy. The method begins with a series of interviews to explore the process in order to produce standardised accounts of the working practices taking place, alongside organisational documentation. The next phase, required Author 1, to follow the trajectory of the computer through each of the organisations, shadowing or working alongside the actors involved. It should be noted that the author entered each site, post WEEE implementation. Focusing on the action enabled Author 1 to move fluidly with the workers to understand a collective account and not an isolated story (ibid.). Moving with and between the workers enabled Author 1 to gain insight into the pre- WEEE era. When actors spoke of changes to current practices, Author 1 was able to corroborate the accounts against other explanations and the standardized story that had been created in stage 1. As Czarniawska reminds us, the researcher never enters the research at the start of the story. This approach is in keeping with the theoretical framing of this paper on two counts. First, from an ontological perspective, as with the theory of imbrications, the method is concerned with understanding how actors interpret organisational phenomena. Second, epistemologically, social constructivism, like trading zones, view organisations as independent cultural phenomena that are constantly adapting to their environment and are made up of multiple networks of actors with their subjective viewpoint (ibid.; Thornton and Ocasio, 1999).

As previously mentioned, we focus on three organisations – IT Asset Recovery Organisation (IARO), Recycling SME (RSME) and Repair and Reuse Charity (RRC). These organisations provided services and advice to corporations, governments,

consumers and charitable institutions on effective e-waste disposal practices. Each

enterprise had been in operation for at least a decade prior to the legislation coming

into force. Due to their longevity, we consider they offer the opportunity to critically

and constructively compare how logics are altered. How, and if, the institutional

logics of environmental policy altered working practices had not been considered at

the time of the initial analysis in 2008-2010, but emerged due to subsequent

conversations between the authors of this article sometime after the field research had

taken place.

Data was collected in four ways: interviews with senior managers and operational

staff (17 formal and 46 informal), participant observation (246 A4 pages) and

organisational documentation (e.g. working practices, annual reports, advertising

brochures, working practice documentation). The three types of data and the adopted

software tool (Atlasti) enabled the findings to be examined for common themes

(Abramson and Mizrahi, 1994). Re-interrogating the organisational texts, participant

observations and the interviews of the organisational actors provided insight into how

they made sense of the legislation in relation to institutional logics.

5.0 Computer Sourcing – Imbricating Logics Post and Pre WEEE Eras

Through our three-exemplar cases, we show a range and diversity of imbrications;

specifically focusing on sourcing waste enables us to place the spotlight onto how the

institutional logics of a fractionated trading zone imbricate.

5.1 Recycling SME – Sourcing Metals:

RSME is a 50-year-old family scrap metal business that has undergone significant expansion over the years. In 1998 they moved into IT recycling and asset waste management, offering services that included basic collection, disposal, inventory, data wiping and hard disk removal, alongside their core business functions - recycling and processing of metals, cars, car tyres and skip hire (RSME Brochure, 2005). Purchasing and then merging with local recycling facilities, by 1999, RSME operated out of five locations (RSME Internal News, 2013). Typically they sourced their IT equipment from public sector contracts, such as local councils via the civic amenity sites. The Managing Director advised that profits made in the early days related to *"gate fees"*, costs associated with collection and treatment of waste, and this charging was *"absolutely fundamental to being able to sustain a business … anything else is then a bonus and it is a difficult bonus to get"*. With the challenge of obtaining further economic value from discarded IT equipment, such as data services, resale of components and/or equipment for reuse, discussions took place as to what direction RSME should head and what market opportunities there were.

The organisation employed a WEEE Manager in 2001/2 to focus specifically on the impact of the forthcoming legislation. In 2003, a decision was reached to invest in the recycling of hazardous waste elements of IT – in particular the Cathode Ray Tube (CRT) computer monitors and televisions. The Managing Director explained that monitors *"were coming at us quick and fast"* and at that time *"there was an export market for reuse"*. The forthcoming legislative mandate, requiring CRTs to be treated separately from other collected WEEE, due to the hazardous phosphors (fluorescent coating) inside the monitors (WEEE Directive, 2003; 37), and the market

demand, triggered RSME to invest £40,000 in recycling equipment and a further one

million pounds to expand into a new warehouse (Research Journal, 2008).

After the UK WEEE Regulation came into force, RSME made further changes to

their business operations in 2007. Their waste management licences to process, store

and handle specific types of waste were expanded to include what could and could not

be processed (see Waste Management Licencing (Amendment) Regulation 2003; 3-

5). In addition, a change in sourcing occurred as manufacturers became responsible

for meeting the cost of recycling and were required to provide evidence to the

relevant authority (WEEE, 2006; 12, 15). This imbrication of pre- and post- WEEE

logics repelled one another. With the change in legislation sourcing e-waste became

much more uncertain due to manufacturers' new found interest in the consumer

electronics disposed at civic amenity sites. Previously, RSME sourced most of the

discarded technologies through the public sector and directly from civic amenity sites.

Their contracts altered as the manufacturers and manufacturing consortiums took over

the relationships due to their new obligation (e.g. evidence of waste volumes and cost

absorption). The repelling imbrication undermined any interlock between public

administration and partnership logic. In fact, the public administration became

unimportant for RSME because of the changing nature of the circulation of e-waste.

The Strategic Development Manager elucidated that the "*shift has been from working

with big waste management companies, that were looking after the [civic amenity]

sites, to the [manufacturing consortium ...] our main source of WEEE will always be

[with manufacturing representatives] purely because the [manufacturing

representatives] want all the WEEE in the UK"*. RSME were pushed towards

working with a different group of partners. As well as the shift in contracts, the

legislation brought with it the need for further reporting and subsequently generated significant amounts of paperwork (UK WEEE Regulation 2006: 35).

Although there was an increase in demand for the processing of certain elements of IT equipment, the organisation witnessed a decrease in demand for IT asset recovery. Confused by which direction to take, the CEO described how this area of the business "*needed some resources*" and RSME "*allowed that to drift due to the slower demand and lower income stream*". By the end of 2008, the IT Waste Operations Manager set up his own company partnering with RSME. They "*would supply the material and [the IT Waste Operations Manager] could work his magic on it. Allowing [RSME] to keep [their] market share and the business but, have an outlet at the same time*" (*CEO Interview, 2009).*

The pre- and post- WEEE policy logics confounded against each other, triggting a divergence in company practices. Despite expanding, the most significant change that occurred was the shift from being a profit centred business to a labour focused one. RSME reinvented themselves in 2009, opening a new organisation comprising of three elements: the commercial venture – the recycling services, investing in people through training in recycling and waste management, and a charitable operation aimed to support socially and economically disadvantaged individuals in their return to work (Research Journal, 2009). RSME's vision was to continue expansion by building eco-commercial buildings using products they had made from waste, and employ individuals who had been supported through their charity to aid integration back into the workplace. The emphasis of the new organisation was social as well as environmental. This periodization of imbrication is an example of what Hayes et al.,

(2014) discern as the unintended consequence, which is not the outcome of one particular logic, but is emergent from their imbrication. The logic of waste management appeared to imbricate with the post-WEEE logic of accountability for the natural environment, through the triple bottom line. For the Managing Director the biggest WEEE legislative impact was *"people, people and money, in two fairly equal measures – recruiting people to comply with the legislation and money in order to bid for large contracts"*. At RSME, the logic of waste management is coupled around the logic of hazardous waste; a narrowing of the waste management to particular types of e-waste provides a new and emergent opportunity for business growth. Examples include the expansion of the hazardous recycling services that required 20 people to process 500 computer monitors; and the investment in training socially and economically disadvantaged people in the recycling trade.

Although the decision was to refocus on metals and training, RSME chose one element of the computer - the disposal of CRT monitors because there was a high volume, an export market for reuse, and they held the pre-existing waste permits. This business opportunity, which gives contemporary expression to the issue of social cohesion, relies on the affordances created by handling waste, yet expands RSME's focus on human resource training and skills development that centres on hazardous waste management. By the end of the research, in 2009, RSME operated out of six locations, employed 132 members of staff, were the recipients of a prestigious British Business Award for sustainability and enterprise, and had generated a gross profit of several million pounds.

5.2 IT Asset Recovery Organisation and Sourcing Services:

In 1991 IARO started off as an entrepreneurial endeavour by two individuals who sourced and auctioned discarded computers, later expanding into selling equipment on behalf of clients for a commission. Their service offered clients a relatively easy solution to old IT removal e.g. collection and resale. In the late 1990s the owners noticed a coterie of customers gathering at the end of the auction to purchase equipment that no one was sure worked. The CEO remembered selling the equipment at a loss "*I am up there going ten, five, anyone? Anyone? Nought? Take it away? Nothing? Take it away? Nothing nought, then minus five, we will pay you a fiver to take this away"*. At this point the CEO recognised that IARO was in a different market e.g. asset recovery. In conjunction with broken equipment not selling, their corporate customers were asking questions about data security and where the IT equipment was ending up. IARO shifted its trading activities to focus on a service business around collection, data disposal, electrical safety testing, function testing, removal of client identification markings, resale of reusable equipment to the second user market, recycling and an audit report for their clients (The History of IARO Documentation, 2009-2015, para.1).

Initially, IARO offered all their services from one warehouse that comprised of two areas with freestanding lockable units that looked like large garden sheds. The IT equipment was sourced from a variety of places in the UK - the Government, the public sector, private business and private households. By 1999, the ownership of IARO transferred to a European IT infrastructure sales and support leader, as their IT Recovery and Remarketing Division. With the newfound service focus, IARO joined the International Standards Organisation (ISO) accreditation body for environmental

management (ISO 14001), health and safety (ISO18001) and quality management (ISO9001) (International Compliance Manager Interview, 2009).

By 2001 IARO employed an Environment and Safety Manager/Head of Sustainability who become responsible for the organisation's WEEE compliance. The Manager had been involved with WEEE since 1997, when the first UK discussions began, and had served as a member of the UK's WEEE Advisory Board. Continuing to grow, IARO gained recognition for their innovative IT Asset Management practices and commercial success from the British Business Awarding body.

After the advent of the EU WEEE legislation in 2003, IARO purchased their waste management licences so that they could store and handle e-waste, and subsequently purchased a third warehouse. Once the UK WEEE Regulation was mandated, in 2007, IARO increased their recycling services by dealing with some of the technology components on site. The new legal requirements for e-waste management processes appeared to trigger pre- and post- WEEE logics to complement each other, by providing the platform to create new services. What became apparent was an even tighter interlocking of logics such that competitive advantage and managing sustainability became increasingly connected. As can be seen above, prior to WEEE, the ethos IARO was situated in computer auctioning and looking for competitive advantage by expanding their services. Imbricating ethos logics pre- and post- WEEE can be characterised as drawing upon past antecedents, the search for new services, with the post WEEE logic strengthening and reinforcing existing practices (Leonardi, 2011). For example, with the introduction of the role of Environmental Safety Manager to oversee compliance, multiple references were made to environment

issues, but the significant change was the consolidation and entrenchment of data security services. When the Reuse Manager was asked what the most significant changes had been since joining the organisation he replied

> "*the focus was on the data security side of things, and the environmental reuse, as opposed to the requirements of the WEEE Regulation ... what we do now is a lot tighter, from a security, from every point of view, everything is a lot more controlled than it was ten years ago.*"

The IT Data Security Services now included onsite data removal, hard-drive shredding, the ability for clients to log onto IARO's systems to track their devices and software removed data up to a UK Military of Defence standard. This reinforcement of existing practices, typifies how the waste logic of competitive advantage is bolstered at the same time as the logic of managing sustainability becomes increasingly predominant.

In 2008, IARO employed 38 members of staff and opened their component resale business. "*That department didn't exist [...] and does now and is doing twice as much than is expected with regards to what the WEEE Directive says*", recounted the Recycling Manager. Going from strength to strength, the organisation received another British Business Award, this time for setting an example benchmark in environmental, social and economic development. However, the WEEE legislation had begun to impact on IARO practices in terms of their ability to keep their ISO accreditations. One of the recycling team mentioned that "*in order to conform to the WEEE standards we have had to change how we do things so that we can keep our accreditations*". This was contrary to the views of other members of the organisation who believed that "*WEEE has raised awareness but if it had not happened I think we would be doing very much the same thing anyway*" (International Compliance Manager, 2009). Clientele were interested not just in data security but also in

legislative compliance and would ask what practices IARO adopted. The Service Co-ordinator, International Compliance Manager and Head of Sustainability reiterated the point and they all stated that now they "*had to be very explicit*".

With the implementation of the legislation coinciding with the economic downturn, of 2008, there was a slowdown in sourcing equipment to maintain the sales of reuse equipment. By 2009, gaps became noticeable at the distribution plant storing refurbished equipment for resale. "*We are buying in a lot of equipment in to sell now. The enigma is we can buy stuff from our competitors and sell it for a higher margin and yet when we bid for contracts we are losing out to people that we are literally buying stuff from*" (Head of Sustainability, 2009).

The decrease in longevity of IT equipment (Bakker et al., 2014) and the commoditisation of e-waste, due to manufacturers and non-private households (public, private and third sector organisations) bearing the cost for disposal appeared to slow down the stream of available IT equipment. Starting life as a computer auction company, it seemed only fitting that IARO altered their practices, albeit momentarily, to source computers another way in order to fulfil demand (i.e. to purchase them from a competitor). Bratteteig and Verne (2012) focus on the degree to which imbrications are more or less tightly interlocked, to the extent that they are characterised as entangled. Similarly, Post WEEE afforded IARO with the ability to continue what they were doing through the greater entanglement of their existing approach, which focused on sourcing and selling second-hand equipment and security and compliance. IARO's attention on ISO accreditation in Information Security Management and continual efforts to demonstrate legislative compliance demonstrate

the increasingly entangled pre- and post- WEEE logics. In this pre- and post-WEEE imbrication, IARO sought new ways to maintain and extend existing practices over time by increasingly integrating sourcing and security. By the end of the research, IARO operated out of four different warehouses, achieved a further ISO accreditation in Information Security Management (27001), was processing 50,000 IT units a month, on average tracked 1.5 million units a year, and employed 158 members of staff (Annual Financial Statement, 2009), with an average turnover of £25 million.

5.3 Repair - Sourcing Funds

RRC started in 1997 in a garage where one man collected furniture *"one afternoon a week and distributed to people who could not afford things"* (Induction Manager, 2008). The idea inspired the founder to formalise the charity in 2000. RRC's principle objectives were to divert waste from landfill, sell reused and unwanted household goods at a low cost to local economically disadvantaged people, and offer training provisions to assist individuals with re-entry back to work. It was around the same time that the organisation started to branch out and include collection, repair and maintenance training, and resale of electrical goods. 96% of the operational costs for the charity were generated through funding grants with organisations, such as the UK National lottery or government volunteer schemes (Financial Statement, 2002).

RRC first became aware of the opportunities to get involved with IT reuse in 2001. A grant was awarded due to the involvement RRC had with the nationwide Furniture Recycling Network (Delivery Project Executive Interview, 2008). Through the network, the Project Manager and the organisation had gained a reputation as a charity that had expertise in both waste management and social accountability. By

2005, RRC were able to introduce IT maintenance and repair to their training portfolio, and the sale of reused computers. The 10-week course provided the platform for trainees to learn how to make repairs and maintain IT systems. Seven tonnes of equipment materialised, far higher than anticipated, and as a result RRC moved into a larger warehouse to meet the new demand. Despite having a strong relationship with their local community, the pre- and post- WEEE logics confronted each other. Pre- WEEE RRC received computers donated from private households and local businesses. Ironically, although the initial volume of equipment exceeded expectations, the charity started to see a slowdown once the legislation was mandated. The vision of the new warehouse dealing with just IT did not materialise. One explanation placed the onus on the legislation raising awareness through targets set for e-waste recovery *"for us as a re-user it is [the WEEE legislation that is] killing reuse, because there is more money in recycling it, stripping it and honestly, the WEEE, the whole waste hierarchy is reduce, reuse, recycle. Recycle is further down because it costs more energy to recycle but in environmental terms it is killing reuse, which is stupid"* (DPE Interview, 2008). The introduction of the legislation had exacerbated competition for discarded computers and increased awareness of data security matters.

Even after the UK legislation was announced, the course proved to be popular but due to the size of the IT workshop, there were limited spaces (Research Journal Two, 2008). On average, each computer cost £37.00 to £46.00, took between 15 minutes to 5-6 days to repair, and sold in various RRC outlets for £30.00-£120.00. Incongruously, the computers were not selling, raising concerns for the IT Workshop Manager as to the future of his department given that he had "*to achieve £2000 a*

month to break even [...] and to contribute to the full running of [RRC] [...] £56,000 a year".   The confrontation between the existing logic and the legislation afforded the opportunity for additional training provision to be offered, helping people back to work, diverting goods away from landfill to be resold to the disadvantaged community, and reinforcing the overarching aims of the organisation.

RRC's running cost averaged one million pounds in 2007 (Financial Report, 2008). By this time period, the organisation had expanded to run eight schemes, inclusive of the IT repair and maintenance. Previously, each scheme was underpinned by different grants but RRC had begun to experience less success and the grant income generation had fallen to 46%.   With the expansion, RRC began offering commercial contracts, but by 2008 their grant income had dropped to just 10%.   The Delivery Project Executive expounded, "*we [have] got £100,000 of grant income that is £900,000 we have got to find from somewhere.   We have got to make that money and it is very hard to make, well there are not many businesses in [Northern England]... that make a million pounds a year."*

Having attended the initial seminars and discussion in 2001, the WEEE legislation provided the platform for the DPE to generate £12,000 for a month's work by offering consultancy services so that the Charity could continue their training opportunities (DPE Interview, 2008). Reinforcing the shift into a more commercial mind-set, the manager responsible for the volunteers stated "*we have to operate like a business, albeit be competitive, so we advise the volunteers that they cannot discuss matters outside of work*".   The IT Manager also saw an opportunity and began to sell computer components on eBay.

Not dissimilar to RSME, post-WEEE, the slowdown of funds, reduced volume of computers and having moved into a new warehouse to anticipate the influx, RRC had to make decisions based on generating revenue to keep the Charity in operation. Drawing upon third sector and commercial logics simultaneously, the organisation-generated funds through the resale of reused goods, grants from charitable organisations, consultancy, and from government funding for the training provision they provided. The fraternization between waste and e-waste logics contributed to the opportunity for the DPE to attend the additional Government training sessions and build upon his expertise in the waste field. By the end of the research, significant changes had taken place, but the organisation had not shifted away from their principal markets.

Our focus on imbrication denotes an analytical concern with distinctive expressions of interdependency over time and place. What can be extracted from our research is that the imbrication of waste and e-waste logics takes a multiplicity of forms across the three e-waste organisations studied: the WEEE legislation creates a multiplicity of differentiated interconnections as waste and e-waste logics imbricate historical antecedents and discontinuities, preoccupations with cross-sector partnerships, the ethos of sustainability, industry standards and licences to operate, judgements about market opportunities, and new expressions of value. Table 1 summarises how these different elements of waste and e-waste logics create particular imbrications.

Insert Table 1: Imbrications and Waste Logics here

6.0 Discussion and Conclusion

Our research suggests that a fractionated trading zone, characterised by collaboration and heterogeneity, also extends to the diversity of imbrications that can be witnessed. The range of imbrications we have illustrated focus on the materiality with less emphasis on the 'inter-language' interaction between companies and other organisations: what is shared in this e-waste zone are the imbrications of pre- and post-WEEE logics enacted through the materiality of e-waste. In that sense, our findings extend the concept of a fractionated trading zone through imbrication and reinforce the unique feature of a fractionated trading zone, which is that inter-language communication is not key.

The pre- and post-WEEE legislation logics we have analysed demonstrate differentiated and multiple imbrications. The six imbricated logics we have discerned, are not the only possible institutional logics, however they can act as a fruitful entry point for other researchers interested in exploring the implications of legislative change at an organisational level in a variety of contexts. As we have shown, imbricated logics do not have to integrate with each other in order to have meaning and impact in a particular context. We have discerned differentiated forms of imbrication across three companies showing how the distinctive features of an institutional logic are brought out.

We have analysed and discerned six imbrications pre- and post-WEEE – that is, how they reproduce continuities within a fractionated trading zone. It is worth noting that a trading zone can change its form – there is no single best trading zone of course – but

to foster novelty and innovation a trading zone needs to become space where different imbrications meet, new ways of speaking and understanding are learned, and knowledge and expertise shared. This emphasises the interactional difficulties and time-intensive nature of innovation in a fractionated trading zone. It also highlights the limits of a legislative based approach to change, such as embodied in the WEEE directive for our three-exemplar cases. Without careful, sustained, nuanced support and guidance that goes beyond legislative and economic practices, we think the economy of greening is likely to remain the dominant feature of e-waste management.

It is a cliché that the challenges and opportunities of contemporary environmental problems do not come neatly packaged nor are they easily managed. What can be extracted from our research outlined above, is that there are multiple logics occurring at the same time within a fractionated trading zone, imbricating in a diversity of ways and this affords various forms of material and cultural communication, action and agency across communities, policies and practices: the WEEE legislation affords the formation of an emergent institutional logic of the green economy while also functioning, as we have shown, as a potential site for "the economy of greening".

Focusing on the imbricating institutional logics would be a productive avenue for future research particularly when conjoined with the concept of a fractionated trading zone. When a new institutional logic, such as the UK WEEE Regulation, is considered as a discontinuity, ushering into existence a green economy, we forget the ways in which existing institutional logics imbricate or condition, rather than cause, emergent institutional logics to create what we term an "economy of greening". In each of these imbrications, we have shown a multiplicity of logics in the pre- and

post-WEEE legislation era. Imbricated relationships are never of one kind as we have shown; in a fractionated trading zone institutional logics will infuse, be complementary, conflict, problematize, bind together and sometimes interact at a distance. We have shown how imbricating institutional logics can provide insight into how change and continuity occurs within a fractionated trading zone: imbricated institutional logics play an integral role in the reinforcement of prevailing practices - the economy of greening, whilst they are simultaneously framed as something novel or what others refer to as the green economy.

Although we have focused on imbricated logics within a fractionated trading zone, in response to the EU 2003 and UK 2006 versions of the WEEE legislation, our findings can be used in different contexts. Nonetheless, there are particularities and limits to the generalisations from our study of a limited number of companies in a particular period. Recent interest in the circular economy, an economy premised on keeping goods and materials in circulation for as long as possible and by default minimises waste (European Commission, 2018), might require a different approach from policy-makers. Otherwise, as Schulz and Bailey (2014), Gregson et al. (2015) and Adam (1998) remind us, the past antecedents that emphasise economic growth above all else are likely to prevail in the future.

To conclude, we have shown three example cases to specify imbrications in relation to existing institutional logics in a fractionated trading zone. These imbrications are: confounding, repelling, complementary, infusing, confrontation and fraternization. We have shown how the logic of e-waste created organisational working practices that fell back into neo-liberal ideals centred on economic growth thus promoting "the

economy of greening". Given the emphasis on the discontinuities brought about by technological innovation, our findings illustrate the continuities of fractionated trading zone practice: within a fractionated trading zone, the heterogeneity of imbrications served to re-create the prevailing logic of an economy of greening. We think that further research on imbrication in a fractionated trading zone would be valuable and hope our research has contributed to this agenda, to enrich insights into the impact of policy in the e-waste sector and, more widely, in understanding how more sustainable ways of resource usage might be fostered and further developed.

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Table 1: Summary of Waste and e-Waste logics

	Waste logic (1970's)	e-Waste logic (1999)
Era of	EEC – Common Market	EU - Triple bottom line
Ethos	Competitive advantage	Managing for sustainability
Governance	Legislation	Legislation and accreditation
Managed by	Public Administration	Partnerships
Relationship with the natural environment	Blindness and an externality	Interdependence

Table 2: Imbrications and Waste Logics

Imbrication	Organisational Change	Waste Logic	e-Waste Logic	Role of WEEE Policy
Periodisation (RSME)	Reinventing themselves	Common Market	Triple bottom	Confounding
Managed by (RSME)	Profitable partnerships	Public administration	Partnerships	Repelling
Ethos (IARO)	Extending services	Competitive Advantage	Managing for sustainability	Complement
Governance (IARO)	Sourcing computers	Legislation – waste management permits	Legislation and accreditation Waste management permits And ISO Data security accreditations	Entangled
Relationship with external environment (RRC)	Sourcing computers	Blindness to externality	Interdependence	Confrontation
Symbolic (RRC)	Sourcing funds	Means to an ends (physical waste)	Ends in itself (resource is a resource)	Fraternization